Accident and Incident Investigations Division

Accident
- Preliminary Report -
AIID Ref No: CA18/2/3/10051

Figure 1: The ZU-RDX helicopter. (Source: Pilot)

Description:
On 9 October 2021, a pilot on-board a helicopter with registration ZU-RDX was transitioning at 3 metres after lift-off when he heard a thud, which was followed by the helicopter yawing to the left. The pilot lost control of the helicopter and it impacted the ground with the left skid and entered a dynamic rollover, where after the main rotor blades severed the tail boom. The helicopter came to rest on its right-side.

INTRODUCTION

Reference Number	**:** CA18/2/3/10051
Name of Owner	**:** G J Bingham
Manufacturer	**:** RotorWay International
Model	**:** Executive 162F
Nationality	**:** South African
Registration Marks	**:** ZU-RDX
Place	**:** Morning Star Airfield, Western Cape province
Date	**:** 9 October 2021
Time	**:** 1150Z

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****.*

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 was notified to the Accident and Incident Investigations Division (AIID) on 9 October 2021 at 1227Z. The investigators dispatched to the accident site on 9 October 2021 to conduct an on-site investigation. The investigators co-ordinated with all authorities on site by initiating the accident investigation process according to CAR Part 12 and investigation procedures. The State of Manufacture was notified of the accident and the AIID 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*
- *Helicopter — the RotorWay Executive 162F 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
°	Degrees
°C	Degrees Celsius
AIID	Accident and Incident Investigations Division
AMO	Aircraft Maintenance Organisation
AMSL	Above Mean Sea Level
AOC	Air Operator Certificate
ATF	Authority to Fly
CAR	Civil Aviation Regulations
C of A	Certificate of Airworthiness
C of R	Certificate of Registration
CRS	Certificate of Release to Service
CVR	Cockpit Voice Recorder
EFIS	Electronic Flight Instrument System
FADEC	Full Authority Digital Engine Control
FDR	Flight Data Recorder
FSTD	Flight Simulator Training Device
ft	Feet
GPS	Global Positioning System
IAW	In accordance with
Km	Kilometre(s)
Kt	Knot
m	meter
MPI	Mandatory Periodic Inspection
MTOW	Maximum take-off weight
PPL	Private pilot licence
QNH	Query: Nautical Height
RPM	Revolution Per Minute
RWY	Runway
SACAA	South African Civil Aviation Authority
SACATS	South African Civil Aviation Technical Standards
SAPS	South African Police Service
SAWS	South African Weather Service
TBD	To Be Determined
TBO	Time before overhaul
VFR	Visual Flight Rules
VHF	Very High Frequency
Z	Zulu (Term for Universal Co-ordinated Time - Zero Hours Greenwich)

1. FACTUAL INFORMATION

1.1. History of Flight

1.1.1. On 9 October 2021, a pilot accompanied by a passenger on-board a RotorWay Executive 162F helicopter with registration mark ZU-RDX took off from Morning Star Airfield, Western Cape province, with the purpose of conducting a private scenic flight in the area. The flight was conducted in accordance with (IAW) the provisions of Part 94 of the Civil Aviation Regulations (CAR) 2011 as amended.

1.1.2 According to the pilot (who was also the owner of the helicopter), the helicopter was towed out of the hangar to the apron in front of the hangar. The battery, which had been on the charger, was fully charged. The pre-flight inspection procedures were uneventful — all hatches were removed, and the helicopter was inspected appropriately; the belts were inspected, both visually and physically with the passenger turning the tail rotor by hand to detect any defects on all three tail rotor belts; the idler pulleys were noted to be in good order and none of the tele-temp markers indicated a previous overheat fault; the tail boom and tail rotor appeared to be normal in all respect; inspection of the engine via the hatch at the main rotor mast also showed no defects as the main fly wheel and all belts were in good order.

1.1.3 The pilot further stated that the start-up was uneventful with the oil pressure increasing promptly, and the oil temperature and pressure rising accordingly. During an on-site inspection, it was noted that the Hobbs metre was reading zero. This was because the internal battery in the Electronic Flight Instrument System (EFIS) had been replaced since the last flight and the Hobbs metre had not been reset to give the correct reading. However, the flight time indicator was functioning accordingly. No defects were detected in the Full Authority Digital Engine Control (FADEC) system and there was no drop in revolutions per minute (rpm) on either of the ignition banks. Both fuel pressure pumps were noted to be providing sufficient pressure to keep the fuel pressure in the green arc. The fuel tanks were topped to capacity (63 litres) prior to take-off. No water was detected in the fuel reservoir system. All pre-take-off checks were normal; the clutch disengaged appropriately, and no defects were detected. Prior to take-off, all gauges were in the green arc and all switches were noted to be appropriately positioned, except that the secondary bearing temperature indicator (bottom right-side of the EFIS screen) was not displaying (likely faulty).

1.1.4 While hovering in ground effect, the pressures and temperatures remained steady and the rpm readings were maintained with a manifold pressure setting of 31 inches (leaving two inches of residual power). Lift-off was initiated into wind following the hover, and transition was reached quickly due to the 8 knots headwind. Following transition, the helicopter was accelerated and, after travelling approximately 58 metres (m), an audible and palpable thud ran (moved) through the helicopter. This was followed by a yaw to the left and an alteration in engine power. The pilot executed a flare and the helicopter touched down while still moving forward and in a slight yaw. The marks on the ground (soft sand) showed that the helicopter travelled about 10m before a dynamic rollover to the right-side.

1.1.5 Following the accident, the pilot shut off the fuel flow and turned off all the switches and electricals. Thereafter, the pilot and the passenger exited the helicopter through the shattered windshield and put distance between themselves and the helicopter.

1.1.6 The flight was conducted in Visual Flight Rules (VFR) by day. The helicopter impacted the ground and came to rest approximately 15m from the first point of impact at Global Positioning System (GPS) co-ordinates determined to be South 33º45'44.37" East 018º32'54.69" at an elevation of 200 feet (ft).

Figure 2: An aerial view of the accident site. (Source: Google Earth)

1.2. Injuries to Persons

Injuries	Pilot	Crew	Pass.	Total On-board	Other
Fatal	-	-	-	-	-
Serious	-	-	-	-	-
Minor	-	-	-	-	-
None	1	-	1	2	-
Total	1	-	1	2	-

Note: Other means people on ground.

1.3. Damage to Helicopter

1.3.1 The helicopter was substantially damaged during the accident sequence.

Figure 3: Tthe helicopter as it came to rest. (Source: Pilot)

1.4. Other Damage

1.4.1. None.

1.5. Personnel Information

Nationality	South Africa	Gender	Male	Age	65
Licence Number	0270245657	Licence Type	Private Pilot Licence (H)		
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Night				
Medical Expiry Date	31 March 2022				
Restrictions	Nil				
Previous Accidents	Nil				

Note: Previous accidents refer to past accidents the pilot was involved in, when relevant to this accident.

Flying Experience:

Total Hours	2359
Total Past 24 Hours	0.1
Total Past 7 Days	0
Total Past 90 Days	0
Total on Type Past 90 Days	0
Total on Type	158

1.5.1 The pilot was issued a Private Pilot Licence (PPL) Helicopter (H) on 6 October 2020 with an expiry date of 31 August 2022. The pilot was issued a Class II aviation medical certificate on 4 March 2021 with an expiry date of 31 March 2022.

1.5.2. According to the pilot logbook, his last flight was on 10 April 2021, six months prior to the accident flight.

1.5.3 The following information is an extract from the South African Civil Aviation Regulations 2011 as amended.

91.02.4 *(1) A pilot shall not act as PIC of a helicopter, or second-in-command (SIC) of a helicopter required to be crewed by more than one pilot, carrying passengers by day, unless such pilot has personally, within the 90 days immediately preceding the flight, carried out either by day or by night at least three take-offs and three landings in the same class or, if a type rating is required, type or variant of aeroplane, and in the case of a helicopter three circuits including three take-offs and three landings in the same type of helicopter as that in which such flight is to be undertaken. The landings required by this sub-regulation may be completed in an FSTD approved for the purpose. In the case of a tail-wheel aeroplane, each landing shall be carried out to a full-stop.*

1.6. Helicopter Information

1.6.1 The following information is an extract from www.helistart.com

The Executive 162F is the latest in the Executive series of helicopters manufactured by RotorWay International. The RotorWay Executive line is a successful kit helicopter concept that took off in the early 1990s. The Executive 90 was developed in the early 1990s, and it was, at the time, the only piston-powered helicopter to utilise an asymmetrical aerofoil for improved autorotation *characteristics and safety.*

Airframe:

Manufacturer/Model	RotorWay Executive 162 F	
Serial Number	6911	
Year of Manufacture	2009	
Date of Manufacture	31 July 2009	
Total Airframe Hours (At Time of Accident)	177	
Last Annual Inspection (Date & Hours)	6 November 2020	173
Hours Since Last Annual Inspection	4	
Authority to Fly (Original Issue Date)	2 September 2016	
Authority to Fly Expiry Date	30 September 2021	
C of R (Issue Date) (Present Owner)	19 August 2009, Gavin Bengham	
Type of Fuel Used in the Helicopter	Mogas	
Operating Categories	Production built	
Previous Accidents	Nil	

Note: Previous accidents refer to past accidents the helicopter was involved in, when relevant to this accident.

Engine:

Manufacturer/Model	RotorWay RI 600
Serial Number	9016
Hours Since New	177
Hours Since Overhaul	TBO not yet reached

Main Rotor blades:

Manufacturer/Model	RotorWay E20-9000	
Serial Number	4403 (M)	4402(S)
Hours Since New	177	177
Hours Since Overhaul	TBO not yet reached	TBO not yet reached

1.6.2 There were no applicable Airworthiness Directives (ADs) and Service Bulletins (SBs) that had to be complied with from the manufacturer.

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

1.6.4 According to the Authority to Fly (ATF) certificate for ZU-RDX, the expiry date was 30 September 2021; the ATF certificate had expired nine days before the date of the accident.

1.6.5 The following information is an extract from the South African Civil Aviation Regulations 2011 as amended.

24.02.6 (*1) An authority to fly and a proving flight authority shall be valid until—*

(a) the expiry date;
(b) it is surrendered by the holder thereof, or is suspended by an authorised officer, inspector or authorised person;
(c) cancelled by the Director, or the organisation designated for the purpose in terms of part 149, as the case may be;
(d) a major modification is affected to the helicopter; or
(e) the helicopter is involved in an incident or accident that results in major damage to its primary structure.

Weight and Balance:

1.6.6 During the interview with the pilot on 10 October 2021, a day after the accident, the pilot stated that his and the passenger's weight were approximately 86 kilograms (kg) individually. At the time of the interview, the pilot did not have the weight and balance calculations of the helicopter.

1.6.7 On 14 October 2021, the pilot of the ZU-RDX helicopter submitted the weight and balance calculations, dated 9 October 2021. According to the submitted calculations, the weights of the pilot and the passenger were revised to: 177 pounds (lb) (80kg) for the pilot weight, and 185 lb (83.9kg) for the passenger. The total calculated take-off weight was 1483.2 lb, which was below the maximum take-off weight (MTOW) of the helicopter type, which is 1500lb.

1.6.8 Considering the initial weight of about 86kg initially provided by the pilot (for him and the passenger, individually), the total take-off weight was calculated to be 1500.4 lb (680.5kg), which was above the maximum take-off weight (MTOW) by 0.5kg.

1.7. Meteorological Information

1.7.1. The weather information in the table below was obtained from the South African Weather Service (SAWS) recorded at Morning Star Airfield weather station on 9 October 2021 at 1100Z.

Wind Direction	180°	Wind Speed	10 knots	Visibility	9 999m
Temperature	21.5°C	Cloud Cover	BKN	Cloud Base	3 500 feet
Dew Point	11.7°C	QNH	1016.2hpa		

1.7.2 The weather information in the table below was obtained from the pilot questionnaire, which he obtained from the internet on 9 October 2021 at 1100Z.

Wind Direction	225°	Wind Speed	7 knots	Visibility	> 10km
Temperature	21.5°C	Cloud Cover	BKN	Cloud Base	3 500 feet
Dew Point	11.7°C	QNH	1021hpa		

1.8. Aids to Navigation

1.8.1. The helicopter was equipped with standard navigational equipment as required by the Regulator (SACAA) for the helicopter type. The helicopter was equipped with MGL Avionics Stratomaster Enigma. There were no recorded defects with the navigation equipment prior to the flight. MGL Avionics designs and produces a variety of helicopter avionics from sophisticated, highly flexible EFIS system to airband transceivers.

Figure 4: MGL Avionics Stratomaster Enigma installed in the helicopter.

1.9. Communication

1.9.1. The helicopter was equipped with standard communication equipment as required by the Regulator for the helicopter type. There were no recorded defects with the communication equipment prior to the flight.

1.10. Aerodrome Information

1.10.1. The accident occurred at Morning Star Airfield. The helicopter impacted the ground and came to rest approximately 15m from first point of impact at GPS co-ordinates determined to be South 33º45’44.37”, East 018º32’54.69” at an elevation of 200ft.

Aerodrome Location	Morning Star, Western Cape
Aerodrome Status	Registered
Aerodrome Co-ordinates	S33°45'50.0" E018°33'00.0"
Aerodrome Altitude	200 feet
Runway Headings	02/20
Runway Dimensions	650m X 10m
Runway Used	None. (Helicopter took off from apron)
Runway Surface	Asphalt
Approach Facilities	Nil
Radio Frequency	124.8MHz

1.10.2. The airfield is equipped with close circuit television (CCTV) cameras. According to the airfield manager, the cameras do not record or store historic footage; the cameras are installed to provide pilots with real time weather information.

1.11. Flight Recorders

1.11.1. The helicopter was not equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR), nor was it required by regulation to be fitted to the helicopter type.

1.12. Wreckage and Impact Information

1.12.1. Examination of the accident site was conducted on 10 October 2021; the helicopter was recovered to a hangar the same day after the accident had occurred and after the investigators had granted permission as the wreckage was blocking the taxiway. Examination of the helicopter revealed impact damage from the mid-section towards the tail section, while the cabin structure remained intact.

1.12.2. Photos of the helicopter before it was recovered showed that it landed on a flat and open area between the main runway and a taxiway at Morning Star Airfield. The helicopter was lying on its right-side with its nose facing north-east post-accident.

1.12.3. The main wreckage was lying approximately 67m from the point of take-off and the tail boom was located approximately 12m east of the main wreckage.

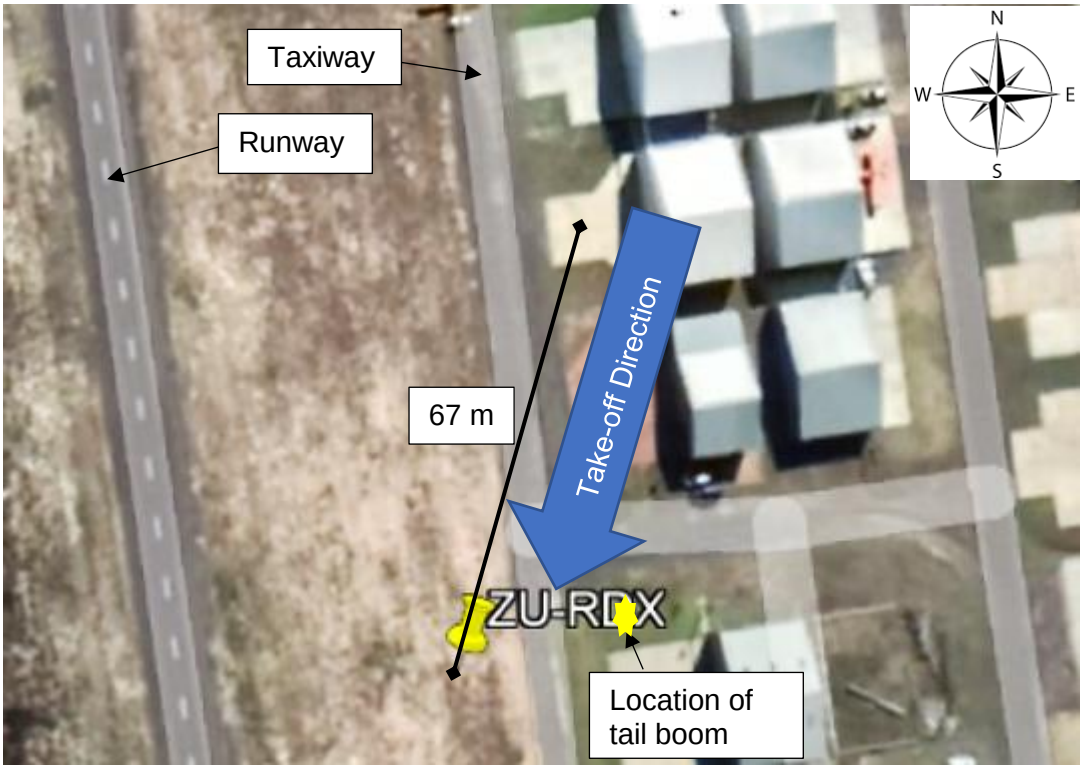

Figure 5: Wreckage location and information. (Source: Google Earth)

1.12.4. Examination of the helicopter's skids and fuselage indicated that the helicopter first contacted the soft sand with its left skid. This is an indication that the helicopter yawed to the left during loss of control.

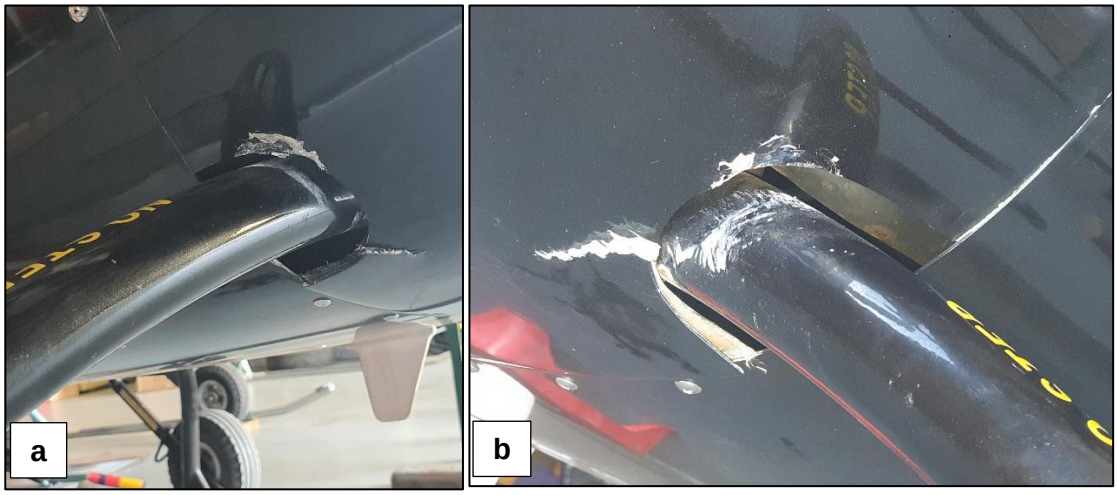

Figure 6*:* Damaged on the fuselage and skids (**a** shows right-side skid, **b** shows left-side skid).

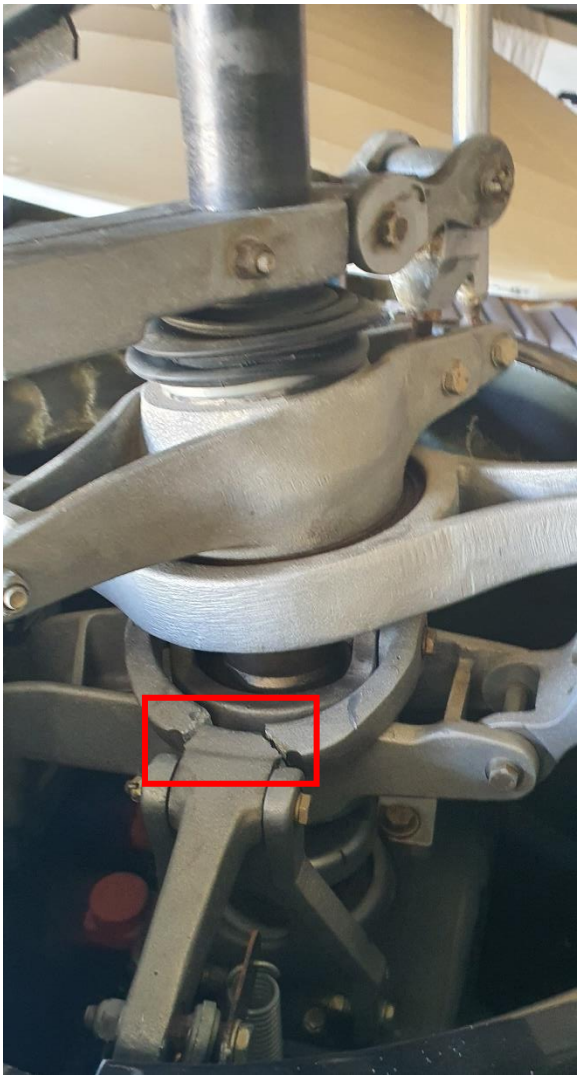

Figure 7: Red block shows fractured joint component of the main rotor hub's non-rotating swashplate.

1.12.5 Both main rotor blades and pitch links were still attached; the main rotor hub had a slight bent to the left (when viewed from the rear of the helicopter). The windshield was found shattered in the cabin, which is consistent with the pilot's description of how he kicked the windshield for them to exit the wreckage while the helicopter was lying on its right-side.

Figure 8: The red block shows the condition of the main rotor hub assembly and rotor blades post-accident.

1.12.6 Continuity of the flight controls (collective and cyclic) was established, and the controls moved freely with no obstruction. The engine compartment was free from visible damage, except for the torn drive belt.

1.12.7 One of the blades broke off near the root and had deformation damage in the centre of its leading edge (Figure 9a). The other blade showed no distortion near the root section, however, it exhibited deformation damage in the centre of its trailing edge. This blade also had separated near its tip section of the trailing edge (Figure 9b). The deformations are indicative of metal-to-metal contact at low rotation speed. The blades' fractures are indicative of slow separation exhibited by its tensile nature, this overload occurred while the helicopter rolled on its right-side.

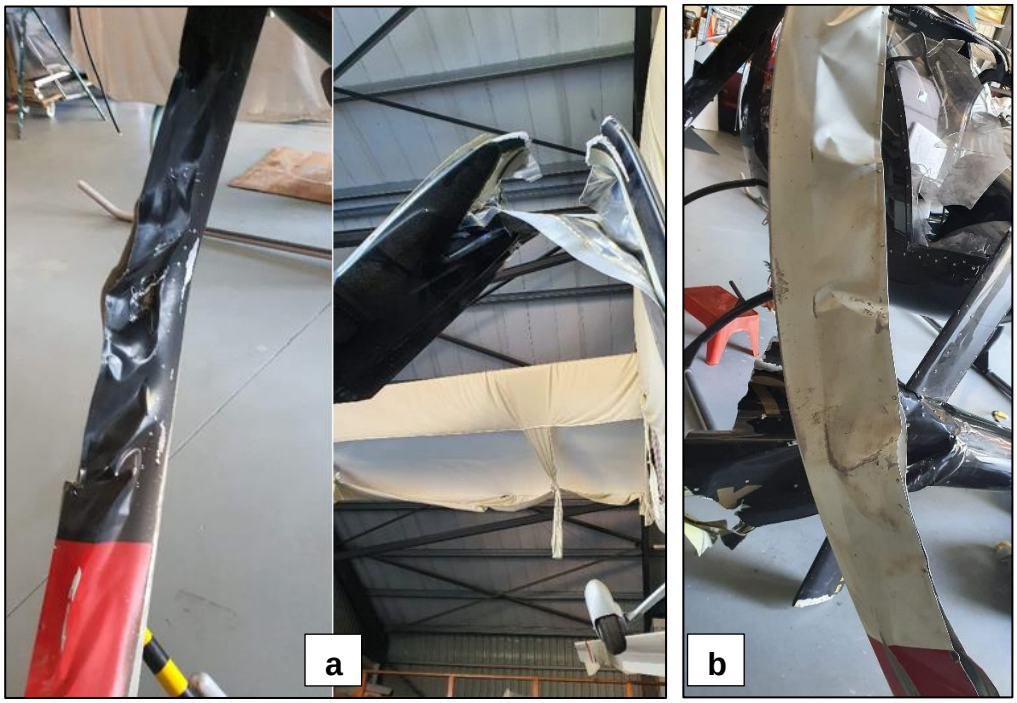

Figure 9: a) The deformed leading edge and the broken rotor blade. **b)** The deformed trailing edge blade which separated at the blade tip.

1.12.8 A section of the drive belt was found near the tail boom. The tail boom assembly had impact damage consistent with the bent main rotor hub and main rotor deformation, which is an indication of mast bumping during impact. One of the tail rotor blades separated from the hub due to impact with the ground. The tail gearbox was still intact on its attachment points. Continuity check between the gearbox and the output shaft was carried out and the drive was positive.

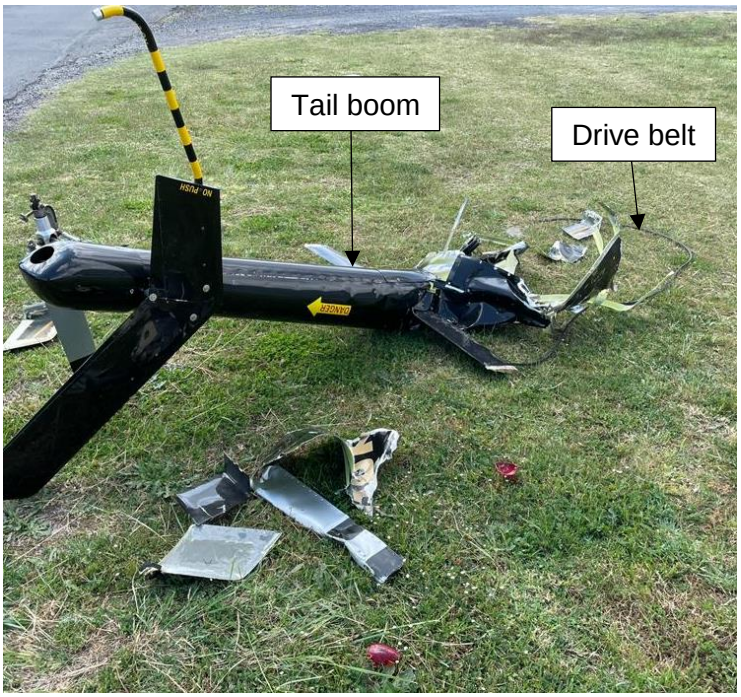

Figure 10: Location of the tail boom after the accident. (Source: Owner/pilot)

1.13. Medical and Pathological Information

1.13.1 None.

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 survivable as the helicopter was approximately 3m high (above ground) before it impacted the ground. The cabin structure was still intact, with only a shattered windshield. The occupants were strapped in their respective seats by the factory fitted safety harnesses during the accident.

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 IAW the provisions of Part 94 of the Civil Aviation Regulations 2011 as amended.

1.17.2 The aircraft maintenance organisation (AMO) which carried out the last annual inspection on the helicopter prior to the accident flight was in possession of an approved AMO certificate that was issued on 4 February 2020 with an expiry date of 15 September 2021, under the provisions of Part 94 of the CAR 2011 as amended.

1.18. Additional Information

1.18.1 To be discussed in the final report.

1.19. Useful or Effective Investigation Techniques

1.19.1 To be discussed 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 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.

2.1.1 The pilot was initially issued a Private Pilot Licence (helicopter) on 28 January 2016 and validation was carried out on 6 October 2020 with an expiry date of 31 August 2022.

2.1.2 The pilot was issued an aviation medical certificate on 4 March 2021 with an expiry date of 31 March 2022, without medical waiver.

2.1.3 According to the pilot logbook, the pilot's last flight was on 10 April 2021, six months prior to the accident flight. According to Part 91.02.4 *(1) A pilot shall not act as PIC of a helicopter, or second-in-command (SIC) of a helicopter required to be crewed by more than one pilot, carrying passengers by day, unless such pilot has personally, within the 90 days immediately preceding the flight, carried out either by day or by night at least three take-offs and three landings in the same class or, if a type rating is required, type or variant of aeroplane, and in the case of a helicopter three circuits including three take-offs and three landings in the same type of helicopter as that in which such flight is to be undertaken. The landings required by this sub-regulation may be completed in an FSTD approved for the purpose. In the case of a tail-wheel aeroplane, each landing shall be carried out to a full-stop.*

2.1.4 According to the flight folio, the last entry prior to the accident flight was on 10 April 2021.

2.1.5 The helicopter was issued an Authority to Fly on 2 September 2016 with an expiry date of 30 September 2021. The Authority to Fly certificate had expired nine days before the date of the accident.

2.1.6 The last annual inspection was carried out on 6 November 2020 with the next annual inspection due on 5 November 2021 or at 273 hours, whichever occurs first. The helicopter had flown a further four hours since the last annual inspection.

2.1.7 The helicopter was issued the Certificate of Registration with the present owner on 19 August 2009.

2.1.8 The approved person (AP) was issued an AP certificate under Part 94 of the CAR 2011 as amended on 4 February 2020, with an expiry date of 15 September 2021.

2.1.9 According to the provided mass and balance calculation sheet for the ZU-RDX helicopter, the helicopter was operated at approximately 1483.2lb total weight, which

was below the MTOW of 1500lb. However, while using the weight of 86kg (189.6 lb) for both occupants individually (initially provided by pilot), the total take-off weight was calculated to be 1500.4 lb (680.5kg), which was above the maximum take-off weight (MTOW) by 0.5kg.

2.1.10 The flight was conducted under VFR by day. Fine weather conditions prevailed at the time of the accident and did not contribute to the accident.

2.1.11 Post-accident on-site investigation revealed that the helicopter impacted the soft sand with its left-side skid first before entering a dynamic rollover, coming to rest on its right-side. The observations made were consistent with one of the witness' account of events. According to the witness, a loud metal noise drew her attention to the direction of the helicopter, after which she saw the helicopter hit the ground on its left-side before it got into a rolling motion and coming to rest on its right-side.

2.1.12 Damage observed on the wreckage indicated that the main rotor blades severed the tail boom during the accident, and this could also be attributed to the severed drive belt (SN: E18-1150).

2.1.13 The tail boom assembly had impact damage which is consistent with the bent main rotor hub and deformed main rotor blades.

2.1.14 The helicopter's debris was scattered at a diameter of about 15m around the main wreckage.

3. On-going Investigation

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

4. Appendices

4.1 None.

This report is issued by:

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