Australian Government
Australian Transport Safety Bureau

Collision with terrain involving Robinson R44, VH-YMJ

near Riversleigh ALA, Queensland, 12 November 2016

ATSB Transport Safety Report
Aviation Occurrence Investigation
AO-2016-150
Final – 9 February 2017

Released in accordance with section 25 of the *Transport Safety Investigation Act 2003*

Publishing information

Published by: Australian Transport Safety Bureau
Postal address: PO Box 967, Civic Square ACT 2608
Office: 62 Northbourne Avenue Canberra, Australian Capital Territory 2601
Telephone: 1800 020 616, from overseas +61 2 6257 4150 (24 hours)
Accident and incident notification: 1800 011 034 (24 hours)
Facsimile: 02 6247 3117, from overseas +61 2 6247 3117
Email: atsbinfo@atsb.gov.au
Internet: www.atsb.gov.au

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Addendum

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Collision with terrain involving Robinson R44, VH-YMJ

What happened

On 12 November 2016, a Robinson R44 helicopter, registered VH-YMJ, departed from a landing site on the Riversleigh Station property for the return leg of a private sight-seeing flight to Adels Grove aircraft landing area (ALA), Queensland. On board the helicopter were the pilot and three passengers.

The pilot used the helicopter to ferry two groups of people from Adels Grove ALA, to a dirt road landing site near a river in the morning for swimming, and then ferried the first group back to Adels Grove after lunch. At about 1420 Eastern Standard Time (EST), the pilot attempted the last planned departure of the day from the landing site for the return flight. The take-off direction followed the road, which was a south-south-east direction. The pilot reported that there were no power performance issues in the hover, but then during the initial climb, at about 100–130 ft above ground level (AGL) and between 15–20 kt airspeed, the helicopter started to experience a loss of performance. The helicopter started to descend and the pilot advised there was insufficient engine power to prevent the descent.

As the helicopter approached the ground, the pilot raised the collective lever[1] to cushion the landing. The right skid of the helicopter landed first, on the side of the road and the left skid landed off the side of the road below the right skid, which resulted in the helicopter rolling onto the left side before coming to rest (Figure 1). One passenger received minor injuries and the helicopter was substantially damaged.

Figure 1: VH-YMJ accident site

Source: Operator

[1] Collective: a primary helicopter flight control that simultaneously affects the pitch of all blades of a lifting rotor. Collective input is the main control for vertical velocity.

Terrain and weather conditions

Riversleigh Station is located in the north-west quarter of Queensland, about 200 km south-west of the southern corner of the Gulf of Carpentaria. The countryside along the river in the vicinity of the accident site was described by the pilot as hilly with plateaus and escarpments and tall gumtrees.

The pilot reported that the weather conditions started fine in the morning, but changed late in the morning with a hot wind, which was gusting in strength and varying in direction. Wind strength varied from 0–20 kt, and wind direction varied between south and south-east. The temperature was about 38 °C, the elevation of the landing site was about 430 ft above mean sea level (AMSL), and the QNH[2] was about 1010 hPa. There were also rain showers in the vicinity.

Aircraft performance

The maximum take-off weight (MTOW) published for the Robinson R44 in the rotorcraft flight manual is 1,088 kg. The weights of the occupants and estimated fuel on board at the time of the accident indicate the all-up weight (AUW) of the helicopter was about 1,041 kg. With an estimated elevation of 430 ft, QNH of 1010 hPa and maximum height on take-off of 130 ft, the pressure altitude was about 650 ft when the pilot noticed there was insufficient power to continue the climb. The pilot reported that they started the take-off with about 10 kt of head wind and the helicopter had just passed through translational lift[3] and was at about 15–20 kt before the descent started.

If the wind speed dropped during the initial climb, then the helicopter could have been below translational lift at 100-130 AGL when the descent started. In this case the helicopter would have been in the hover out of ground effect[4] (HOGE) flight regime (Figure 2). At the reported temperature and AUW, this would place the helicopter at the limit of the hover altitude for the power available (point B, Figure 2).

In comparison, the hover in ground effect (HIGE) performance chart indicated the helicopter could maintain a hover at about 4,500 ft pressure altitude at the AUW and 38 °C.

Air density

The power produced by the engine and the lift produced by the helicopter rotors are influenced by air density. Low atmospheric pressure[5] and hot and humid conditions decrease air density. A decrease in air density decreases power available from the engine, but increases the power required for rotor thrust, because a larger angle of attack[6] is required from the rotor blades to produce the same lift.

Tail rotor and demand for power

The helicopter tail rotor is an anti-torque device, which is controlled by the tail rotor pedals to increase or decrease the angle of attack of the tail rotor blades. The engine provides the power for the tail rotor drive. Therefore, an increase in demand for anti-torque 'bleeds off' engine power. When the relative wind is directly in front of the nose of the helicopter, the helicopter airframe behaves like a weathervane, holding the nose of the helicopter into the wind and reducing the requirement for anti-torque. However, if the wind strikes the helicopter from the right side, this will increase the demand for left tail rotor pedal to maintain heading, which will bleed off engine power.

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2 QNH: the altimeter barometric pressure subscale setting used to indicate the height above mean seal level.

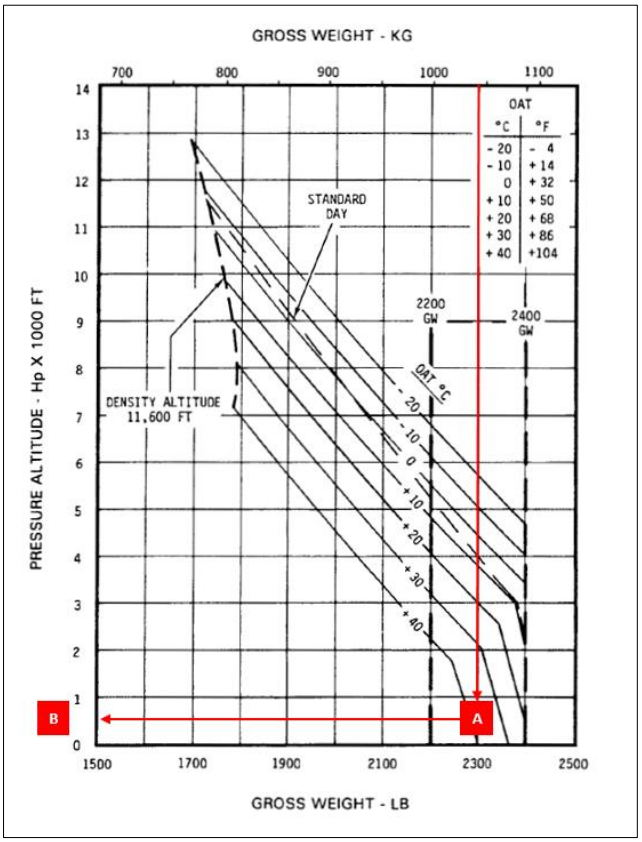
3 Translational lift is additional lift gained from induced airflow through the main rotors gained from forward airspeed. It reduces the power required for rotor thrust and becomes noticeable as the helicopter experiences about 12–14 kt of airspeed.

4 Out of ground effect: helicopters require less power to hover when in 'ground effect' then when out of 'ground effect' due to the cushioning effect created by the main rotor downwash striking the ground. The height of 'ground effect' is usually defined as more than one main rotor diameter above the surface. This is 33 ft for the R44.

5 Standard atmospheric pressure is 1013 hPa.

6 Angle of attack is the angle between the rotor blade chord line and resultant relative wind. A larger angle of attack produces more drag and therefore requires more engine power.

Figure 2: R44 HOGE performance



Source: Manufacturer, annotated by ATSB

Previous incidents

Previous ATSB reports of Robinson R44 helicopters descending with insufficient power in low airspeed and low air density (high density altitude) conditions include the following:

- Collision with terrain involving a Robinson R44, VH-HLB (*AO-2014-154*)
- Collision with terrain involving a Robinson R44, VH-UGC (*AO-2013-203*)
- Collision with terrain 10 km west of Gunpowder Mine, Qld, 21 February 2006, VH-HBS (*200600979*)

Safety analysis

The AUW of the aircraft was below the published MTOW and within the published limits for HIGE operations. At the time of take-off, there were no unusual noises or vibrations, the engine was delivering power to the rotors and the rotor speed did not decrease below limits. The pilot estimated they had a 10 kt headwind component, but that the wind was gusting in strength and variable in direction. Therefore, it is likely that the forced landing was the result of insufficient power for the prevailing environmental conditions at the helicopter's AUW.

Two possible scenarios for insufficient power are a shift in wind direction to the right side of the helicopter or a decrease in head wind strength. In the first scenario, a shift in wind direction to the right would demand more left tail rotor pedal to maintain take-off heading and decrease the power available from the engine for main rotor thrust. In the second scenario, a decrease in wind strength just after translational lift would place the helicopter inside the HOGE flight regime and at the limit for the take-off AUW and temperature.

Findings

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

- The forced landing was the result of power required to continue flight in excess of power available for the take-off AUW, temperature and wind conditions.
- The helicopter was within the published maximum take-off weight limit.

Safety message

This incident highlights the effect of high AUW, high air temperature and gusting wind conditions on the R44 helicopter's performance. In particular, the combination of high AUW and high air temperature increase the power required and decrease the power available, which can lead to a significant difference between the HIGE and HOGE performance. In addition, the pilot reported that it is important to keep a close eye on changing wind conditions as they had never previously experienced a similar loss of performance.

General details

Occurrence details

Date and time:	12 November 2016 – 1420 EST	
Occurrence category:	Accident	
Primary occurrence type:	Collison with terrain	
Location:	Near Riversleigh ALA, Queensland	
	Latitude: 18° 58.88' S	Longitude: 138° 45.32' E

Aircraft details

Manufacturer and model:	Robinson Helicopter Company	
Registration:	VH-YMJ	
Serial number:	2143	
Type of operation:	Private – pleasure / travel	
Persons on board:	Crew – 1	Passengers – 3
Injuries:	Crew – 0	Passengers – 1
Aircraft damage:	Substantial	

About the ATSB

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; and fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

About this report

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope, fact-gathering investigation was conducted in order to produce a short summary report, and allow for greater industry awareness of potential safety issues and possible safety actions.