

LIMITED OCCURRENCE INVESTIGATION REPORT – FINAL

Reference Number	CA18/2/3/10349						
Classification	Accident	Date	11 July 2023		Time	0615Z	
Type of Operation	Private (Part 91)						
Location							
Place of Departure	Worcester Private Farm, Thabazimbi, Limpopo Province		Place of Intended Landing	Boesmanskraal Safaris Private Farm, Thabazimbi, Limpopo Province			
Place of Occurrence	Boesmanskraal Safaris Private Farm						
GPS Co-ordinates	Latitude	24°09'50.69" S	Longitude	027°00'51.06" E	Elevation	3 018 ft	
Aircraft Information							
Registration	ZS-ORG						
Make; Model; S/N	Robinson R44 Raven II (Serial Number: 11285)						
Damage to Aircraft	Substantial		Total Aircraft Hours	1 184.6			
Pilot-in-command							
Licence Type	Private Pilot Licence (PPL)		Gender	Male		Age	62
Licence Valid	Yes	Total Hours	1 058.7		Total Hours on Type	149.8	
Total Hours 30 Days	17.5		Total Flying on Type Past 90 Days	32.9			
People On-board	1 + 1	Injuries	0	Fatalities	0	Other (on ground)	0
What Happened							
<p>On Tuesday morning, 11 July 2023 at 0600Z, a pilot on-board a Robinson R44 Raven II helicopter with registration ZS-ORG took off from Worcester private farm with the intention to land at Boesmanskraal Safaris private farm, both near Thabazimbi in Limpopo province. 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.</p> <p>According to the pilot, the passenger door of the helicopter was removed prior to take-off from Worcester private farm. The flight to Boesmanskraal Safaris was approximately 15 minutes and was uneventful. This was the pilot's first time to land at this farm. The pilot landed into the wind facing an easterly direction. The area where the helicopter landed was an open field with grass patches, approximately 400 metres (m) north-west of Boesmanskraal Safaris. The pilot did not shut down the helicopter engines whilst the passenger boarded the aircraft and sat on the left front seat. The pilot completed his pre-take-off checks and pulled the collective pitch lever with the manifold pressure (MP) indicating approximately 22 inches. The helicopter lifted off into a hover about 15 feet (ft) above ground level (AGL). Shortly thereafter, the helicopter yawed to the right. The pilot lowered the collective whilst applying full left anti-torque pedal to stop the yaw, but it had no effect. The low main rotor revolutions per minute (RPM) horn sounded which indicated that the RPM were below 97%.</p>							

There were no other illuminated knobs on the panel apart from the low RPM light, according to the pilot. The pilot pulled the collective pitch lever to cushion the landing, but the helicopter impacted the ground hard whilst still yawing to the right. The pilot further stated that before the impact, he closed the throttle to minimise the yaw. However, the skid gear got hooked on the dry grass (dry terrain) and a dynamic rollover followed; the helicopter rolled over to the right. The pilot switched off the master switch before he (and his passenger) vacated the helicopter through the left front door area.

The helicopter sustained substantial damage during the accident sequence, however, neither of the occupants were injured.



Figure 1: The helicopter after the accident. (Source: Pilot)

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

The R44 II is a four place, single main rotor, single engine helicopter constructed primarily of metal and equipped with skid-type landing gear.

The primary fuselage structure is welded steel tubing and riveted aluminium sheet. The tail cone is a monocoque structure in which aluminium skins carry most of the primary loads. Fiberglass and thermoplastic are used in secondary cabin structure, engine cooling shrouds, and various other ducts and fairings. The cabin doors are also constructed of fiberglass and thermoplastics.

Four right-side cowl doors provide access to the main gearbox, drive system and engine. A left-side engine side door provides access to the engine oil filler and dip stick. Additional access to controls and other components for maintenance is provided by removable panels and cowlings.

General:

*In ground effect (IGE) hover controllability has been substantiated in **17 knot** wind from any direction up to 9800 feet (2 990 meters) density altitude.*

Take-off Procedure:

- 1. Verify doors latched, governor and hydraulics ON, and RPM stabilised at 101% to 102%*
- 2. Clear area. Slowly raise collective until aircraft is light on skids. Reposition cyclic as required for equilibrium, then gently lift aircraft into the hover.*
- 3. Check gauges in green and note hover MAP.*
- 4. Lower nose and accelerate to climb speed following profile shown by height-velocity diagram in Section 5. Avoid exceeding two inches MAP above IGE hover power to prevent excessive nose-down attitude. If RPM drops below 101%, lower collective.*

Audio Alerts:

All R44 helicopters have a low RPM horn which sounds when the rotor RPM is below 97%. The horn is muted when the collective is fully down. On earlier aircraft, the horn was provided by one or two speakers on the side of the instrument console. On later aircraft, a tone generator in the audio system provides the horn through crew headsets.

Safety Notice SN-42 Unanticipated Yaw (Source: POH)

A pilot's failure to apply proper pedal inputs in response to strong or gusty winds during hover or low-speed flight may result in an unanticipated yaw. Some pilots mistakenly attribute this yaw to loss of tail rotor effectiveness (LTE), implying that the tail rotor stalled or was unable to provide adequate thrust. Tail rotors on Robinson helicopters are designed to have more authority than many other helicopters and are unlikely to experience LTE.

To avoid unanticipated yaw, pilots should be aware of conditions (a left crosswind, for example) that may require large or rapid pedal inputs. Practising slow, steady-rate hovering pedal turns will help maintain proficiency in controlling yaws. Hover training with a qualified instructor in varying wind conditions may also be helpful.

Note that thrust of any tail rotor decreases significantly as RPM decreases. Low RPM combined with high torque, as when over-pitching, may result in an uncontrollable right yaw. (See also Safety Notice SN-34)

Loss of Tail Rotor Thrust in the Hover (Source: POH)

Failure is usually indicated by the nose right yaw which cannot be stopped by the left pedal.

- 1. Immediately roll the throttle off into overtravel spring and allow the aircraft to settle.*
- 2. Raise collective just before touchdown to cushion landing.*

Low RPM:

Indicates rotor speed below 97% RPM. To restore RPM, immediately lower collective, roll throttle on and, in forward flight, apply aft cyclic. Light is disabled when the collective is fully down.

Winds (Source: [FAA-helicopter handbook-8083-21.pdf](https://www.faa.gov/documentLibrary/media/Handbook/handbook-8083-21.pdf))

Wind direction and velocity also affect hovering, take-off and climb performance. Translational lift occurs anytime there is relative airflow over the rotor disc. This occurs whether the relative airflow is caused by helicopter movement or by the wind. As wind speed increases, translational lift increases, resulting in less power required to hover. The wind direction is also an important consideration. Headwinds are the most desirable as they contribute to the most increase in performance. Strong crosswinds and tailwinds may require the use of more tail rotor thrust to maintain directional control. This increased tail rotor thrust absorbs power from the engine, which means there is less power available to the main rotor for the production of lift. Some helicopters even have a critical wind azimuth or maximum safe relative wind chart. Operating the helicopter beyond these limits could cause loss of tail rotor effectiveness.

Meteorological information

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

Wind Direction	090°	Wind Speed	20 kts G35kts	Visibility	9999 m
Temperature	15°C	Cloud Cover	Nil	Cloud Base	CAVOK
Dew Point	2°C	QNH	Unknown		

Findings

Personnel Information

The pilot was initially issued a Private Pilot Licence on 19 August 2012. The licence was renewed on 19 November 2021 with an expiry date of 31 October 2023. The pilot had flown a total of 1 058.7 hours of which 149.8 hours were on the helicopter type. The helicopter type was endorsed on his licence and on the pilot's logbook. The pilot was issued a Class 2 aviation medical certificate on 7 November 2022 with an expiry date of 30 November 2023 with a medical waiver. The pilot was properly licenced to conduct the flight and was medically fit in accordance with Part 67 of the CAR 2011.

The helicopter was established at hover in ground effect with the wind at 20 knots and gusting at 35 knots; this caused the yaw to the right before the pilot lost control. The helicopter is certified to hover IGE with the wind at 17 knots from any direction but, in this case, it was hovered at the wind speed above 17 knots. Strong crosswinds and tailwinds may require the use of more tail rotor thrust to maintain directional control. The increased tail rotor thrust absorbs power from the engine, which means that there would be less power available to the main rotor for the lift and, thus, a subsequent loss of rotor RPM would occur. The pilot lowered the collective whilst applying full left anti-torque pedal to stop the yaw, which was an incorrect technique (to correct the right yaw); this resulted in loss of control.

Helicopter Information

The last mandatory periodic inspection (MPI) that was conducted on the helicopter prior to the accident flight was on 19 August 2022 at 1 104.0 airframe hours. Since the last MPI, the helicopter accrued 80.6 hours, with the total of 1 184.6 hours since new. The helicopter had a valid Certificate of Airworthiness (C of A) that was initially issued on 27 June 2006. The C of A was renewed on 27 June 2023 with an expiry date of 30 June 2024. The Certificate of Release to Service (CRS) was issued on 19 August 2022 with an expiry date of 18 August 2023 or at 1 204.0 hours, whichever comes first. The Certificate of Registration (C of R) was issued to the current owner on 16 August 2017. There were no defects reported prior to the accident, therefore, the helicopter was airworthy. The wreckage was contained in one area with all major components still attached. The examination of the helicopter after it was recovered did not reveal any anomalies. The engine was fitted on the airframe and a ground run was performed; the engine operated normally.

The pilot went ahead with the flight even though the wind conditions were not favourable. The allowable maximum wind to hover in ground effect is 17 knots, according to the POH. At the time of the accident the wind was 20 knots gusting 35 knots (see the table above).

<p>The meteorological aerodrome report (METAR) from the South African Weather Service (SAWS) that was issued for Pilanesberg Aerodrome (FAPN), which is the closest weather station, was: FAPN 110700Z 15003KT CAVOK 09/00 Q1037=</p> <p>The pilot landed into the wind facing an easterly direction. Although the pilot reported that the wind was gusting from the south, the investigation established that the wind was coming from the south-easterly direction as per the SAWS report.</p>
<p>Probable Cause(s)</p> <p>During lift-off, the helicopter experienced an unanticipated yaw to the right as a result of the high and gusty wind conditions. The pilot applied the left pedal and lowered the collective control which did not stop the yaw and, thus, loss of control and the crash followed.</p>
<p>Contributing Factor(s)</p> <ul style="list-style-type: none"> • Operating the helicopter at wind speeds higher than the certified 17 knots. • Incorrect technique used during recovery.
<p>Safety Action(s)</p> <p>None.</p>
<p>Safety Message</p> <p>Pilots operating helicopters are urged to conduct proper wind assessments before the flight and to familiarise themselves with the wind limitations for their helicopter types as stated in the POH to avoid endangering the aircraft and causing injury to occupants.</p>
<p>About this Report</p> <p><i>The decision to conduct a limited investigation is based on factors including whether the cause is known and the evidence supporting the cause is clear, the level of safety benefit likely to be obtained from an investigation and that will determine the scope of an investigation. For this occurrence, a limited investigation has been conducted, and the Accident and Incident Investigations Division (AIID) has relied on the information submitted by the affected person/s and organisation/s to compile this limited report. The report has been compiled using information supplied in the initial notification, as well as from follow-up desk top enquiries to bring awareness of potential safety issues to the industry in respect of this occurrence, as well as possible safety action/s that the industry might want to consider in preventing a recurrence of a similar occurrence.</i></p> <p><i>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.</i></p>
<p>Purpose</p> <p><i>In terms of Regulation 12.03.1 of the Civil Aviation Regulations (CAR) 2011 and ICAO Annex 13, this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and not to apportion blame or liability.</i></p>
<p>Disclaimer</p> <p><i>This report is produced without prejudice to the rights of the AIID, which are reserved.</i></p>

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