

PRELIMINARY ACCIDENT REPORT

Accident and Incident Investigations Division

Accident
- Preliminary Report -
AIID Ref No: CA18/2/3/10391



Figure 1: The file picture of the ZS-PSZ helicopter. (Source: www.flightzone.co.za)

Description:

On Thursday afternoon, 23 November 2023, two pilots on-board a Robinson R44 Raven II helicopter with registration ZS-PSZ were on a private flight from the Ultimate Heli facility in Midrand, Gauteng province, with the intention to land back at the same take-off facility.

According to the pilot flying (PF), the engine started without difficulty and was allowed to run for a few minutes until all the parameters were within the acceptable limits. At 1400Z, the helicopter took off and flew in the direction of the general flying area (GFA). The air traffic control (ATC) officer reported that the helicopter was established at 6 000 feet (ft) above mean sea level (AMSL), and that the PF was in contact with them. After approximately 39 minutes of flight time whilst on the return flight to Ultimate Heli facility abeam the quarry which is approximately 3.92 nautical miles (NM) south of FAGC, the aircraft experienced an engine failure; no distress call was made. Subsequently, the helicopter lost height and impacted the ground hard on its skids landing gear. The helicopter was destroyed by impact forces; both occupants were seriously injured.

Occurrence Details

Reference Number : CA18/2/3/10391
Occurrence Category : Category 1
Type of Operation : Private (Part 91)
Name of Operator : Ultimate Heli (Pty) Ltd
Aircraft Registration : ZS-PSZ
Aircraft Make and Model : Robinson R44, Raven II
Nationality : South African
Place : Open field east of Ultimate Heli facility
Date and Time : 23 November 2023, 1439Z
Injuries : Yes
Damages : Destroyed

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 promoting aviation safety and reducing aviation accidents or incidents' risk and not apportioning blame or liability.

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.

Investigation Process

The Accident and Incident Investigations Division (AIID) was notified of the occurrence involving the Robinson R44 Raven II helicopter which occurred on an open field east of Ultimate Heli facility and south of Grand Central (FAGC) Aerodrome, Gauteng province, on 23 November 2023 at 1439Z. The occurrence was classified as an accident according to the CAR 2011 Part 12 and the International Civil Aviation Organisation (ICAO) STD Annex 13 definitions.

The AIID has appointed an investigator-in-charge to conduct the investigation. Notifications were sent to the State of Registry, Operator, Design and Manufacturer in accordance with the CAR 2011 Part 12 and ICAO Annex 13 Chapter 4. The states did not appoint an accredited representative and advisor. The AIID will lead the investigation and issue the final report of this accident in accordance with the CAR 2011 Part 12 and ICAO Annex 13.

The information contained in this preliminary report is derived from the information gathered during the on-going investigation into the occurrence.

The AIID reports are made available to the public at:

<https://www.caa.co.za/industry-information/accidents-and-incidents/>

Notes:

1. *Whenever the following words are mentioned in this report, they shall mean the following:*
Accident — this investigated of accident
Aircraft — the Robinson R44, Raven II helicopter 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 have been adjusted from the original for the sole purpose of improving clarity of the report. Modifications to images used in this report were limited to cropping, magnification, file compression; or enhancement of colour, brightness, contrast; or addition of text boxes, arrows, or lines.*

Disclaimer

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Abbreviation	Description
AIID	Accident and Incident Investigations Division
A/C	Aircraft
ACCID	Accident
AGL	Above Ground Level
AMO	Aircraft Maintenance Organisation
AIP	Aeronautical Information Publication
AMSL	Above Mean Sea Level
ATC	Air Traffic Controller
°C	Degree Celsius
CAA	Civil Aviation Authority
CAR	Civil Aviation Regulations
CVR	Cockpit Voice Recorder
C of A	Certificate of Airworthiness
C of R	Certificate of Registration
FAGC	Grand Central Aerodrome
FDR	Flight Data Recorder
hPa	Hector Pascal
Km	Kilometres
Kts	Knots
M	Metre
MHz	Megahertz
MPI	Mandatory Periodic Inspection
N/A	Not Applicable
NDB	Non-directional Beacon
NM	Nautical Miles
POH	Pilot's Operating Handbook
PPL	Private Pilot Licence
PSI	Pounds Per Square Inch
QNH	Query: Nautical Height
RPM	Revolutions per Minute
SACAA	South African Civil Aviation Authority
SAWS	South African Weather Service
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
Z	Zulu (Term for Universal Co-ordinated Time - Zero Hours Greenwich)

1. FACTUAL INFORMATION

1.1. History of Flight

- 1.1.1. On Thursday afternoon, 23 November 2023, two pilots on-board a Robinson R44 Raven II helicopter with registration ZS-PSZ were on a private flight from Ultimate Heli facility in Midrand, Gauteng province, with the intention to land back at the same take-off facility. Visual meteorological conditions (VMC) by day prevailed at the time of the flight which was conducted under the provisions of Part 91 of the Civil Aviation Regulations (CAR) 2011 as amended.
- 1.1.2. According to available information, the pair conducted a pre-flight inspection on the helicopter, which was parked on the helipad outside the Ultimate Heli facility; nothing abnormal was found. The helicopter's technical logs revealed no outstanding defects and the flight folio page serial number 1605 showed that the helicopter had 175 litres (l) of Avgas 100LL fuel in the tanks. Before departure, the pilot flying (PF) who was seated on the right front seat, broadcasted his intentions to the Grand Central Aerodrome (FAGC) air traffic control (ATC) officer on very high frequency (VHF) 122.80-Megahertz (MHz). The PF's intentions were acknowledged.
- 1.1.3. According to the PF's written statement on the pilot's questionnaire (form CA 12-03), the engine started without difficulty and was allowed to run for a few minutes until all the parameters were within the acceptable limits. At 1400Z, the helicopter took off in the direction of the general flying area (GFA). The ATC officer reported that the helicopter was established at 6 000 feet (ft) above mean sea level (AMSL) and the PF was in contact with the ATC officer. After approximately 39 minutes of flight time whilst on the return flight to Ultimate Heli facility and abeam the quarry which is approximately 3.92 nautical miles (nm) south of FAGC, the aircraft experienced an engine failure. No distress call was made. The helicopter descended and impacted the ground hard on its skid landing gear; it was destroyed by impact forces. Both occupants sustained serious injuries, and they were airlifted to a hospital in Johannesburg for medical attention.
- 1.1.4. The accident occurred during daylight, east of Ultimate Heli facility and approximately 3.92nm south of FAGC at Global Positioning System (GPS) co-ordinates determined to be 26°03'18.3" South 28°07'24.8" East, at an elevation of about 4 700 feet (ft) above mean sea level (AMSL).



Figure 2: Aerial view showing the Ultimate Heli facility and the accident site. (Source: Google Earth)

1.2 Injuries to Persons

Injuries	Pilot	Crew	Pass.	Total On-board	Other
Fatal	-	-	-	-	-
Serious	2	-	-	2	-
Minor	-	-	-	-	-
None	-	-	-	-	-
Total	2	-	-	2	-

Other means people on the ground.

1.3 Damage to Aircraft

1.3.1 The helicopter was destroyed by impact forces.



Figure 3: The helicopter at the accident site. (Source: Operator)

1.4 Other Damage

1.4.1 None.

1.5 Personnel Information: Pilot Flying

Nationality	South African	Gender	Female	Age	39
Licence Type	Private Pilot Licence (PPL)				
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Night				
Medical Expiry Date	4 March 2025 (Class 2)				
Restrictions	None				
Previous Accidents	None				

Flying Experience:

Total Hours	161.90
Total Past 90 Days	2.90
Total on Type Past 90 Days	2.90
Total on Type	108.50

1.5.1 The PF was initially issued a Private Pilot Licence (PPL) on 11 January 2022. Her last licence validation test was conducted on 14 December 2022, and was issued a licence on 11 January 2023 with an expiry date of 31 December 2024.

1.5.2 The PF was issued a Class 2 aviation medical certificate on 4 March 2020 with an expiry date of 4 March 2025.

1.6 Helicopter Information

1.6.1 Helicopter Description (Source: Pilot's Operating Handbook [POH])

The Robinson R44 Raven II is a single-engine helicopter manufactured by Robinson Helicopter Company. It was powered by a Lycoming IO-540-EA1A5 six-cylinder fuel injected engine rated at 205 brake horsepower (BHP) and was certified for day operation under visual flight rules (VFR). The maximum operating altitude of the helicopter is 14 000ft density altitude and maximum take-off weight is 2 504 pounds (lbs) / 1 136 kilograms. Helicopter length is 9.12 metres (m) / 359 inches and width is 2.18m / 86 inches, height of this helicopter is 3.27m / 129 inches. The standard helicopter seating configuration is one pilot and three passengers. The helicopter is constructed primarily of metal and equipped with skid-type landing gear. Primary structure is welded steel tubing and riveted aluminium. The tail cone is a semi-monocoque structure in which aluminium skins carries most of the primary loads. Fiberglass and thermoset plastics

were used in the secondary structure of the cabin, engine cooling system, and in various other ducts and fairings.

Airframe:

Manufacturer/Model	Robinson Helicopter Company, R44 Raven II	
Serial Number	11169	
Year of Manufacture	2006	
Total Airframe Hours (At Time of Accident)	4 702.0	
Last Inspection (Date & Hours)	20 November 2023	4 685.9
Hours Since Last Inspection	16.1	
CRS Issue Date	13 November 2023	
Certificate of Airworthiness (Issue Date & Expiry Date)	2 July 2015	31 July 2024
C of R (Issue Date) (Present Owner)	25 June 2021	
Type of Fuel Used	Avgas 100LL	
Operating Category	Private (Part 91)	
Previous Incident / Accidents	On 2 May 2014, the helicopter landed hard, consequently, damaging the skids landing gear and the tail cone at 1 984.9 recorded airframe hours.	

1.6.2 Hydraulic Flight control Assistance (Source: POH)

The main rotor flight controls are hydraulically boosted to eliminate cyclic and collective feedback forces. The hydraulic system operates at a pressure between 450–500 pounds per square inch (psi) and consists of a pump, three servos, a reservoir, and interconnecting lines. The pump is mounted on and driven by the main rotor gearbox. A servo is connected to each of the three push-pull tubes that activate the main rotor swashplate. The reservoir is mounted on the steel tube frame behind the main rotor gearbox and includes a filter, pressure relief valve, and pilot-controlled pump bypass valve. A sight gauge for pre-flight fluid level checks is incorporated in the reservoir, which has a vented filler cap. The pump bypass valve is solenoid-actuated and controlled by the hydraulic switch on the T-bar cyclic. When selected to HYD (ON), the solenoid is deactivated. This fail-safe ensures hydraulic assist is retained in the event of a loss of electric system power. The switch should be on from start-up to shut down, except during the hydraulic system check or simulated hydraulic failure training. When selected to OFF, power is applied to the solenoid and high-pressure hydraulic fluid is returned to the reservoir, removing hydraulic assist from the controls.

1.6.3 Governor and tachometer system (Source: POH)

The collective pitch control stick on the helicopter included a twist grip throttle. When the collective pitch control stick is moved upward, the engine throttle opens automatically by an interconnecting linkage. The helicopter was equipped with one electronic dual (engine and rotor) tachometer and the engine governor system which senses the engine revolutions per minute (RPM) and corrective inputs forces to the throttle to maintain engine RPM as needed. The governor system comprised a solid-state electronic controller which determined the engine RPM from the tachometer points in the engine right magneto. When the governor sensed the need to adjust the engine RPM, it activates a motor which drives the throttle directly. The governor system is also designed to assist the pilot in controlling the RPM in the normal flight / normal operating range.

Engine:

Manufacturer/Model	Lycoming IO-540-EA1A5
Serial Number	L-31018-48A
Part Number	Unknown
Hours Since New	4 784.2
Hours Since Overhaul	1 044.8

Propeller:

Manufacturer/Model	Robinson Helicopter Company / C016-2
Serial Numbers	8242
Part Number	Unknown
Hours Since New	946.5
Hours Since Overhaul	TBO Not reached

1.7 Meteorological Information

1.7.1 The weather information in the table below was obtained from the South African Weather Service (SAWS).

Wind Direction	070°	Wind Speed	10kts	Visibility	9999m
Temperature	31°C	Cloud Cover	CAVOK	Cloud Base	NIL
Dew Point	12°C	QNH	1022 hPa		

1.8 Aids to Navigation

1.8.1 The helicopter was equipped with standard navigational equipment as approved by the Regulator (SACAA). There were no records indicating that the navigational equipment was unserviceable prior to the flight.

1.9 Communication

1.9.1 The helicopter was equipped with a standard communication system as approved by the Regulator. There were no recorded defects with the communication system prior to the flight.

1.10 Aerodrome Information

1.10.1 The accident occurred during daylight, east of Ultimate Heli facility and at approximately 3.92nm south of FAGC at GPS co-ordinates determined to be 26°03'18.3" South 28°07'24.8" East, at an elevation of about 4 700 ft AMSL.

1.10.2 FAGC information as outlined in the Aeronautical Information Publication (AIP).

Aerodrome Location	Midrand, Gauteng Province
Aerodrome Co-ordinates	S25° 59'.11" E028° 8'24"
Aerodrome Elevation	5 327 feet AMSL
Runway Dimensions	1 830 x 23m
Runway Designations	17/35
Runway Used	N/A
Runway Surface	Asphalt
Aerodrome Status	Licensed
Approach Facilities	Runway lighting and non-directional beacon (NDB)

1.11 Flight Recorders

1.11.1 The helicopter was neither equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR), nor was it required by regulation to be fitted to the aircraft type.

1.12 Wreckage and Impact Information

1.12.1 The accident site was inspected, and all major components were present, indicating that nothing of significance broke off from the helicopter prior to impact. The fuel bladder tanks were intact and contained sufficient fuel that was consistent with Avgas 100LL. There was no evidence of fuel leaks. The helicopter impacted the ground hard which resulted in the skids landing gear breaking off. One of the main rotor blades with serial number 7282 severed the tail boom during the accident sequence. The vertical stabiliser, tail rotor guard and tail skid were damaged and disrupted. The helicopter's fuselage seemed to have bounced after impact, consequently coming to rest approximately 10m from the broken skids landing gear.



Figure 4: The wreckage and the broken skids landing gear.



Figure 5: The main wreckage and the severed tail boom.

1.12.2 Examination of the cockpit revealed the rotor brake in a 'pulled' position. None of the circuit breakers (CBs) popped. The right-side throttle/twist grip was in a position close to idle. The pilot and co-pilot throttles/twist grips both moved in unison when the pilot's (right side) throttle was activated. The collective pitch lever was found in the UP position and the governor switch was selected to the ON position, consistent with a normal flight.



Figure 6: The pilot's collective pitch control stick in the UP position and the governor switch in the ON position.

1.12.3 The movement of the collective pitch sticks was limited due to the damaged right-side collective pitch control stick. Continuity of the throttle control cable was confirmed from the collective jackshaft to the throttle bell crank assembly, and was securely attached. The hydraulic switch on the pilot's (right side) T-bar cyclic control stick had broken. The anti-torque pedals could not be activated due to the restrictions caused by impact damage. The mixture control was pressed (OFF position), it appeared to have been disturbed during the accident sequence. The flight control continuity to the main rotor head and tail rotor could not be established due to impact damage.

1.12.4 The engine and the main transmission remained mounted on the airframe and all the main rotor blades were secured to their respective grips, which remained attached to the main rotor head and mast. Drive train to the main and tail rotors could not be established. The main gearbox housing was intact and attached to the bottom of the main rotor mast and the centre frame. The main gearbox rotated freely and exhibited continuity from input to the main rotor drive shaft, and the free-wheeling sprag clutch operated as expected. One of the pitch links broke at the adjusting course area; it displayed signatures consistent with compression loads emanating from impact. The main rotor blade with serial number 7282 had dents and scratches on the leading-edge inboard area (white painted portion), which indicated impact damage with the tail boom structure.



Figure 7: The main rotor blade leading edge area showing the impact print.

1.12.5 The main rotor blades showed little to no damage along their respective spans towards the blade tips, which was consistent with low rotor revolutions per minute (RPM) at the time of impact. Also, the thin white markings inside the engine cooling fan were aligned, which indicated that the engine was producing little to no power at the time of impact.



Figure 8: The engine cooling fan.

1.12.6 The v-belts on the engine output shaft were in place and intact. The long tail rotor drive shaft was severed; however, the tail rotor gearbox shaft was intact and it rotated freely. The tail rotor gearbox housing was also intact. The inspection sight gauge (glass) indicated a sufficient lubrication oil level.



Figure 9: The v-belts on the engine output shaft.

1.13 Medical and Pathological Information

1.13.1 Not applicable.

1.14 Fire

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

1.15 Survival Aspects

1.15.1 To be discussed in the final report.

1.16 Tests and Research

1.16.1 To be discussed in the final report.

1.17 Organisational and Management Information

1.17.1 This was a private flight conducted under the provisions of Part 91 of the CAR 2011 as amended.

1.17.2 The 100-hour mandatory periodic inspection (MPI) that was conducted on the helicopter prior to the accident flight was certified on 20 November 2023 at 4 685.9 airframe hours. The accident occurred at 4 702.0 total airframe hours, which meant that the helicopter was flown a further 16.1 airframe hours since the last inspection.

1.17.3 The aircraft maintenance organisation (AMO) which conducted the last MPI on the helicopter had an approval certificate that was issued on 16 May 2023 with an expiry date of 31 May 2024.

1.17.4 The helicopter was issued a Certificate of Release to Service (CRS) on 20 November 2023 with an expiry date of 19 November 2024 or at 4 784.9 airframe hours, whichever occurs first.

1.18 Additional Information

1.18.1 To be covered in the final report.

1.19 Useful or Effective Investigation Techniques

1.19.1 To be covered in the final report.

2. FINDINGS

2.1 General

From the available evidence, the following preliminary findings were made with respect to this accident. These shall not be read as apportioning blame or liability to any 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.

2.2 Findings

2.2.1 The PF was initially issued a Private Pilot Licence (PPL) on 11 January 2022. Her last licence validation test was conducted on 14 December 2022, and was issued a licence on 11 January 2023 with an expiry date of 31 December 2024.

2.2.2 The PF was issued a Class 2 aviation medical certificate on 4 March 2020 with an expiry date of 4 March 2025.

2.2.3 The flight was conducted under visual meteorological conditions (VMC) by day and under the provisions of Part 91 of the CAR 2011.

2.2.4 The helicopter was issued a Certificate of Registration (C of R) on 25 June 2021.

- 2.2.5 The helicopter was issued a Certificate of Airworthiness (C of A) on 11 December 2022 with an expiry date of 31 January 2024.
- 2.2.6 The last 100-hour mandatory periodic inspection (MPI) that was conducted on the helicopter prior to the accident flight was certified on 20 November 2023 at 4 685.9 airframe hours.
- 2.2.7 The helicopter was issued a Certificate of Release to Service (CRS) on 20 November 2023 with an expiry date of 19 November 2024 or at 4 784.9 airframe hours, whichever occurs first. The helicopter was flown a further 16.1 airframe hours since the last 100-hour inspection.
- 2.2.8 The AMO which conducted the last MPI on the helicopter had an approval certificate that was issued on 16 May 2023 with an expiry date of 31 May 2024.

3. ON-GOING INVESTIGATION

- 3.1 The AIID investigation is on-going and the investigators will be investigating other aspects of this occurrence which may or may not have safety implications.

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