AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

Reference:	CA18/2/3/9848

Aircraft Registration	ZU-EWD	**Date of Accident**	12 January 2020	**Time of Accident**	1612Z
Type of Aircraft	FK 14B POLARIS	**Type of Operation**	NTCA (Part 94)		
Pilot Licence Type	National Pilot Licence	**Age**	54	**Licence Valid**	Yes
Pilot Flying Experience	**Total Flying Hours**	787.2	**Hours on Type**	377.6	
Last Point of Departure	Springs Aerodrome (FASI) – Gauteng Province				
Next Point of Intended Landing	Springs Aerodrome (FASI) – Gauteng Province				

Location of the accident site with reference to easily defined geographical points (GPS readings if possible)

In an open area north of FASI, approximately 450m from the threshold of Runway 21, at GPS co-ordinates 26°14'22.42" South 028°24'04.34" East and at a field elevation of 5328ft AMSL

Meteorological Information	Wind: 340° at 09kts; Temperature: 24°C; Dew Point: 11°C; Clouds: Few at 4000ft; Visibility: 9999m; QNH: 1023hPA				
Number of People On-board	1+1	**No. of People Injured**	0	**No. of People Killed**	2

Synopsis

On Sunday 12 January 2020, at approximately 1612Z, a pilot accompanied by a passenger on-board a FK 14B Polaris aircraft, with registration mark ZU-EWD, took off on a local private flight from Runway 03 at Springs Aerodrome (FASI) with the intention to land back at the same aerodrome.

Two eyewitnesses had observed the aircraft taking off. They stated that after take-off, the aircraft made a sharp right turn before it entered a stall, which resulted in the aircraft spinning and subsequently, crashed. The eyewitnesses reported that they saw a puff of white smoke coming from the aircraft just before it crashed. A surveillance camera located outside a hangar south-east of the accident site captured the ZU-EWD aircraft spinning moments before it crashed. The aircraft was destroyed on impact and both occupants were fatally injured.

The aircraft took off with the right tank almost empty and with minimum fuel in the left tank. It is probable that after take-off, the engine started spluttering and later stopped, which might have led the pilot to attempt to do 180° turn to return to the aerodrome. The pilot had then executed a right-side turn, but it was steep (left wing high and almost at 90° bank angle). Thus, the aircraft entered a stall which led to a spin from which the pilot could not recover.

Probable Cause/s and/or Contributory Factors

The aircraft stalled during a steep right turn following an engine stoppage. This resulted in a right-side spin from which the pilot could not recover.

Contributory Factor:

Engine stoppage during take-off due to fuel starvation.
Inadequate pre-flight inspection.

SRP Date	19 January 2021	Publication Date	5 February 2021

Abbreviation	Description
°	Degrees
°C	Degrees Celsius
AMS	Accepted Maintenance Schedule
AMSL	Above Mean Sea Level
AOA	Angle of Attack
AOPA	Aircraft Owners and Pilots Association
AP	Approved Person
ATF	Authority to Fly
B.R.S.	Ballistic Rescue Systems
CAR	Civil Aviation Regulations
C of R	Certificate of Registration
CRS	Certificate of Release to Service
CVR	Cockpit Voice Recorder
E	East
EFIS	Electronic Flight Information System
FASI	Springs Aerodrome
FDR	Flight Data Recorder
ft	Feet
GPS	Global Positioning System
IAW	In Accordance With
kg	Kilograms
km	Kilometre(s)
kt	Knots
l/h	Litres per Hour
LSA	Light Sport Aircraft
m	Metre(s)
MML	Maintenance Manual Line
MTOW	Maximum Take-off Weight
NPL	National Pilot Licence
NTCA	Non-type Certified Aircraft
PIC	Pilot-in-command
POH	Pilot’s Operating Handbook (Rev 24E)
QNH	Query: Nautical Height
RWY	Runway
S	South
SACAA	South African Civil Aviation Authority
SAWS	South African Weather Service
SD-card	Secure Digital Memory Card
S/N	Serial Number
TBO	Time Between Overhaul
UCT	Co-ordinated Universal Time
VFR	Visual Flight Rules
VHF	Very High Frequency
Wägebericht	Manufacturer’s Weight Report for Aircraft 014-052
Z	Zulu (Term for Universal Co-ordinated Time - Zero Hours Greenwich)

DESCRIPTION OF ACCIDENT

Reference Number	**:** CA18/2/3/9848
Manufacturer	**:** B & F TECHNIK VERTRIEBS GMBH
Model	**:** FK 14B POLARIS
Nationality	**:** South African
Registration Marks	**:** ZU-EWD
Place	**:** Springs Aerodrome (FASI)
Date	**:** 12 January 2020
Time	**:** 1612Z

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 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 establish blame or liability****.*

Investigations Process:

The accident was notified to the Accident and Incident Investigations Division (AIID) on 12 January 2020 at about 1612Z. A team of investigators dispatched to the accident site at Springs on 12 January 2020. The investigators co-ordinated 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 (RSA) is the state of occurrence.

Note:

1. *Whenever the following words are mentioned in this report, they shall mean the following:*
    - *Accident – this investigated accident*
    - *Aircraft – the FK 14B Polaris 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 were taken from different sources and may be adjusted from the original for the sole purpose of improve 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:
This report is produced without prejudice to the rights of the AIID, which are reserved.

FACTUAL INFORMATION

1.1. History of Flight

1.1.1. On Sunday 12 January 2020, at approximately 1612Z, a pilot accompanied by a passenger on-board a FK 14B Polaris aircraft with registration mark ZU-EWD took off from Runway (RWY) 03 at Springs Aerodrome (FASI) with the intention to land back at the same aerodrome. This was a private flight conducted in visual meteorological conditions (VMC) by day under the provisions of Part 94 of the Civil Aviation Regulations (CAR) 2011 as amended.

1.1.2. Two eyewitnesses; one, a flight instructor preparing to take-off from the same runway (RWY 03) after ZU-EWD, and the other, a resident residing approximately 300 metres (m) north-east of FASI; both observed the aircraft take-off and climb. They stated that the aircraft was observed making a sharp right turn in what was seen to have been an attempt to return to the aerodrome. The aircraft's right-side wing stalled which led to the aircraft entering a spin until it subsequently crashed onto the ground.

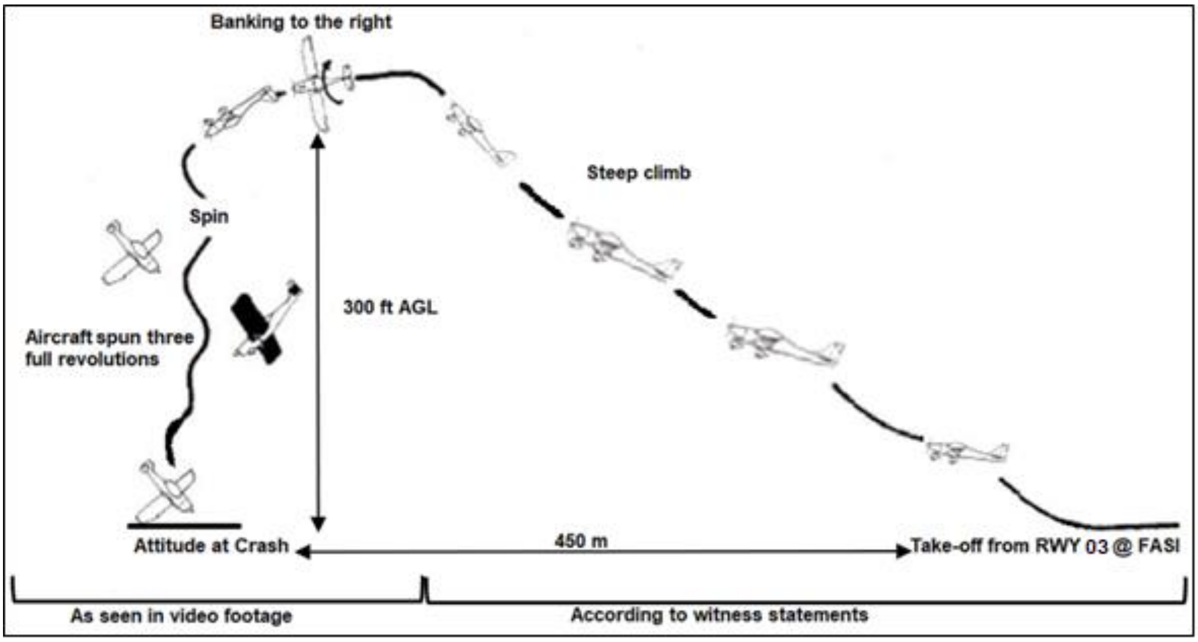


Figure 1: Schematic illustration of the accident flight.

1.1.3. According to the flight instructor eyewitness, when the aircraft was seen in the right-wing low attitude, it was approximately 300ft above ground level.

1.1.4. A close circuit surveillance camera located outside Hangar 28 at FASI, south-east of the accident site, had captured the accident as illustrated in Figure 1. The footage showed the ZU-EWD aircraft enter the frame from the left in a sharp right bank in a north-easterly heading (Figure 2). The aircraft was seen descending with a profile consistent to a stall, which developed into a spin before crashing. The aircraft was seen spinning and completing three revolutions before it crashed on the ground.

1.1.5. The eyewitnesses reported that they saw a puff of white smoke coming from the left-side of the aircraft just before it crashed. One of the witnesses (a flight instructor) took off from RWY 03 after ZU-EWD had crashed to locate the crash site. He also notified the FASI safety officer about the accident.

1.1.6. The other eyewitness (who lives 300m from the accident site) had arrived at the accident site at about 1615Z and had notified the local search and rescue services personnel about the accident. One of the rescue services' personnel, who was approximately 500m away from accident site, had also arrived at the accident site at about 1618Z and found both occupants fatally injured.

Figure 2: A close circuit surveillance image from a camera located outside Hangar 28 at FASI. (Source: Rainbow Skyreach (Pty) Ltd)

1.1.7. The aircraft crashed on an open field near a residential area, north of FASI, approximately 450m from the threshold of RWY 21 at the following Global Positioning System (GPS) co-ordinates: 26°14'22.4" South 028°24'04.1" East, at an elevation of 5340 feet (ft) above mean sea level (AMSL). Fine weather conditions with few clouds prevailed at the time leading to the accident.

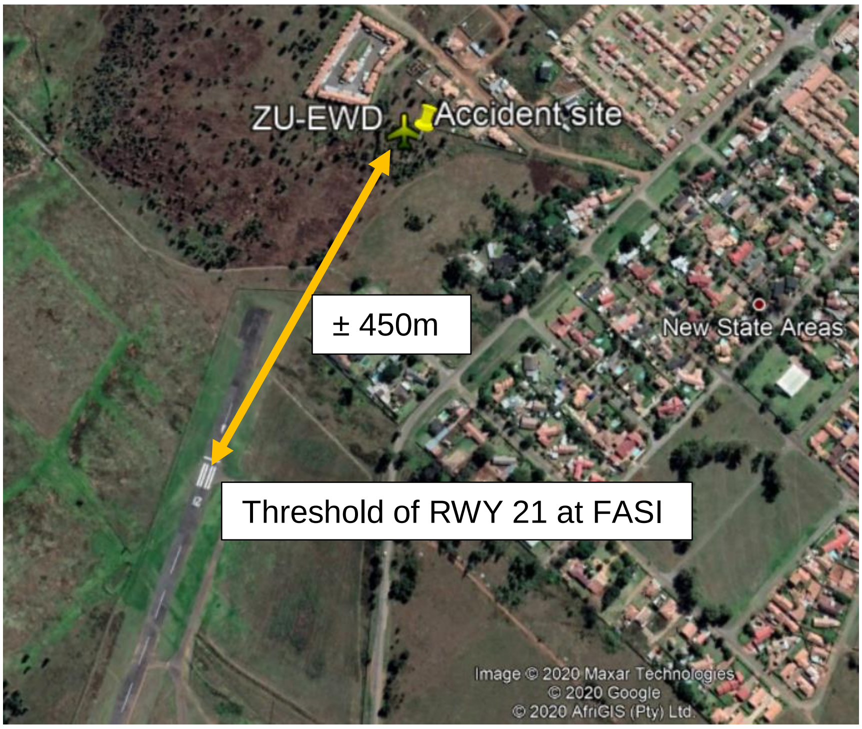


Figure 3: The aerial view showing the accident site's proximity to the threshold of Runway 21 at FASI. (Source: Google Earth)

1.2. Injuries to Persons

Injuries	Crew	Passengers	Total in the Aircraft	Others
Fatal	1	1	2	-
Serious	-	-	-	-
Minor	-	-	-	-
None	-	-	-	-
Total	1	1	2	-

1.2.1. Both occupants were South African citizens.

1.3. Damage to Aircraft

1.3.1. The aircraft was destroyed on impact.

Figure 4: The aircraft post-accident.

1.4. Other Damage

1.4.1. None.

1.5. Personnel Information

1.5.1. Pilot Information

Nationality	South African	Gender	Male	Age	54
Licence Number	0279012991	Licence Type	National Pilots Licence		
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Nil				
Medical Expiry Date	28 February 2021				
Restrictions	Nil				
Previous Accidents	Nil				

Pilot Flying Hours

Total Hours	787.2
Total Past 90 Days	11.8
Total on Type Past 90 Days	11.8
Total on Type	377.6

Pilot Experience

1.5.1.1. The pilot met all requirements to operate the aircraft type X306 – FK 14B Polaris, which was initially endorsed on the pilot's licence on 8 August 2015, following satisfactory completion of the examination and practical skills test for a Recreational Pilot Licence carried out using ZU-EWD.

1.5.1.2. The pilot had conducted the last Examination and Practical Skill Test Report for Recreational Pilots on 9 June 2018, 19 months prior to the accident. During the assessment, the pilot was scored 3 (an average score) for the following exercises:

- ***Pre-flight procedures:*** *Pre-flight inspection, checks before starting and radio*
- ***Take-off:*** *Attitude, airspeed and direction of climb; and engine failure during/after take-off. The testing officer noted "air-speed, nose down"*
- ***Climbing turns:*** *Control of attitude, airspeed and direction and exiting*
- ***Stalling (simulated):*** *Safety measures, definition of stalling speed. The testing officer noted the use of engine as "good"*

1.5.1.3. According to the pilot's file, the revalidation examination for the renewal of the Recreational Pilot Licence for a light sport aircraft (LSA) was conducted with ZU-EWD. The remarks of the testing officer were that the "National Pilot Licence (NPL) renewal was completed and found to be satisfactory – OK". The pilot was issued a NPL in terms of Part 62 of the CAR 2011 as amended.

1.5.1.4. Following the application of the renewal of the Recreational Pilot Licence on 9 June 2018, between 23 June 2018 and the last flight prior to the accident flight on 28 December 2019, the pilot had further accumulated 118.2 flying hours.

1.5.1.5. At the time of the accident, the pilot had a period of 42 months and 377.6 hours on the ZU-EWD light sport aircraft.

1.5.2. Maintenance Personnel

1.5.2.1. The ZU-EWD aircraft had been maintained by the same approved person (AP) since 27 October 2015.

1.5.2.2. According to the Approved Person Certificate, the certificate was reissued on 7 February 2018 with a renewal date of 29 February 2020.

1.5.2.3. The AP was rated APC2, A & C, and was approved to carry out repairs and maintenance for aircraft groups 1, 2, 3, 4 and 13 and engine groups 1, 2 and 3 installed in the aircraft groups. These ratings were endorsed on the AP's certificate.

1.6. Aircraft Information

1.6.1. Aircraft Description According to the FK 14 B Pilot's Operating Handbook (POH)

The FK 14B Polaris is a single-engine, low-wing ultralight aircraft with two side-by-side seats, and non-retractable tricycle landing gear.

The FK 14B was fitted with dual controls, allowing it to be flown from both positions, although the preferred pilot position would be the left-side according to the instrument panel lay-out.

The aircraft had a fuel tank in both wings which were vented and had a fuel drain under the wings. The two wing tanks were interconnected, and their contents was supplied to the main tank via an electric fuel pump. There was an auxiliary electric fuel pump as a back-up to supply fuel directly to the carburettors in case of engine mechanical fuel pump failure.

The aircraft was neither fitted with a stall warning device nor stall strips.

The aircraft was equipped with a spring-trimmed elevator and electrically operated fowler flaps.

A Rotax 912ULS engine and a 3-blade "DUC" ground adjustable pitch propeller were fitted on ZU-EWD.

1.6.2. According to the equipment list, the ZU-EWD aircraft was fitted with the following equipment:

- Fuel tanks totalling 78 litres capacity
- Emergency Parachute Recovery System (Ballistic Recovery Systems, Inc. – B.R.S. 5 – 1050)
- Xtreme – Electronic Flight Information System (EFIS)

Airframe

Type	FK 14B POLARIS	
Serial Number	052	
Manufacturer	B&F TECHNIK VERTRIEBS GMBH	
Year of Manufacture	2005	
Airframe Hours (At time of Accident)	795.7	
Last Annual Inspection (Hours & Date)	778.3	16 September 2019
Next Scheduled Inspection (Hours & Date)	878.3	16 October 2020
Hours Since Annual Inspection	16.5	
Authority to Fly (Date of Issue & Expiry Date)	16 October 2019	31 October 2020
C of R (Date of Issue) (Present owner)	19 May 2015	
Operating Categories	Amateur-Built, Part 94	

1.6.3. **Airframe – Maintenance Information and History**

1.6.3.1. According to the Airframe Logbook, the following observations were made regarding the aircraft's maintenance information and history:

Class 1 Product Removal and Replacement Record indicated that a new Rotax 912 ULS 2-01 non-certified engine with serial number (S/N) 9569761 with zero hours was installed on the ZU-EWD aircraft on 17 February 2018. The reason for the removal of the previously installed Rotax 912 ULS 2-01 non-certified engine with serial number (S/N 5644589) was that it had exceeded the 12-year overhaul period.

1.6.3.2. According to the Scheduled Inspection Record, the following observations were made:

- Since 27 October 2015 until the last inspection on 16 September 2019, the ZU-EWD aircraft maintenance inspections were performed by the same AP and the same inspector.
- In September 2019, two inspections were recorded – one on 8 September 2019 and the other on 16 September 2019.

- On 8 September 2019, the following maintenance was performed: oil changed, oil filter replaced, mag plug removed and checked for deposits.
- On 16 September 2019, annual inspection was carried out in accordance with (IAW) the approved South African Civil Aviation Authority (SACAA) checklist and provisions of Regulation 43.02.8 (Section B) and the South African Civil Aviation Technical Standards (SA-CATS) 43.02.8.

- According to the Certificate Relating to Maintenance/Inspection of an Aircraft issued on 16 September 2019, the airframe total time was 778.3 and the engine hours were 84.9.

1.6.4. The Accepted Maintenance Schedule (AMS) followed for the inspection of the ZU-EWD aircraft showed that the checklist was "performed in conjunction with the applicable manufacturer's engine and propeller checklists, and also SA-CATS 44.01.06 Annexure A for minimum maintenance requirements".

1.6.5. Following the annual inspection, the aircraft was issued a Certificate of Release to Service (CRS) set to lapse at 878.3 hours of flight or on 16 October 2020, whichever occurs first, and the application for the renewal of an Authority to Fly (ATF) non-type certified aircraft (NTCA) was submitted to the SACAA on 9 October 2019.

1.6.6. The investigation found no technical defects with the airframe or installed systems and components that were recorded in the logbook or defect reports.

Engine

Type	Rotax 912 ULS	
Serial Number	9569761	
Installation (Date & Hours Since New)	17 February 2018	Zero hours (Installed new)
Hours Since New (At time of Accident)	146.6	
Hours Since Overhaul	TBO not yet reached	

1.6.7. **Engine – Maintenance Information and History**

1.6.7.1. According to the Engine Logbook, Volume 1, the following observations were made regarding the engine's maintenance information and history:

The Rotax 912 ULS 2-01, S/N 9569761 engine was manufactured on 1 September 2019. The engine was recorded to have been installed on 14 February 2018, 19 months before its date of manufacture, with zero hours since new.

1.6.7.2. According to the BRP-Rotax Line Maintenance Manual (MML), 912 ULS engines with S/N 6775790 and above have a time between overhaul (TBO) of 2000 hours or 15 years, whichever comes first. [Source: http://www.angelesflying.com/documents/manuals/MaintenanceManual912Serie_LineMaintenance.pdf, pg. 41]

1.6.7.3. During the last annual inspection on 16 September 2019, the engine had 84.9 hours and the following maintenance tasks were recorded: oil change, oil filter replaced, mag plug checked, and annual inspection.

1.6.8. According to another witness, about two weeks before the accident flight, the pilot and owner of the ZU-EWD aircraft was seen working on the engine and had mentioned that the engine had some issues, but he did not mention what the issues were. About a week later (a week before the day of the accident), the ZU-EWD aircraft was seen taking off from RWY 03 at FASI, and immediately after the aircraft was airborne, the pilot requested to return to the aerodrome as the aircraft had experienced an engine problem. Again, the pilot and owner of the aircraft did not state the nature of the problem.

1.6.9. The investigation found no technical defects with the engine that were recorded in the logbook or defect reports.

Propeller

Type	DUC SWIRL	
Serial Number	1119	
Pitch	Ground adjustable	
Installation (Date & Hours Since New)	20 March 2007	Zero hours (Installed new)
Hours Since New (At time of Accident)	795.7	
Last Overhaul (Date & Hours)	TBO of 800 hours not yet reached	

1.6.10. According to the propeller logbook, the only scheduled inspection carried out on the propeller since the date of installation was on 16 September 2019.

1.6.11. The investigation found no technical defects with the propeller that were recorded in the logbook or defect reports.

1.6.12. **Ballistic Recovery System (B.R.S.-5 ™)**

1.6.12.1. The aircraft was equipped with an internally mounted Ballistic Recovery system (B.R.S.-5 ™), model 1050, which the pilot actuated prior to impact; however, the parachute failed to deploy. It was still in the sleeve and was lying over the left-side wing (see Figure 5).

1.6.12.2. According to section 7.3 of the FK 14B POH, “detailed information concerning max. speed, capacity and maintenance cycles are provided in the respective rescue system manual”. The Mandatory Canopy Inspections and Repacks from the B.R.S. Owner’s Manual are stated in section 1.15.3.4 of this report. Additionally, there was no record of compliance to *Service Bulletin (SB) 07-05* of 24 August 2007 in the airframe logbook.

1.6.12.3. According to the B.R.S. Owner’s Manual’s Emergency Procedures for Deployment Scenarios in which activation of the B.R.S. may be considered, the manual states that during a stall/spin “the B.R.S. unit is not guaranteed to fully decelerate an aircraft from extremely low altitudes, but a spin below 500 feet is a grave problem, and the B.R.S. unit may offer your only alternative”.
“If the aircraft speed was high at deployment, this de-stabilisation can continue longer. If the altitude at deployment was low (a relative factor; “low” may be 100 or 500 feet), the oscillations may not cease before the aircraft reaches the ground. If the latter is true, the aircraft may strike the ground in an unusual attitude, which could result in injury or death to occupants.”

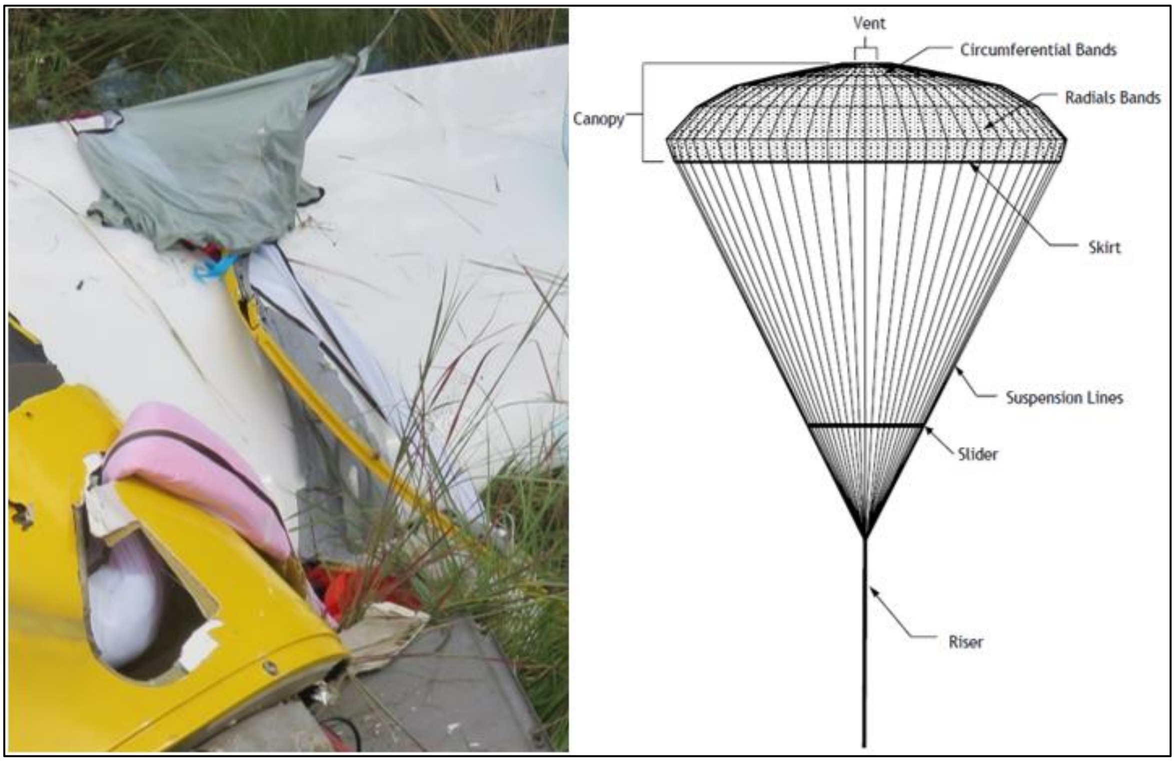


Figure 5: The parachute canopy still in the sleeve (left); and an illustration of the failed B.R.S. parachute assembly (right).

1.6.12.4. The balance harnesses, which are installed in ducts along the fuselage to the aft airframe connection did not crack the skin of the fuselage as they should have, according to the B.R.S. Owner's Manual.

1.6.12.5. The B.R.S. activation red handle was pulled out and its safety pin was found lying on the fuselage floor under the handle.

1.6.12.6. According to the B.R.S. Owner's Manual, "the maintenance schedule for B.R.S. products is defined in this manual and it is *mandatory* that all owners follow this. If the maintenance schedule is not followed, the parachute must be placarded as "inoperative" until maintenance can be performed".

Additionally, "the serial number for your B.R.S. is imprinted on a small data label which appears as a part of a larger label. Along with the serial number, a date shows when the parachute must be repacked. In addition, there is a small data label on the rocket launch tube and on the rocket case itself which indicate when the rocket is due for replacement. All B.R.S. rocket motors must be replaced by their date of expiry".

1. *Mandatory Canopy Inspections and Repacks*

In addition to the preflight inspections described earlier, BRS parachute containers must be removed from the aircraft for factory inspection and repacking at intervals determined by the style of unit and the mounting location. The following chart illustrates the differences:

Style	Internal Mount	External Mount
Canister	6 yrs.	6 yrs.
VLS	6 yrs.	6 yrs.
Hand-Packed Softpack*	6 yrs. (2 yrs. if partially enclosed)	1 yr.
Pressure-Packed Softpack	6 yrs. (2 yrs. if partially enclosed)	1 yr.

This repack schedule is only valid for current BRS products and BRS products produced after 1995 (BRS-5 or newer). If you have an older unit, please contact the BRS service department with your serial number for service options relative to your specific unit.

1.6.12.7. According to the data label, the B.R.S. unit was manufactured on "*03/2005*" with an expiry date of "*03/2017*" (see Figure 6).

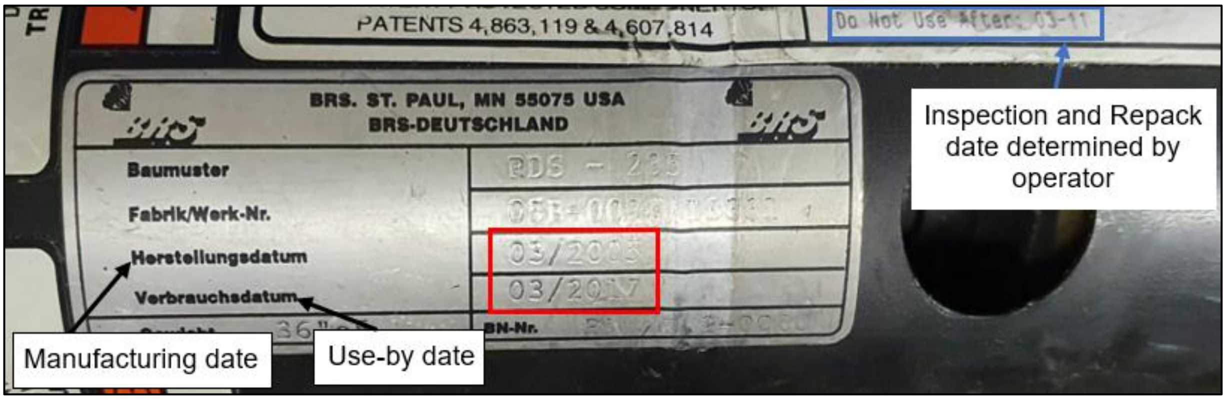


Figure 6: B.R.S. unit data label.

1.6.12.8. On 24 August 2007, B.R.S. issued a mandatory SB 07-05. According to B.R.S., the B.R.S. unit was deemed inoperable until compliance with the SB was met. There was no record of SB 07-05 in the Service Bulletin/Letters/Instructions (One Time Action and Repetitive) sections of the airframe logbook.

There was no record of the B.R.S. unit in the Airframe Component Record section of the airframe logbook, and neither was the B.R.S. unit included in the aircraft's equipment list.

1.6.12.9. According to the airframe logbooks scheduled inspections performed, a note was made on 21 January 2010 that the ballistic chute repack was due on 3 May 2011; however, there was no entry subsequent to the note being made of the ballistic chute's repacking being carried out. It was later recorded on 31 August 2013 that the ballistic parachute was Timex, with no corrective action being recorded subsequently.

1.6.13. **Fuel Information**

1.6.13.1. According to the flight folio records, the aircraft was last refuelled with 15 litres of AVGAS on 28 December 2019 and was flown for 1.9 hours on the same day. There were no records of fuel upliftment to the aircraft prior to the accident flight on 12 January 2020; and there were also no other additional fuel log records provided to the investigators.

1.6.13.2. According to the FK 14B POH, the ZU-EWD aircraft had a total fuel capacity of 78 litres with the total useable fuel of 73 litres. The fuel tanks are in the centre section of each wing and have a forward fuel pick-up. The FK 14B POH cautions pilots "never to perform a take-off on a tank containing less than 10 litres" and requires pilots to "be very careful when calculating fuel required during flight preparation". Pilots are directed to "check fuel quantity before flight by means of a calibrated stick".

1.6.13.3. Although the FK 14B POH does not provide the fuel endurance; however, the fuel endurance for the ZU-EWD aircraft was determined to be 3.1 hours with a total fuel capacity of 73 litres usable fuel by using the average fuel consumption of 23.5 litres per hour (l/h).

Fuel usage calculations considered the 'average' and 'reasonably expected' fuel burn for various phases of ground operations and flight, as well as the flight information such as flight duration and previous fuel uplifts as recorded in the flight folios.

The flight duration and previous fuel uplifts recorded in the flight folios were found to be inaccurate and inconsistent. Considering the worst-case scenario, on the day of the accident, the aircraft was probably being operated solely on the right-side fuel tank for the engines run and take-off. Fuel calculations indicated that there was possibly not enough fuel in the selected tank for the flight.

1.6.14. **Weight & Balance**

1.6.14.1. No weight & balance report was found in the wreckage, however, according ZU-EWD aircraft's flight folio and defect report logbook, the aircraft's empty weight was recorded as 308 kilograms (kg) with a maximum all-up weight of 520kg. According to the *Wägebericht* (Manufacturer's Weight Report for Aircraft 014-052) for the ZU-EWD aircraft dated 3 May 2005, the empty weight is 308kg with a maximum weight of 472.5kg.

1.6.14.2. According to the airframe logbook aircraft mass & balance record, the aircraft's empty mass on 20 March 2007 was 308.0kg and was increased to 314.65kg on 23 March 2011. The airframe component record showed that a new EFIS Extreme was installed on 18 June 2015. The aircraft was reweighed on 27 October 2016 and the recorded empty weight of 314.5kg was recorded.

1.6.14.3. According to the FK 14B POH, the aircraft has a maximum take-off weight depending on configuration and certification of up to 544 kilograms (kg) (1199 lbs); and according to the SACAA's Aircraft Summary Report of the ZU-EWD aircraft, the maximum take-off weight was recorded as 4725kg.

1.6.14.4. The weight & balance calculations were based on the aircraft's empty weight of 314.65kg and the weight of the occupants was obtained from SA-CATS Subpart 24.01.2 – Airworthiness: *(16.2) (2) – Light Sports Aeroplanes Classification Parameters*, *for the purpose of establishing conformity with sub-paragraph (1) (a), the following payloads are to be included:*

(a) 80 kilograms per seat;
(b) Full fuel tank or 40kg (whichever is greater);
(c) Luggage mass as specified by the manufacturer;
(d) Safety rescue system if one is fitted;
(e) All standard and additional equipment and systems as fitted.

1.7. Meteorological Information

1.7.1. The weather information on the table below was provided by the South African Weather Service (SAWS) recorded at O.R. Tambo International Aerodrome (FAOR) on 12 January 2020 at 1600Z, which is the closest weather station located 20km from FASI.

Wind direction	340°	Wind speed	09kt	Visibility	9999m
Temperature	24°C	Cloud cover	Few	Cloud base	4000ft
Dew Point	11°C	QNH	1023 hPa		

1.8. Aids to Navigation

1.8.1. The aircraft was equipped with an ASUS Tablet AirNav Pro for navigation. The tablet was destroyed during the accident. Although the tablet had a micro Secure Digital memory card (SD-card) inserted at the time of the accident, the micro SD-card was found with no history of previous flight data. There were no recorded defects with the navigational equipment prior to the flight.

1.9. Communication

1.9.1. The aircraft was equipped with a Filser Electronic ATR-500 very high frequency (VHF) transmitter system. The pilot did not transmit an emergency by broadcasting a PAN-PAN-PAN or MAYDAY before the accident. There were no defects reported with the communication equipment prior to the accident flight.

1.10. Aerodrome Information

1.10.1. Departure Aerodrome Information:

Aerodrome Location	East Rand, Gauteng Province, South Africa	
Aerodrome Co-ordinates	South 26°14'57.40" East 028°23'51.03"	
Aerodrome Elevation	5340ft AMSL	
Runway Designations	03/21	14/32
Runway Dimensions (metres)	1600 x 18	554 x 20
Runway Used	03	
Runway Surface	Asphalt	
Approach Facilities	Nil	
Aerodrome Status	Licensed	

1.11. Flight Recorders

1.11.1. The aircraft was equipped with a compact, multifunctional electronic flight information system (EFIS) Xtreme, which was a single display unit with a single slot for a SD-card interface for data recording. The unit had a built-in black box recorder, which showed all flight data, engine parameters, attitude and GPS data to the pilot while automatically recording up to the last 1000 flight log data on the SD-card.

1.11.2. According to the airframe logbook's Airframe Component Record section, the (EFIS) Xtreme was installed with zero total time and zero total cycles on 18 June 2015.

1.11.3. The EFIS had minor damage, and images of the EFIS taken at the accident site did not reveal whether the SD-card was still inserted in the slot following the accident (see Figure 7). During a follow-up investigation, the EFIS was found removed from the panel and not with the other aircraft components.

1.11.4. At the time of the wreckage inspection, there was no SD card found inside the EFIS and, as a result, it was not possible to retrieve the last flight's log data.

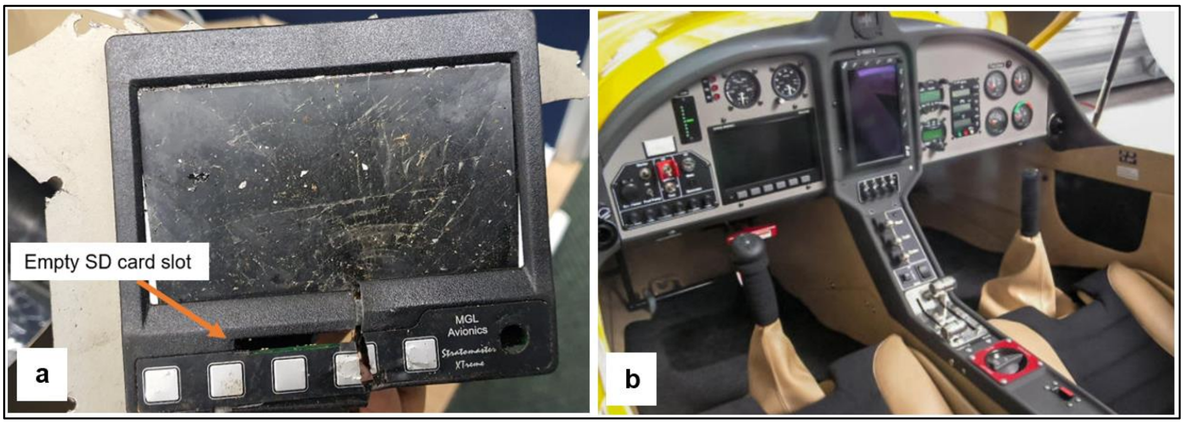


Figure 7: a) The damaged EFIS XTreme with an empty SD card slot. **b)** Example of a complete control panel from a similar aircraft. (Source: https://www.fk-aircraft.com/fl14%20polaris.htm)

1.11.5. A cockpit voice recorder (CVR) was not fitted on this aircraft nor was it required by regulation to be fitted.

1.12. Wreckage and Impact Information

1.12.1. The accident occurred on an open grass surface area near a residential complex, approximately 450m north of the threshold of RWY 21. The fuselage was orientated with the nose facing towards the north-west.

Figure 8: Aircraft wreckage showing the broken tail section, right-side wing and orientation of the B.R.S. rocket and sleeve.

1.12.2. The aircraft crashed onto the ground with a pitch angle of about 45°, first with the engine and front part of the fuselage, and then with the right-side wing. The canopy was found on the left-side wing by the rescue services after the crash.

1.12.3. The aircraft wreckage was confined to the accident site, but the tail had separated from the fuselage, although it was still connected by its elevator connecting rod. The two rudder cables were also still connected to the fuselage. Continuity of the flight controls was determined and there was no evidence of control restriction.

1.12.4. Both the left and right main landing gears were folded under the fuselage.

1.12.5. One of the propeller blades was intact, the second one was broken into two, with a third of its length remaining in the propeller hub. The third blade was deeply lodged into the ground with only a quarter of its length above ground. The damage to the propeller blades indicated that the propeller was not rotating on impact as there were no rotational signature marks.

1.12.6. Both the port and starboard side walls of the fuselage were broken and had separated from the fuselage above the wing roots. The right-side wing was more damaged than the left-side wing. The outer right-side wing section had separated from the rest of the right-side wing, while the left-side wing remained intact. Flaps for both wings were found in a fully retracted position (up position).

1.12.7. The fuel valve selector was found set to the right of the fuel tank. The left-side fuel filter had some fuel; however, the right-side fuel filter was found empty/dry with some contaminated residue present. There was no evidence of fuel on the ground nor was there fuel smell at the accident site on the day of the accident. A fuel sample could not be retrieved from either fuel tank during the on-site investigation, which was conducted the following day; however, there was still no smell of fuel.

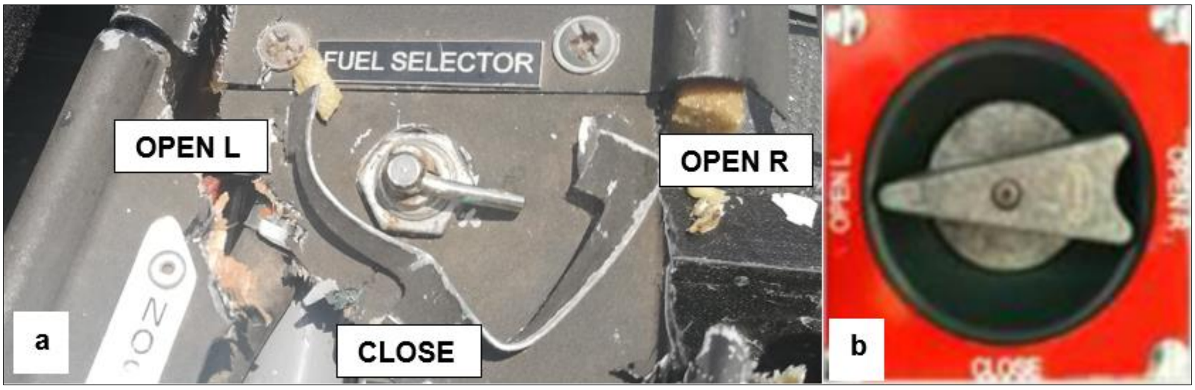


Figure 9: a) Fuel valve selected to the Open R position. b) Example of a fuel selector from a similar aircraft. (Source http://www.aviastock.com/Aircraft/AD14441).

1.12.8. The aircraft was found with four fuel filters, two on the left side and two on the right side. One of the fuel filters on the right-side did not have the inner separator as found in the other three filters. Figure 10 shows the left-side fuel filter with fuel (half full).

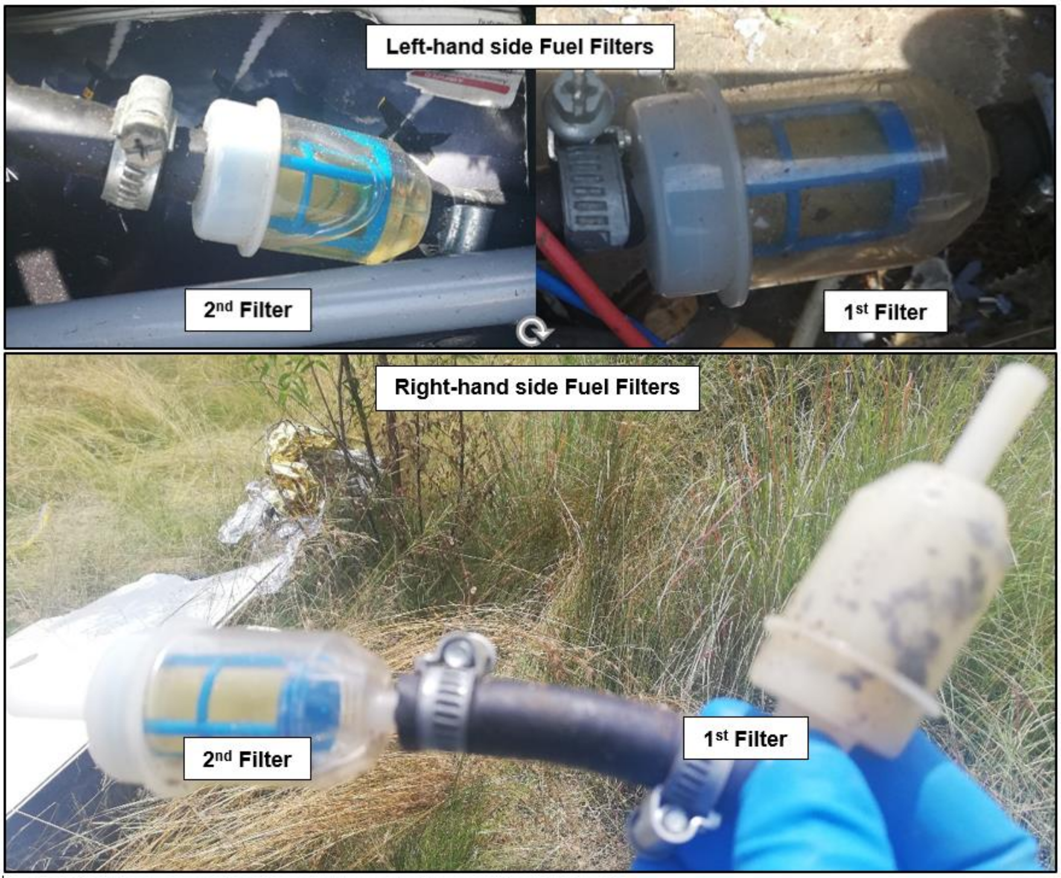


Figure 10: Two left-side fuel filters, the second one with fuel (top) and two right-side fuel filters, both empty /dry (bottom).

1.12.9. The throttle lever was found in the full forward position. The elevator trim was found in a significantly nose-down position (set significantly forward = nose down position).

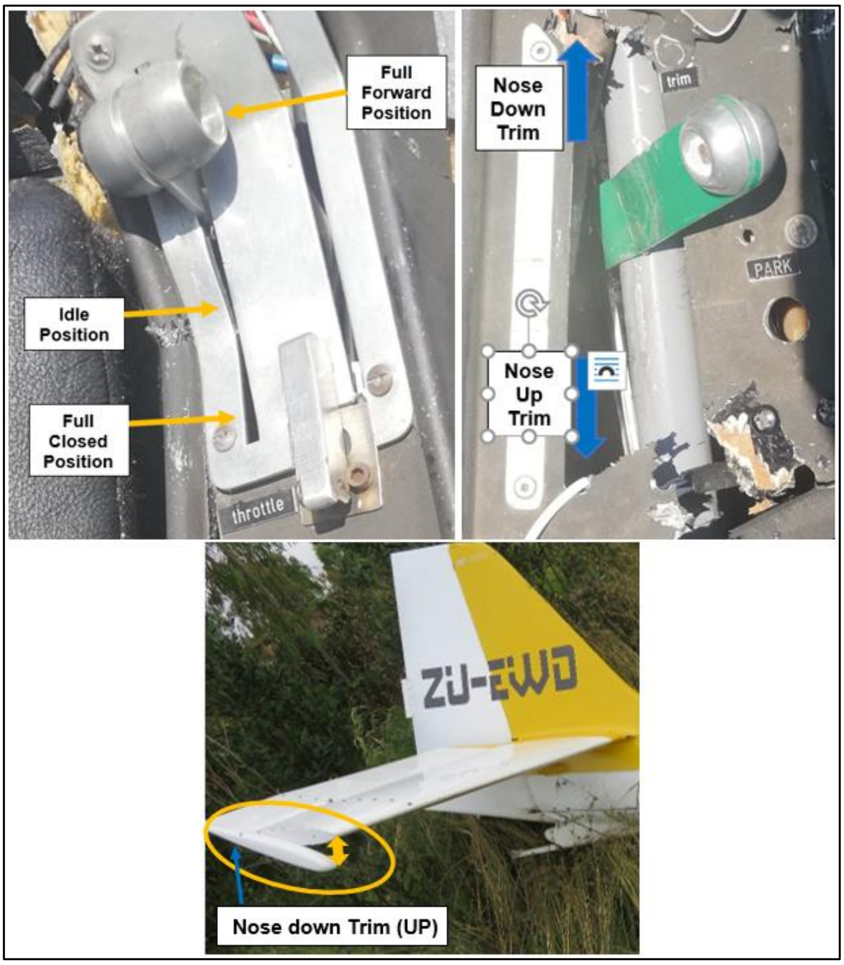


Figure 11: Throttle lever position (top left); elevator trim position (top right and bottom centre) as found at the accident site.

1.12.10. There was no pre-flight inspection checklist, nor was there a calibrated stick (to measure fuel quantity) found in the wreckage. The B.R.S. activating red handle was pulled out and its safety pin was found lying on the fuselage floor under the handle.

1.12.11. The battery master, ignition switches and electrical fuel pump were found in the “off” position; these were switched off by one of the witnesses who had arrived at the accident site before the emergency services personnel.

1.13. Medical and Pathological Information

1.13.1. The pilot’s medical records reviewed from the SACAA showed that he had no medical conditions which could have contributed to the accident.

1.13.2. Both occupants’ post-mortem reports were not available at the time of finalising this report. Should any of the results have a bearing on the circumstances leading to the accident, they will be treated as new evidence and that will necessitate the reopening of the investigation.

1.14. Fire

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

1.15. Survival Aspects

1.15.1. The accident was considered not survivable as the damage was caused to the cabin structure of the aircraft, hence, both occupants were fatally injured.

1.15.2. **Safety Belts and Shoulder Harness Cables**

1.15.2.1. The pilot and the passenger both had their ventral safety belts and shoulder harnesses on.

1.15.2.2. The steel cables that connect the shoulder harness to the structure of the fuselage were found broken for both occupants (2.5 millimetres (mm) diameter cables).

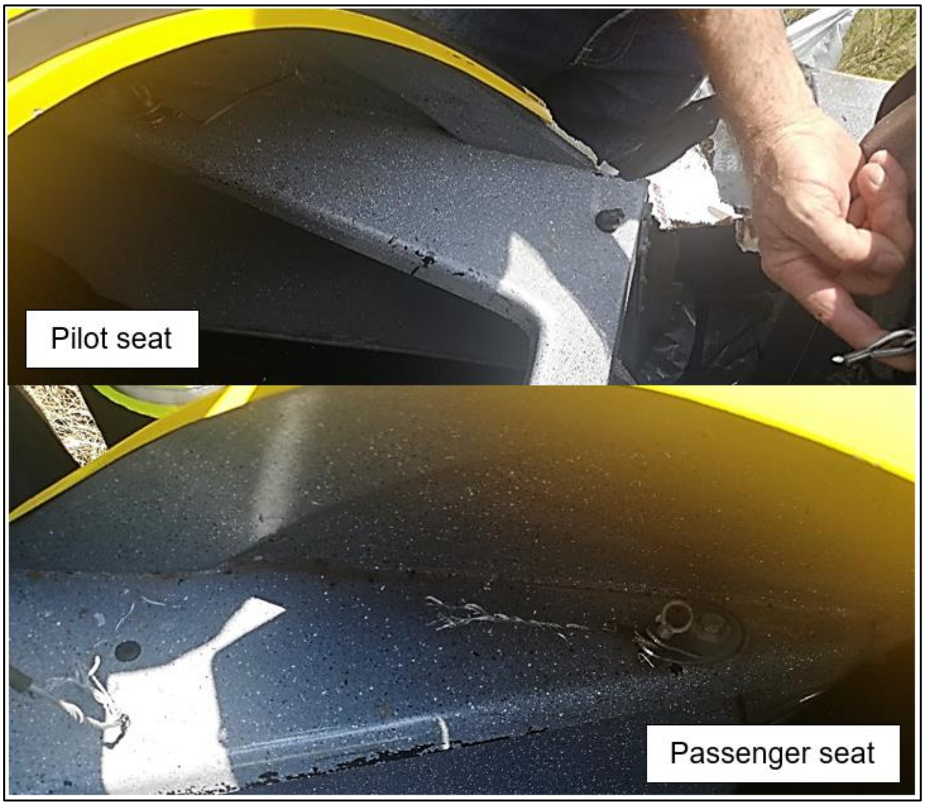


Figure 12: Broken steel cables.

1.16. Tests and Research

1.16.1. On 26 August 2020, an engine teardown and inspection were conducted at an approved Rotax engine distributor facility to determine signs of mechanical anomalies not related to the impact during the aircraft accident. The following observations were made by the AP:

- The teardown inspection of the engine did not reveal any pre-impact mechanical failure and the findings showed that the engine was in good condition, apart from obvious damage caused by accident-related impact.

- Before the engine was dismantled and the engine's crankshaft was rotated, the engine had rotated normally without obstruction.

- Visual examination of the engine-driven fuel pump did not identify any anomalies that may have affected its operation. Disassembly and examination of the magnetos, vacuum pump, oil pump and associated oil system components similarly did not identify any failure or condition that may have affected engine operation.

- The spark plugs were removed and inspected for condition. The bottom spark plugs for cylinders No.3 and No.4 (which were located on the right-side of the aircraft) were damaged during impact. The spark plug terminal had bent; however, it was easily removed. All the spark plugs faces had displayed a light brown tint synonymous with normal engine operation and had the correct electrode gaps.

- Disassembly and inspection of the engine fuel system components did not identify any failure, seizure or blockage that may have prevented fuel flow to the engine cylinders. Small remnants of fuel were found in the left carburettor bowl, while the right carburettor bowl was completely dry.

- In summary, examination of the engine did not identify any mechanical failures or issues that may have contributed to the loss of engine power.

1.16.2. **Stall Characteristics and Recovery** (Source: *lapeeraviation.com*)

1.16.2.1. According to *Skybrary* an aerodynamic stall is defined as follows: "… a sudden reduction in the lift generated by an aerofoil when the critical angle of attack is reached or exceeded".

1.16.2.2. At a low angle of attack (AOA) (a small angle between the chord line and the relative airflow), the airflow over the wing is laminar and smooth. As the angle of attack increases, the smooth airflow over the wing starts to become turbulent. When the critical AOA is reached, the airflow over the wing breaks away and all lift is rapidly reduced. This angle is referred to as the stall angle.

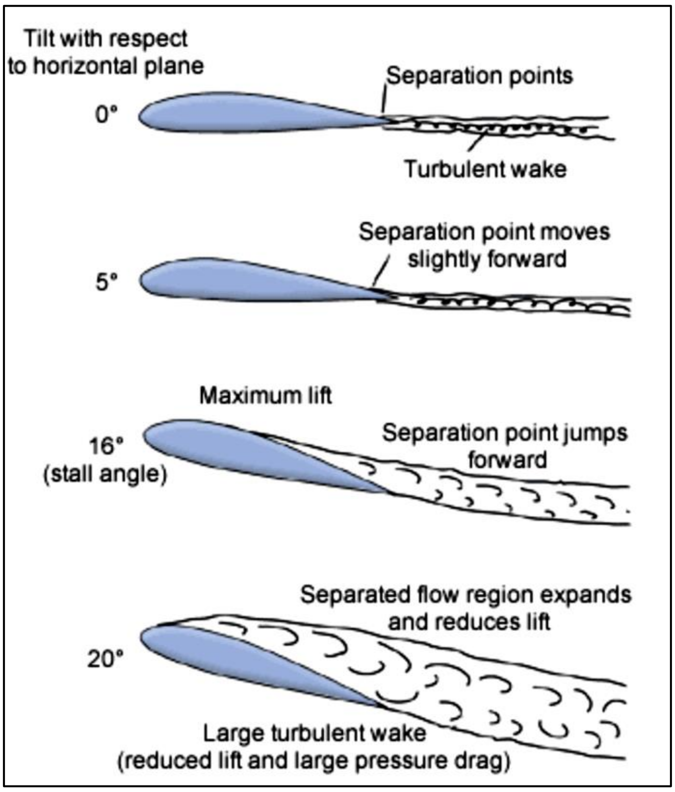


Figure 13: The angle of attack in relation to airflow over the wing (Source: lapeeraviation.com)

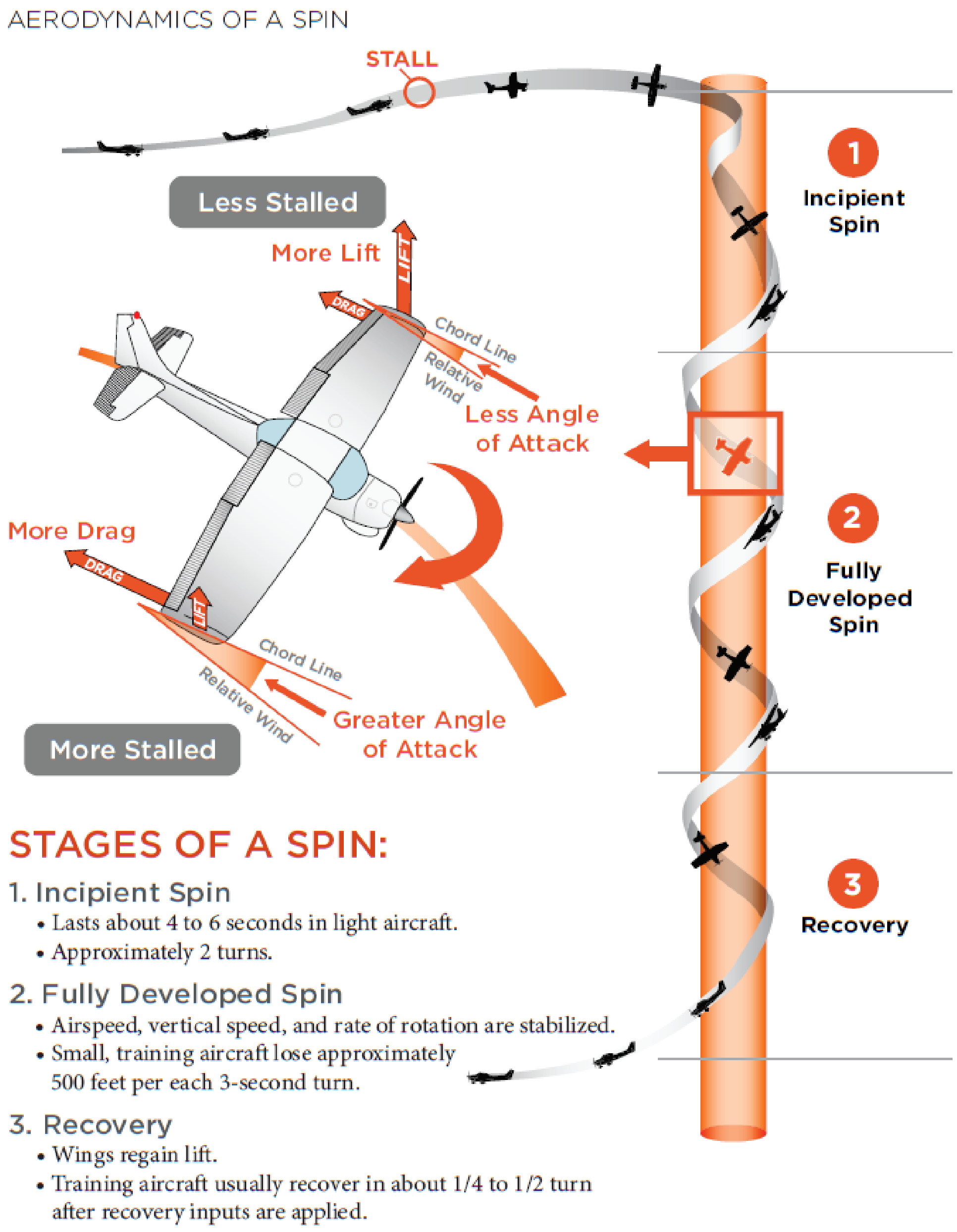
1.16.2.3. A stall can be identified by an increasing descent rate, often accompanied by a rapid reduction in pitch attitude. An un-commanded roll or 'wing drop' may also occur when one wing stalls earlier than the other. Stall recovery practically involves lowering the nose of the aircraft and, if available, applying power to increase airspeed.

1.16.3. **Stalls, Spins and Spin Recovery According to the Aircraft Owners and Pilots Association (AOPA) Air Safety Institute (Refer to the illustration of "Aerodynamics of a Spin")**

The amount of lift produced by any air oil depends on its airspeed and angle of attack (AOA), defined as the angle between its chord line (from the foremost surface on the leading edge to the aftmost along the trailing edge) and what's known as the "relative wind"—essentially the airfoil's trajectory through the surrounding air. While lift increases steadily with airspeed, raising the angle of attack only increases lift to a very specific point. Every airfoil has a critical angle of attack which remains constant regardless of airspeed, attitude, and aircraft weight; when the AOA exceeds that critical value, the smooth flow of air above the wing is disrupted and becomes turbulent, causing the sudden and rapid loss of lift we know as an aerodynamic stall.

Airspeed can serve as a surrogate for AOA near the middle of the flight envelope, but the approximation becomes progressively worse at higher bank angles and/or more extreme pitch attitudes. Abrupt changes in pitch can increase angle of attack much faster than they reduce airspeed, causing stalls well above the nominal wings-level stall speed.

When the airplane is in coordinated flight, both wings stall simultaneously, and the airplane's nose drops straight ahead (different designs have greater or lesser tendencies to fall off on one wing). A prompt reduction in AOA will typically allow recovery within 100 to 350 feet. If the airplane is yawing as it stalls, however, the wing to the inside of the turn stalls earlier and more deeply than the outside wing, causing a spin. The greater lift produced by the outside wing perpetuates a steep bank angle, extreme nose-low attitude, and very rapid turn in a pattern called autorotation.



1.16.4. **Unporting of the Right-Hand Fuel Tank Pickup Outlet**

1.16.4.1. According to AOPA's Training Tip: 'Unported' Fuel article, an aircraft with low fuel engaging in uncoordinated-flight profiles run the "risk of having the remaining fuel supply sloshing away from the lines that carry gas to the engine—a problem known as 'unporting'. AOPA further mentions that, a fuel-starvation situation or unporting of fuel occurs when an aircraft is in a take-off climb with less than the minimum fuel quantity recommended for take-off, as the manufacturer's fuel-quantity stipulation "is due to the location of the fuel pickups in the tanks of the aircraft type, which would allow unporting and fuel supply interruption with steep attitudes, turning type ground manoeuvres during take-offs, or uncoordinated flight".

1.16.4.2. The tanks were in the in-board sections of each wing and each had one forward fuel pick-up on the left of the right fuel tank and the right of the left fuel tank. The fuel system was equipped with a mechanical fuel pump which supplied fuel to the engine.

1.16.4.3. Given that the EFIS's SD-card was not recovered, it could not be determined whether a low-fuel message could have been displayed when the aircraft was in the nose-up position, it is likely that the aircraft's nose-up attitude during take-off led to the unporting of the remaining fuel, which resulted in fuel starvation.

1.16.4.4. Based on the information presented above, it is of the investigators' opinion that the potential for "unporting" of the right-side fuel tank pickup outlet as the aircraft took off with lower than permitted fuel levels in the selected fuel tank could have occurred, which could have resulted in the engine flaming out. Figure 13 shows an illustration of the possible scenarios that could have occurred when considering that the aircraft could have taken off with less than permissible fuel in the selected right-side fuel tank.

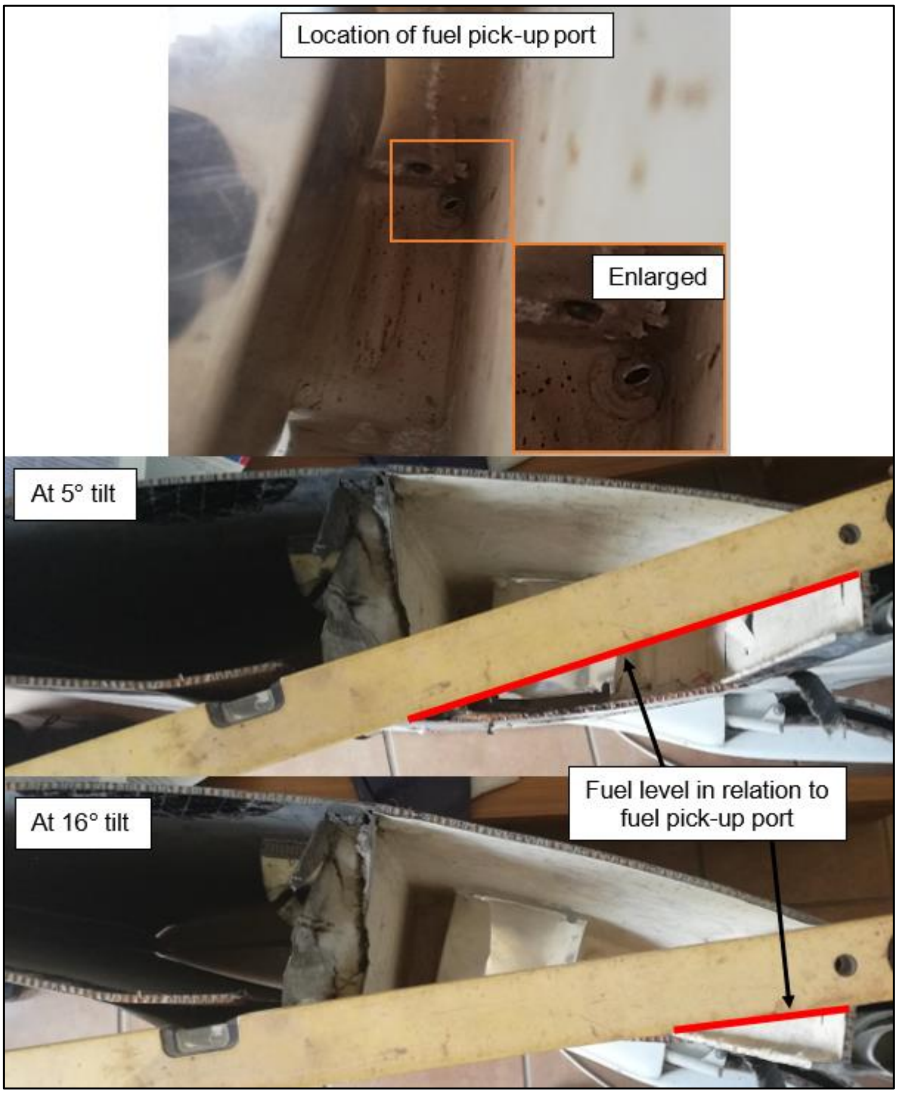


Figure 14: Red lines show the assumed fuel level in relation to the fuel pick-up port of the right-side fuel tank at 5° compared to 16° angle of attack.

1.16.5. Impossible Turn According to FAA-P-8740-44 – AFS–920 (2017) & Engine Failure on Climb-out Leads to Impossible Turn – AOPA (LAX07LA022)

Figure 15 illustrates the following scenario:

You have just completed one of your immaculate departures and had climbed to 300 feet. Without warning, it all goes uncomfortably quiet up front. Some rather revealing experiments have been conducted concerning the average pilot's reaction time; from all accounts, the average pilot needs at least 4 seconds to react when faced with the unscheduled loud silence. Because the modern light plane climbs in a rather nose-high attitude, it is sitting nose-up with no power-the airspeed indicator winds down like a busted clock.

When the engine fails, time is of the essence. As my old flying instructor liked to say, "Gravity never lets up." Because time can be related to height loss, during the time that passes after your engine goes on strike at 300 feet AGL. First, there is 4 seconds reaction time. Then you use up 60 seconds to turn through 180 degrees at standard rate and 15 seconds more for the extra 45 degrees *necessary to point you at the airfield; total time since power failure so far is 79 seconds. An average lightplane in a turn will descend at, say, 1000 fpm: at that rate, 79 seconds translates into a height loss of 1316 feet. Having started the emergency procedure only 300 feet above the ground, you and your wonder plane now would be 1016 feet BGL (below ground level)!*

At 80 knots, a 45-degree bank would approximate to a four-times standard-rate turn, meaning 15 seconds will be necessary to change direction 180 degrees. Take another look at Figure 1: Although for a 70-knot turn it shows a radius of 560 feet and adding 10 knots will not make a lot of difference, to point back at the airfield it is necessary to fly through another 10 degrees. In terms of time, we have 4 seconds in which to react, 15 for the turn through 180 degrees and another 1 second for the extra 10 degrees needed to head for the airfield, for a total of 20 seconds.

Even if the rate of descent remains unchanged (although you know, and I know, that it is bound to increase while banked at 45 degrees) a third of a minute while descending at 1000 fpm means you will have lost 333 feet at the end of the turn, which started from 300 feet AGL.

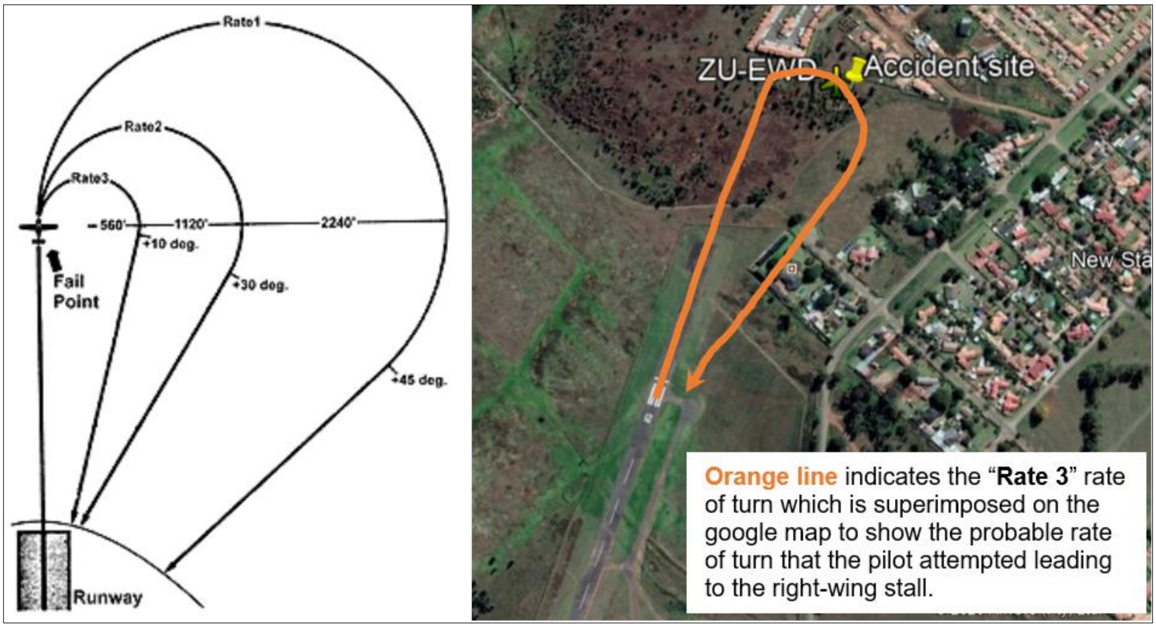


Figure 15: Turn radius when attempting to turn back to the runway. (Source: FAA-P-8740-44 – AFS–920 (2017))

To demand that the landing must be straight ahead would be pointless and potentially dangerous. Ahead may lie the biggest and densest housing development of all time. 10 degrees to one side could be an open field. Figure 16 illustrates the options available if you scan the relatively wide area contained within a 60-degree arc left and right of the take-off path.

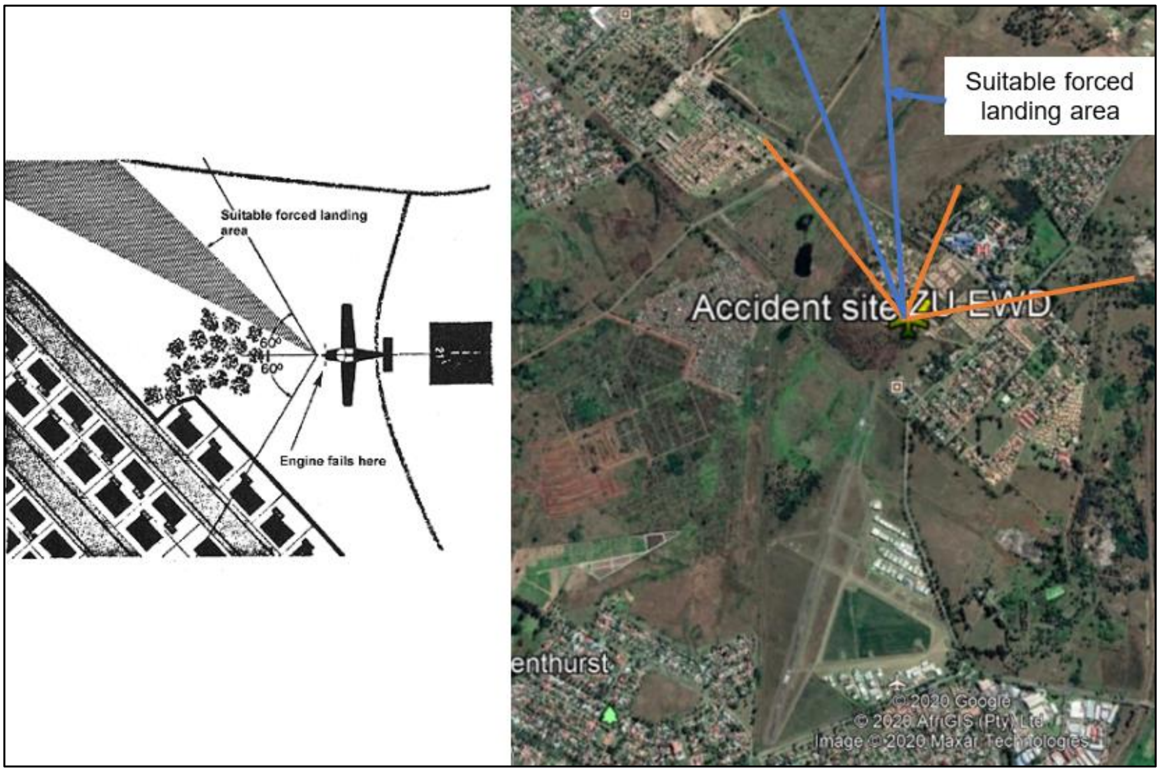


Figure 16: Suitable landing site up to 60 degrees on the left-side of aircraft heading. (Source: FAA-P-8740-44 – AFS–920 (2017))

Turning back at low level is not solution. However, there are other reasons why that turn should not be attempted unless circumstances offer a sporting chance. First, there is the obvious hazard of landing against oncoming traffic. But, even if the airfield is quiet and you have the place to yourself, there still is a downwind landing to contend with. At worst, final approach may be downwind and crosswind, a situation that could result in more damage than a well-executed arrival in a ploughed field. The crosswind further complicates the problem because it extends or reduces your turn radius according to whether you bank left or right on the way back. At low level, with all the pressures and anxieties of an engine failure, do you feel confident enough to make the right decision?

1.17. Organisational and Management Information

1.17.1. Operator

1.17.1.1. The aircraft had been registered to the current owner since 19 May 2015, after purchasing it from the previous owner.

1.17.1.2. According to ZU-EWD's Accepted Maintenance Schedule (AMS), "*this check list must be performed in conjunction with the applicable manufacturer's engine and propeller checklists and also in accordance with SA-CATS 44.01.06 Annexure A for minimum maintenance requirements*".

Upon studying the ZU-EWD's AMS submitted for the last Authority to Fly (ATF) renewal, it was determined that the AMS did not make provision for the inspection of the B.R.S. unit installed in the aircraft.

1.18. Additional Information

1.18.1. **Engine Failure During Take-off run and Inflight Procedure According to the FK-14B POH**

3.4. Engine Failure

during takeoff run:	
Throttle	idle
Brakes	as required
Electrical fuel pump	OFF
Fuel selector	CLOSE
Ignition	OFF (912iS: LANE A+B OFF)
Battery switch	OFF
in flight:	
Glide speed	148 km/h / 80kt flaps up
Electrical fuel pump	ON (req. for starter engagement)
912 iS only: AUX	ON
Fuel selector(s)	check fullest tank OPEN
912 iS only: LANE A+B	reset (OFF then ON)
Engine	start
No restart possible:	
Emergency landing	perform respective procedure

1.19. Useful or Effective Investigation Techniques

1.19.1. None.

2. ANALYSIS

2.1.1. The pilot was initially issued a National Pilot Licence (NPL) on 25 June 2012. The pilot's licence was renewed following a skills test on 9 June 2018, with an expiry date of 8 June 2020. The pilot was issued a medical certificate with no restrictions on 22 February 2018 with an expiry date of 28 February 2021. According to the pilot's file, the FK 14B Polaris aircraft type was endorsed on the pilot's licence on 8 August 2015.

2.1.2. Following the application of the renewal of a Recreational Pilot Licence on 9 June 2018, between 23 June 2018 and the last flight prior to the accident flight on 28 December 2019, the pilot had further accumulated 118.2 flying hours. The pilot had flown 11.8 hours on the aircraft during the past 90 days prior to the accident flight. At the time of the accident, the pilot had a period of 42 months and 377.6 hours on the accident light sport aircraft.

2.1.3. According to the records, the same AP had been maintaining the ZU-EWD aircraft since 27 October 2015 (more than four years) and had performed six annual inspections and was responsible for the engine change that was carried out in 2018.

2.1.4. According to the AP's certificate, the accident aircraft ZU-EWD was a group 2 aircraft (Aeroplanes Composite Construction MTOW <5700kg) fitted with a Rotax 912 ULS, which is classified as a group 2 engine (in-line piston engines), therefore, the AP was rated and approved to perform maintenance on the aircraft and engine types.

2.1.5. The last maintenance inspection undertaken on the aircraft prior to the accident flight was an annual inspection, which was carried out on 16 September 2019 at 778.3 airframe hours. At the time of the accident, the aircraft had flown 16.5 hours since its annual inspection. There were no pre-existing mechanical faults with either the engine or the fuel system recorded in the flight folio and defect logs that could have contributed to the accident. Additionally, there were no snags recorded in folio regarding the air turnback due to engine issues.

2.1.6. Following the annual inspection, the aircraft was issued a Certificate of Release to Service (CRS) on 16 September 2019 stating that the aircraft's next scheduled inspection was to be carried out at 878.3 hours of flight or on 16 October 2020, whichever occurs first.

According to the above information, the aircraft's next inspection would have been carried out after 100 hours of flight or after 13 months, "whichever occurs first". However, according to the provisions of Subpart 44.01.6 (1)(c) of the CAR 2011 as amended, "the annual inspections referred to in paragraphs (a) and (b), shall be carried out not later than 12 months since the previous inspection". Therefore, the issued CRS indicating that the next annual inspection would have been carried out after 13 months from the previous inspection was not in line with the provisions of Subpart 44.01.6 (1)(c) of the CAR 2011 as amended.

2.1.7. Following the accident, the engine was recovered and subjected to a teardown inspection by the AP in the presence of the investigators. The overall examination of the engine and its systems internally and externally was found to be satisfactory. There were no defects found which could have hampered the operation of the engine prior to impact.

About two weeks before the accident flight, a witness reported that the pilot and owner of ZU-EWD was seen working on the engine and mentioned that the engine had some issues but did not mention what the problem was. About a week later (a week before the day of the accident) ZU-EWD was seen taking off from RWY 03 at FASI, and immediately after the aircraft was airborne, the pilot requested to return as the aircraft experienced an engine problem, and again did not state the nature of the problem. However, there were no records of the flight details in the flight folio nor were there any records of any technical defect with the engine found in the logbook or defect reports during the investigation.

2.1.8. Post-accident investigation on site revealed that the aircraft had no fuel in the right tank as indicated by the filters of the right tank that had no fuel, as well as the engine right carburettor bowl that also had no evidence of fuel. The pilot had selected the right tank prior to take-off; thus, it is most likely that the insufficient fuel had been the cause of the engine stoppage.

2.1.9. The aircraft took off with the right tank almost empty and with minimum fuel in the left tank. It is probable that after take-off and during the climb phase, the engine started spluttering and subsequently stopped.

2.1.10. The aircraft was fitted with the B.R.S. system. When serviceable and conditions are favourable, it helps bring the aircraft safely to the ground with minimum damage and minimum injuries to the occupants. The height at which the chute was deployed was insufficient to allow it to fully deploy. The B.R.S. system fitted on the aircraft was not maintained in accordance with the manufacturer's specifications; and the mandatory service bulletin was not carried out and the ballistic chute was Timex.

2.1.11. The puff of white smoke described by eyewitness probably emanated from the late activation of the B.R.S. parachute by the pilot.

2.1.12. There was no pre-flight inspection checklist, nor was there a calibrated stick (to measure fuel quantity) found in the wreckage; additionally, the B.R.S. activation red handle was pulled out and its safety pin was found lying on the fuselage floor under the handle; this indicates that the pilot did not conduct pre-flight inspections which is required by the aircraft manufacturer.

2.1.13. In an attempt to make a 180° turn back to the aerodrome, the pilot had executed a steep right turn (left wing high and almost beyond 75° bank angle) which caused the aircraft to stall and enter a spin, a condition from which the pilot could not recover. During a high bank angle, the aircraft may lose height significantly. When the pilot banked the aircraft, he subjected it to a rate 3 turn, which allowed for the aircraft to turn in a short radius. However, a complete 180° turn was not achievable as the aircraft had lost speed and height, resulting in a spin.

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 conclusion 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 appropriately licensed and qualified for the flight in accordance with (IAW) International Civil Aviation Organisation (ICAO) and the provisions of Part 62 of the CAR 2011 as amended. The pilot was also medically fit with a valid medical certificate to operate the flight in line with the provisions of Part 67 of the CAR 2011 as amended. However, the pilot's knowledge and understanding of the aircraft's emergency rescue system was inadequate.

3.2.2. The AP who had been maintaining the ZU-EWD aircraft since 27 October 2015 was appropriately licensed and approved to carry out maintenance on the FK 14B aircraft type in line with the provisions of Part 24, 44, 66.4, 94 and 96 of the CARs 2011 as amended. However, the AP's knowledge and understanding of the aircraft's emergency rescue system was inadequate.

3.2.3. The aircraft was maintained according to the accepted maintenance schedule (AMS); however, the aircraft was fitted with a ballistic parachute emergency rescue system which was not maintained in line with regulatory and manufacturer requirements. Given the height of the aircraft, the B.R.S. parachute would have not been effective even when deployed.

3.2.4. At the time of the accident, the B.R.S. parachute unit was unserviceable. Although the B.R.S. parachute was actuated at a low altitude, the failure of the B.R.S. parachute to fully deploy could be attributed to the lack of maintenance which was exacerbated by the fact that the B.R.S. parachute unit had passed its use-by date by 2 years and 10 months.

3.2.5. Post-accident investigation on site revealed that the aircraft had no fuel in the right tank as indicated by the filters of the right tank that had no fuel, as well as the engine's right carburettor bowl that also had no fuel. The pilot had selected the right tank prior to take-off; thus, it is likely that the insufficient fuel contributed to the cause of the engine stoppage.

3.2.6. The aircraft was structurally intact prior to impact; there was no evidence of airframe failure, and all damage to the aircraft was attributed to the severe impact forces. The engine examination did not identify any pre-impact failures or issues that may have contributed to the engine stoppage. No pre-impact anomalies could be found that would explain the loss of control in-flight. All the damage found on the wreckage was due to the force of the impact.

3.2.7. There was no pre-flight inspection checklist nor was there a calibrated stick (to measure fuel quantity) found in the wreckage; additionally, the B.R.S. activation red handle was pulled out and its safety pin was found lying on the fuselage floor. This indicated that the pilot did not conduct pre-flight inspections which is a requirement by the aircraft manufacturer.

3.2.8. The aircraft impacted the ground hard and was destroyed by impact forces, and both occupants on-board were fatally injured.

3.2.9. In an attempt to make a 180° turn back to the aerodrome, the pilot had executed a steep right turn (left wing high and almost at beyond 75° bank angle) which caused the aircraft to stall and enter a spin from which the pilot could not recover. During a high bank angle, the aircraft lost height significantly. When the pilot banked the aircraft, he subjected it to a rate 3 turn, which allowed for the aircraft to turn in a short radius. However, a complete 180° turn was not achievable as the aircraft lost speed and height, resulting in a spin.

3.2.10. The aircraft stalled during a steep right turn when the pilot attempted to return to the aerodrome following an engine stoppage. This resulted in the aircraft losing height and forward speed, causing the right spin from which the pilot could not recover; the aircraft subsequently crashed.

3.3. Probable Cause

3.3.1. The aircraft stalled during a steep right turn following an engine stoppage. This resulted in a right spin from which the pilot could not recover.

3.4. Contributory Factors

3.4.1. Engine stoppage during take-off due to fuel starvation.

3.4.2. Inadequate pre-flight inspection.

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 organisations.

4.2 Safety Recommendation/s

4.2.1 Safety message: Pilots must conduct a proper and complete pre-flight inspection to avoid accidents like this one from occurring, given that should the pilot had checked the fuel quantity, then this accident would have been avoided.

4.2.2 Safety message: During pre-flight planning, it is advisable to consider factors such as landing options on and off the aerodrome, which may likely reduce pilots' mental workload in case an engine failure/stoppage occurs. Pre-planning generally mitigates the detrimental effects of decision-making under stress.

5. APPENDICES

5.1. None.

This Report is issued by:

Accident and Incident Investigations Division
South African Civil Aviation Authority
Republic of South Africa