

LIMITED OCCURRENCE INVESTIGATION REPORT – FINAL

Reference Number	CA18/2/3/10379						
Classification	Accident	Date	14 October 2023	Time	1445Z		
Type of Operation	Private (Part 91)						
Location							
Place of Departure	Dwarsfontein Farm near Lephhalale, Limpopo Province		Place of Intended Landing	Dwarsfontein Farm near Lephhalale, Limpopo Province			
Place of Occurrence	Dwarsfontein Farm, Limpopo Province						
GPS Co-ordinates	Latitude	23°47'52.51" S	Longitude	027°51'37.89" E	Elevation	3 486 ft	
Aircraft Information							
Registration	ZT-RLP						
Make; Model; S/N	Robinson Helicopter; R44 Raven II (Serial Number: 13921)						
Damage to Aircraft	Substantial		Total Airframe Hours	383.1			
Pilot-in-command							
Licence Type	Private Pilot Licence		Gender	Male		Age	64
Licence Valid	No	Total Hours	1 253.8		Total Hours on Type	Unknown	
Total Hours 90 Days	50.8		Total Flying Hours on Type Past 90 Days		50.8		
People On-board	1 + 2	Injuries	0	Fatalities	0	Other (on ground)	0
What Happened							
<p>On Saturday afternoon, 14 October 2023, a pilot and two passengers on-board a Robinson R44 Raven II helicopter with registration ZT-RLP took off from Dwarsfontein Farm near Lephhalale in Limpopo province with the intention to land back at the same farm. 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, they were counting Zebra and other antelope species on the farm with the intention to catch the Zebra at a later stage. The antelope that they found were culled from the helicopter, with the shooter positioned behind the pilot on the right side. The shooter used a conventional hunting rifle to shoot the animals. There was no cartridge collector or similar type of device fitted to the rifle to prevent the empty cartridges from falling from the helicopter after being ejected from the rifle. The pilot stated that whilst he was positioning the helicopter for the shooter, the low main rotor revolutions per minute (RPM) audio warning sounded and the warning light on the instrument panel illuminated. He entered autorotational flight and the helicopter touched down hard on the skid gear in a dense bush with rocky terrain. The main rotor and tail rotor blades contacted the dense bush and shrubs around the helicopter which caused substantial damage to the blades. The helicopter also sustained structural damage during the hard landing. The helicopter remained in an up-right position. No person was injured during the accident.</p>							

According to the passenger who was seated next to the pilot on the left front seat, there were several occasions during the flight in which the pilot struggled with power; on several occasions, the pilot pushed the nose down and flew a circuit before he could reposition the helicopter for the shooter.

The accident occurred during daylight at Global Positioning System (GPS) co-ordinates determined to be 23°47'52.51" South 027°51'37.89" East, at an elevation of 3 486 feet (ft).



Figure 1: The helicopter as it came to rest in a dense bush and rocky terrain. (Source: Pilot)



Figure 2: A view of the right side of the helicopter. (Source: Pilot)



Figure 3: A view of the tail boom and tail rotor assembly. (Source: Pilot)



Figure 4: Damage to one of the tail rotor blades. (Source: Pilot)



Figure 5: Damage to one of the main rotor blades. (Source: Pilot)

Weight and Balance:

The pilot stated that he took off with about 60 litres of fuel on-board and was airborne for about 40 minutes when the accident occurred. He indicated that the fuel remaining was approximately 40 litres in the main tank as the auxiliary fuel tank was empty.

The right aft door which weighed 7.5 pounds (lbs) was removed for the purpose of the flight.

According to the weight and balance calculation, the forward centre of gravity (CG) was calculated at 91.7 inches, which was outside of the forward CG limit when looking at the graph (see longitudinal centre of gravity limits graph), which indicated the forward limit as 92 inches from the datum. The lateral CG was also out of limits, which indicated 1.07 inches from the datum.

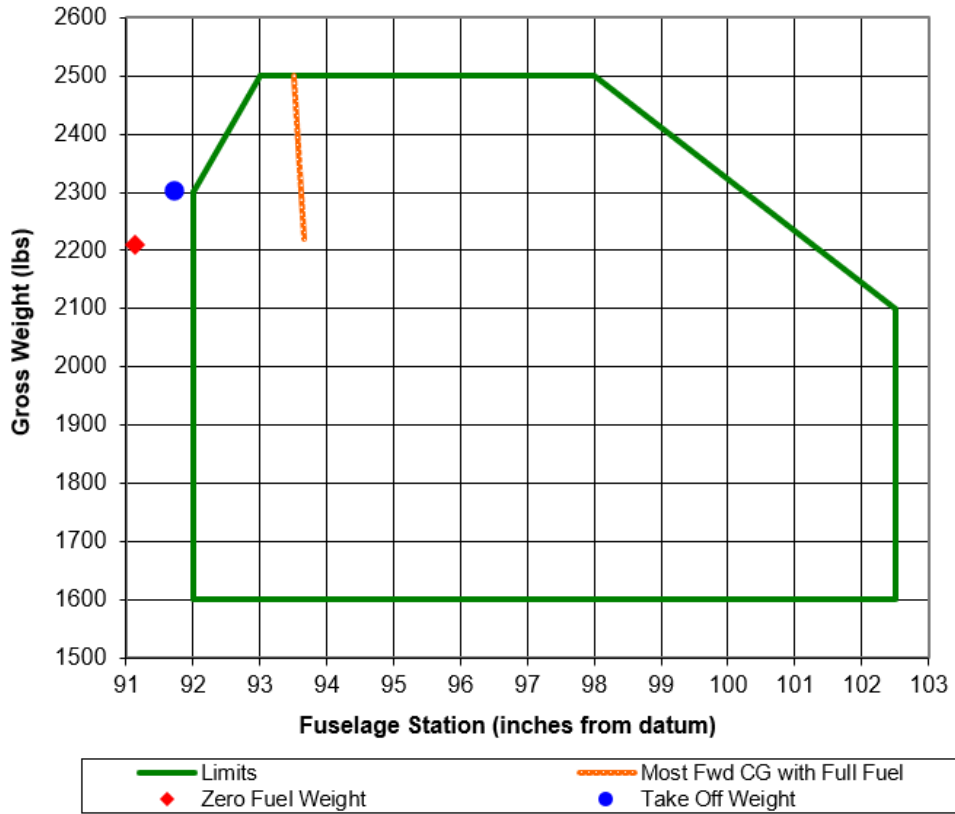
The maximum take-off weight for the Robinson R44 Raven II is 2 500 lbs (1134kg), according to the Pilot's Operating Handbook (POH) Section 2, page 2-3.

R44 II Weight and Balance (ZT-RLP)

Item	Weight (lbs)	Arm (inches)	Longitudinal Moment	Lateral Arm (inches)	Lateral Moment
Empty weight	1 538.90	104.6	160 968.94	0.2	307.78
Pilot (right forward seat)	210	49.5	10 395.00	+12.2	2 562
Left Front Passenger	220	49.5	10 890.00	-10.4	-2 288
Baggage under front right seat	0.00	44.00	0.00	11.5	0.00
Baggage under front left seat	0.00	44.00	0.00	-11.5	0.00
Right Aft Passenger	220	79.5	17 490.00	+12.2	2 684
Baggage under right aft seat	22	79.5	1 749.00	+12.2	268.4
Left Aft Passenger	0	79.5	0.00	12.2	0.00
Baggage under left aft seat	0	79.5	0.00	12.2	0.00
Zero Usable Fuel Weight and CG*	2 210.90	91.14	201 492.94	1.60	3 534.18
Usable main fuel	91.80	106.0	9 730.80	-13.5	-1 239.30
Usable aux fuel	0.0	102.0	0.0	+13.0	0.0
Take-off Gross Weight and CG*	2 302.70	91.73	211 223.74	1.00	2 294.88

* CG location (arm) for loaded helicopter is determined by dividing total moment by total weight.

R44 Raven II Longitudinal Center of Gravity Limits



Lateral Center of Gravity Limits

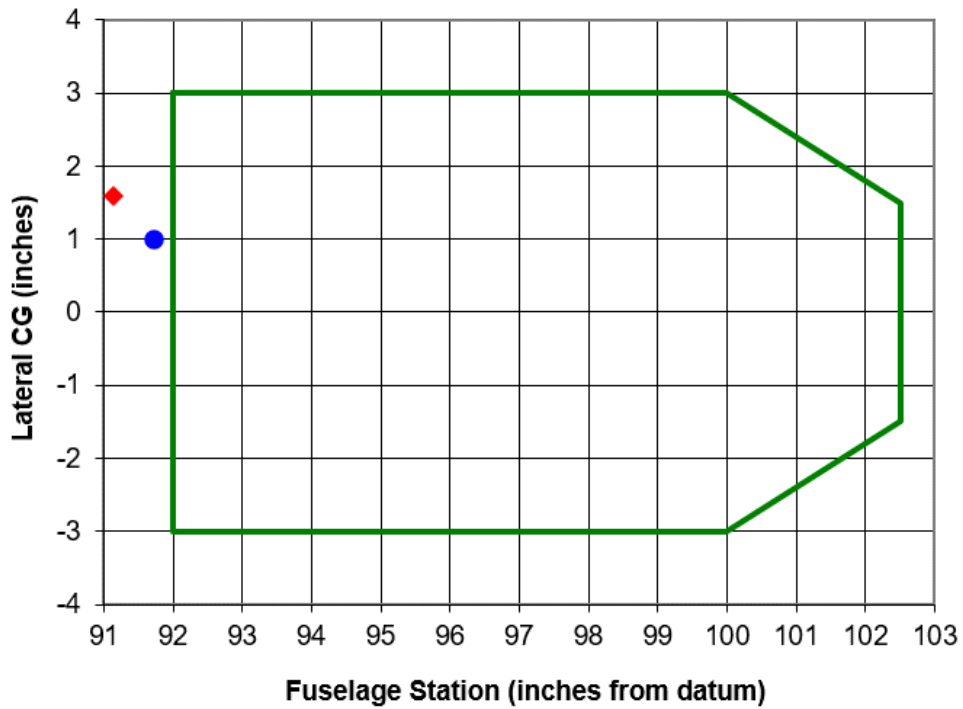
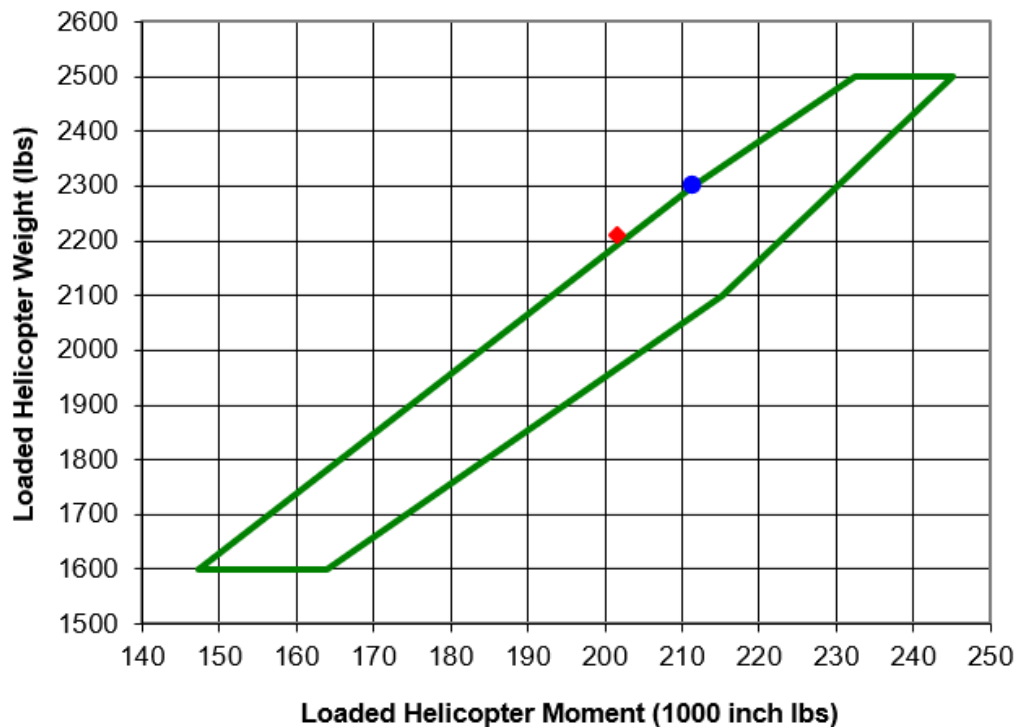


Chart Area **CG Moment vs. Gross Weight Envelope**



Centre of Gravity (CG) (Source: FAA-H-8083-1)

The pilot should ensure that the helicopter is properly balanced and within its centre of gravity limitations, so that minimal cyclic input is required during hovering flight, except for any wind corrections. Since the fuselage acts as a pendulum suspended from the rotor, changing the CG changes the angle at which the aircraft hangs from the rotor mast, the helicopter hangs horizontally; if the CG is too far forward of the mast, the helicopter hangs with its nose tilted down; if the CG is too far aft of the mast, the nose tilts up (see Figure 6).

CG Forward of Forward Limit

A forward CG may occur when a heavy pilot and passenger take off without baggage or proper ballast located aft of the rotor mast. This situation becomes worse if the fuel tanks are located aft of the rotor mast because as fuel burns the CG continues to shift forward.

This condition is easily recognised when coming to a hover following a vertical take-off. The helicopter has a nose-low attitude, and excessive rearward displacement of the cyclic control is needed to maintain a hover in a no-wind condition. Do not continue flight in this condition, since a pilot could rapidly lose rearward cyclic control as fuel is consumed. A pilot may also find it impossible to decelerate sufficiently to bring the helicopter to a stop. In the event of engine failure and the resulting autorotation, there may not be enough cyclic control to flare properly for the landing.

A forward CG is not as obvious when hovering into a strong wind, since less rearward cyclic displacement is required than when hovering with no wind. When determining whether a critical balance condition exists, it is essential to consider the wind velocity and its relation to the rearward displacement of the cyclic control.

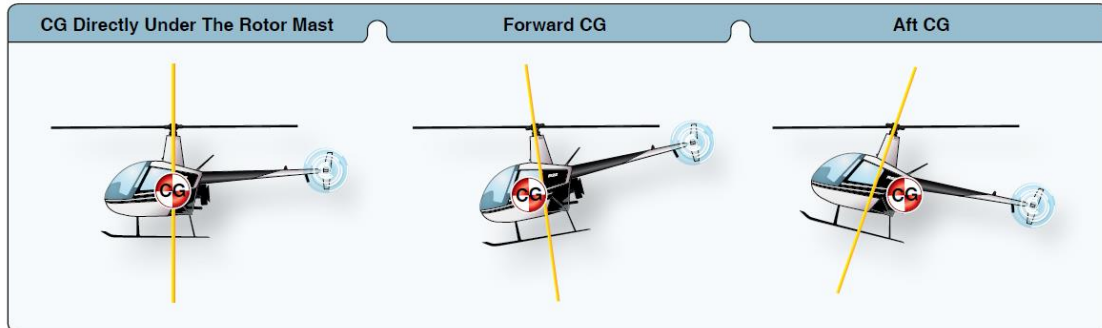


Figure 6: The location of the CG position strongly influences how the helicopter handles.

Meteorological Information

The weather information in the table below was obtained from the pilot questionnaire (form CA 12-03).

Wind Direction	No wind	Wind Speed	Nil	Visibility	9999 m
Temperature	35°C	Cloud Cover	Nil	Cloud Base	CAVOK
Dew Point	10°C	QNH	1005hPa		

Density Altitude

Source: https://wahiduddin.net/calc/calc_da.htm

Density Altitude Calculator				
Elevation	<input type="text" value="3486"/>	<input checked="" type="radio"/> feet	<input type="radio"/> m	
Air Temperature	<input type="text" value="35"/>	<input type="radio"/> deg F	<input checked="" type="radio"/> deg C	
Altimeter Setting	<input type="text" value="1005"/>	<input type="radio"/> in Hg	<input checked="" type="radio"/> hPa	
Dew Point	<input type="text" value="10"/>	<input type="radio"/> deg F	<input checked="" type="radio"/> deg C	
		<input type="button" value="Calculate"/>	<input type="button" value="Reset"/>	
Density Altitude	<input type="text" value="6947"/>	feet	<input type="text" value="2117"/>	m
Absolute Pressure	<input type="text" value="26.12"/>	in Hg	<input type="text" value="884.5"/>	hPa
Air Density	<input type="text" value="0.0621"/>	lb/ft ³	<input type="text" value="0.995"/>	kg/m ³
Relative Density	<input type="text" value="81.2"/>	%	<input type="text" value="81.2"/>	%
Estimated AWOS	<input type="text" value="6800"/>	feet	<input type="text" value="2073"/>	m
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The density altitude at the time of the accident flight was calculated to be 6 947 feet.

During the interview, the passenger who was seated on the left front seat indicated that the prevailing wind, according to his observations, was between 10 and 15 kilometres per hour from the north-west at the time.

Findings

1. Personnel Information

- 1.1 The pilot had a Private Pilot Licence (PPL) that was initially issued on 30 July 2003. His last skills test was conducted on 12 January 2023. The pilot had flown a total of 1 253.8 hours on helicopters, which included the Robinson R22, R44 and Bell 407.
- 1.2 The pilot was issued a Class 2 aviation medical certificate on 17 August 2022 with an expiry date of 31 August 2023. His aviation medical certificate was, therefore, not valid; this was a contravention of the provisions of Part 67.00.9 of the CAR 2011 as amended. Because the aviation medical certificate was invalid, this rendered the pilot's licence invalid.
- 1.3 The pilot did not have a helicopter game or livestock cull rating as required by the CAR 2011, Part 61.01.2(1) read with Part 61.01.3(1)(d)(ix).

2. Aircraft Information

- 2.1 The last maintenance inspection that was conducted on the helicopter prior to the accident flight was certified on 27 July 2023 at 340.5 airframe hours. Since the maintenance inspection, a further 42.6 hours were flown on the helicopter.
- 2.2 The helicopter had a valid Certificate of Airworthiness (C of A) that was initially issued on 31 March 2016. The latest C of A had an expiry date of 31 March 2024. The helicopter was airworthy when it dispatched for the flight.
- 2.3 The helicopter's Certificate of Registration (C of R) was issued to the present owner on 14 March 2019.
- 2.4 The helicopter was issued a Certificate of Release to Service (CRS) on 28 July 2023 with an expiry date of 27 July 2024 or at 440.5 airframe hours, whichever occurs first.

Probable Cause

Whilst manoeuvring the helicopter during a game culling operation, the pilot allowed the main rotor RPM to decay. He entered autorotation flight at 200ft AGL, which resulted in a hard landing in hostile terrain.

Contributing Factors

- (i) High density altitude conditions prevailed during the flight with a temperature of 35°C being recorded at the time, and which had a direct effect on the engine performance.
- (ii) The helicopter was operated near its maximum take-off weight with a substantial forward and lateral CG condition. This explained the observation of the passenger that the pilot had to reposition the helicopter for the shooter several times.
- (iii) The pilot did not have a helicopter cull or livestock rating.

Safety Action(s)

None.

Safety Message

To avoid injuries or damage to property, operators operating in the game capturing or culling fields are advised to ensure that the pilots they hire are correctly rated and skilled for the operation.

About this Report

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.

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

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.

Disclaimer

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