Australian Government
Australian Transport Safety Bureau

Loss of control and collision with terrain involving EC130 helicopter, VH-YHS

19 km south-south-east of Mansfield, Victoria, on 19 January 2019

ATSB Transport Safety Report
Aviation Occurrence Investigation
AO-2019-005
Final – 29 May 2020

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

Publishing information

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Addendum

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Safety summary

What happened

On the morning of 19 January 2019, a Eurocopter EC130 helicopter, registered VH-YHS, conducted a private flight from Moorabbin Airport to an authorised landing area (ALA) near Mansfield, Victoria with the pilot and two passengers on board. A return flight to Moorabbin was planned for later that afternoon.

At about 1500 (Australian Eastern Daylight Time - AEDT), the pilot and passengers boarded the helicopter at the ALA for the return flight. The pilot prepared for take-off and lifted off the helicopter more rapidly than he normally did. As the helicopter became airborne, it began to rotate counter-clockwise (yaw to the left). The pilot tried to control the yaw but the helicopter quickly turned through 360° and, unable to control it, he made a decision to land the helicopter.

The left skid of the descending helicopter subsequently contacted the ground, resulting in a rolling movement that led to the main rotor blades striking the ground. The collision destroyed the aircraft, the pilot sustained minor injuries however the passengers were uninjured.

What the ATSB found

The investigation did not identify any airworthiness issues with the helicopter and it was considered that the loss of control was not attributable to a mechanical issue. It was also determined that the prevailing light winds did not contribute to the loss of control.

The pilot reported that he did not lift the helicopter into a balanced hover, and tried controlling its yaw mainly with the cyclic control instead of through the full application of opposing right, tail rotor pedal. Management of unanticipated yaw in helicopters with shrouded tail rotors (Fenestron) is the subject of the manufacturer's guidance and learnings from similar accidents.

Safety message

This accident demonstrates the criticality of helicopter pilots understanding the aircraft's characteristics so that they can anticipate its response when becoming airborne, and are not surprised by events. Controlling yaw in helicopters with a Fenestron tail rotor, as in this case, is an important consideration. Airbus Helicopters and the European Union Aviation Safety Agency (EASA) provide specific guidance relating to this issue to assist pilots.

The occurrence

What happened

At 1033 Eastern Daylight-saving Time[1] on 19 January 2019, a Eurocopter EC130 helicopter, registered VH-YHS (YHS), departed Moorabbin Airport for a private authorised landing area (ALA), 19 km south-south-east of Mansfield, Victoria. The pilot and two passengers were on board for the private flight to a rural property and intended to conduct a return flight that afternoon. The pilot's pre-flight inspection had not identified any defects or outstanding maintenance issues for the helicopter.

At 1115, after an uneventful flight, YHS landed at the rural property. Over the next few hours, the pilot attended to various matters there as planned, and had lunch with the passengers.

Shortly before 1500, the pilot and passengers returned to the helicopter. The helicopter was parked in an open area, facing south with a 0.5 m-high earth mound to its left (Figure 1). The mound prevented water entering the nearby shed and ran the length of the area, which had clusters of trees around it in different directions. The pilot had undertaken five previous flights to the property in the helicopter in the previous 5 months.

After assisting the passengers to board the helicopter, the pilot conducted a walk-around and did not identify anything unusual. He then boarded and, following a normal engine start, carried out his take-off checks. As was his usual practice, he set the friction settings for both the cyclic[2] and collective[3] controls to minimum resistance.[4] The wind was about 10 kt from the south-west (about 45° to the right of the helicopter), the sky was clear and it was approximately 30º C.

As the pilot increased to full power for take-off, he observed that the front right passenger had not put on her headset and signalled for her to do so. While he waited for her to put the headset on, keeping YHS on the ground, he noticed the cabin temperature was 32 ºC and turned on the air-conditioning.

Shortly after 1500, the pilot was again ready to take-off. He raised the helicopter off the ground, more rapidly than he normally did without getting the usual 'fine balance'[5]. At a height of about 3 m above the ground, the helicopter began to yaw to the left (turning counter-clockwise), seemingly pivoting about the tail and its attitude became progressively unstable (Figure 1, Top).

The pilot applied inputs, mainly cyclic, to control the helicopter's movement but the yaw increased. The aircraft now seemed to be pivoting about the main rotor, moving closer to the trees and shed (Figure 1, Middle). The pilot recalled that the helicopter felt 'unstable' and moved the cyclic but did not get the response he expected. In seconds, the helicopter had turned through 360° (Figure 1, Bottom). Unable to control the helicopter, the pilot decided to land and lowered the collective.

As the helicopter descended, its left skid contacted the mound, resulting in the helicopter pivoting around that skid and the main rotor blades striking the ground. The helicopter came to rest on its left side, facing the shed (Figure 2). The sequence, from lift-off to ground contact, occurred over about 5 seconds.

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1 Eastern Daylight-saving Time (EDT): Coordinated Universal Time (UTC) + 11 hours.

2 Cyclic: a primary helicopter flight control that is similar to an aircraft control column. Cyclic input tilts the main rotor disc, varying the attitude of the helicopter and hence the lateral direction.

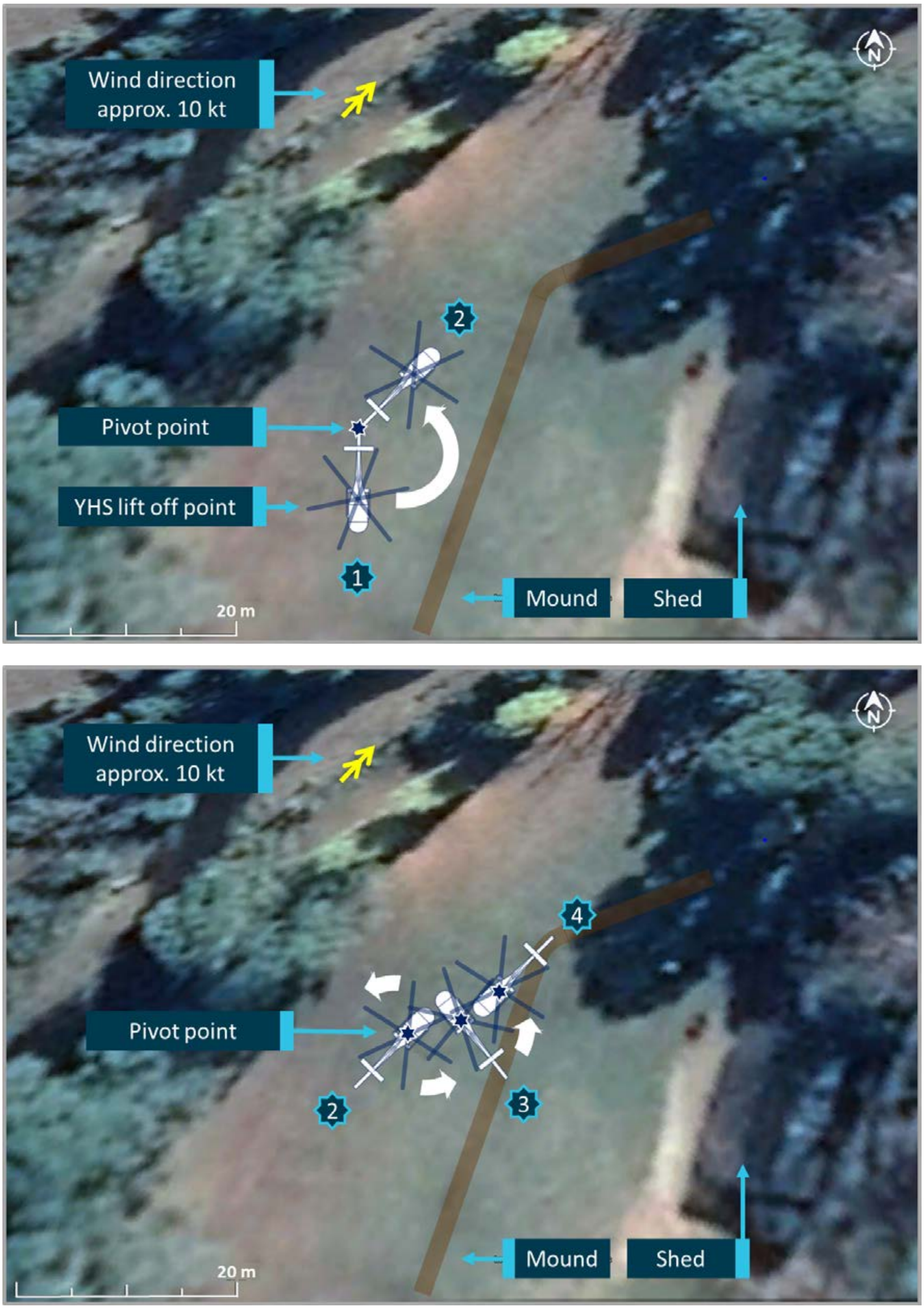
3 Collective: a primary helicopter flight control that simultaneously affects the pitch of all blades of a lifting rotor. Collective input is the main control for vertical velocity.

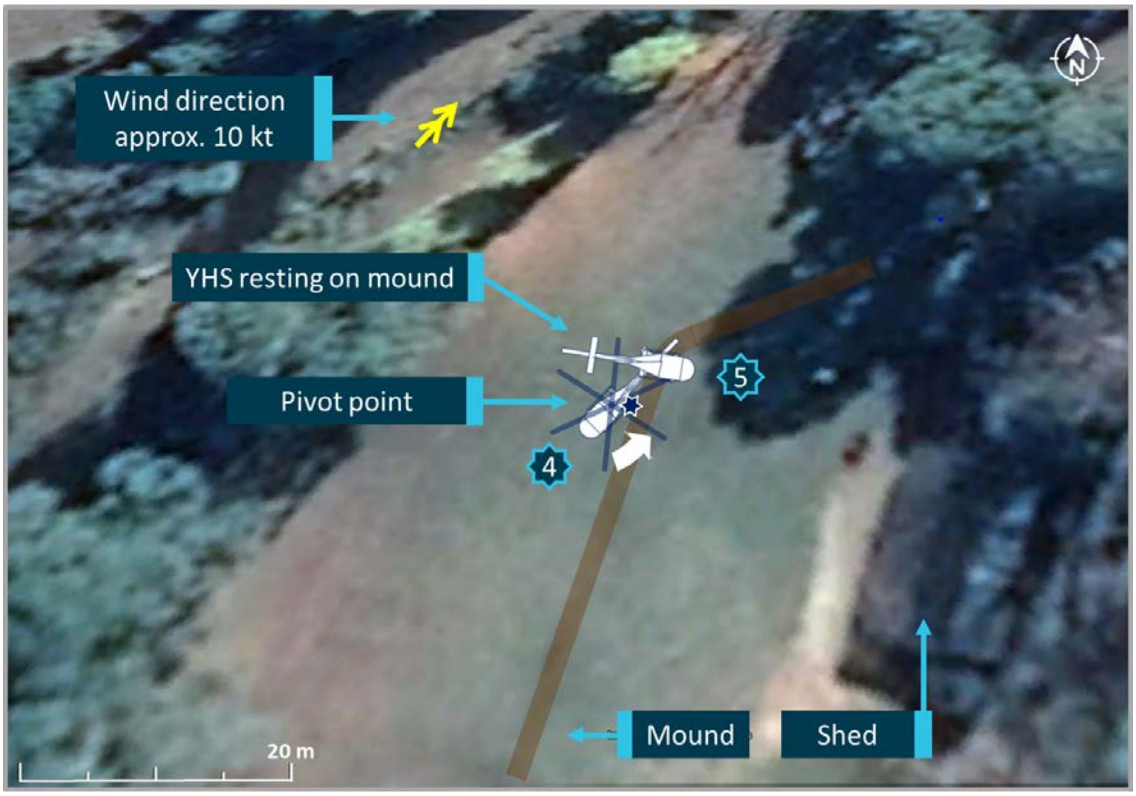
4 The helicopter flight manual suggests adjusting flight control friction settings to the preferred resistance.

5 The fine balance is a two-step lift-off where the pilot lifts the helicopter slightly to be light on the skids, while making control inputs to balance the helicopter, before gently lifting into the hover.

The pilot turned off the engine and battery, exited through the shattered left windscreen and assisted the passengers from the helicopter. The pilot sustained minor injuries while the passengers were uninjured.

Figure 1: Accident sequence





Source: ATSB analysis of information from pilot and witness video (partial) superimposed on Google Earth image

Figure 2: Accident site

Source: Seven News Melbourne, annotated by ATSB

Pilot

The pilot completed his helicopter flight training in a Hughes 300 helicopter in 2010. He completed EC130 type training in November 2011 and had accumulated 227 flight hours in that aircraft (from a total of 315 flight hours). Since his last flight review in November 2017, he had flown YHS for

13.5 hours of which 4 hours had been in the 90 days preceding the accident – the last flight being 46 days prior.

The pilot commented that he had:

- not heard or seen anything unusual with the helicopter before the accident
- tried controlling the yaw mainly with the cyclic, did not know how much right pedal he had used and assessed that he should have used more pedal to control yaw
- not flown regularly since his last flight review and noted that during his EC130 type training he had needed more pedal input than in the Hughes 300.

Aircraft information

The EC130 is a single-turbine engine helicopter with a clockwise-turning main rotor and a shrouded Fenestron tail rotor (Figure 2). The helicopter has a maximum take-off weight of about 2,427 kg and can carry seven occupants. The EC130 is a high-performance helicopter compared to the Hughes 300 (in which the pilot first trained). The Hughes 300 has a counter-clockwise turning main rotor and a conventional unshrouded tail rotor.

The EC130 with its Fenestron anti-torque system[6] requires greater right pedal[7] input to overcome torque from the main rotor during lift off than a helicopter with a conventional tail rotor. The pedal control inputs are also not linear with respect to the effect on helicopter yaw.

The helicopter's manufacturer (Airbus Helicopters) published service letter 1673-67-04 in February 2005 with guidance for managing yaw. The letter reminded pilots that the Fenestron anti-torque system requires more right pedal travel than a conventional tail rotor to counter left rotation (yaw). The letter stated that if sufficient pedal is not applied quickly to correct yaw, its rate will increase. Further, insufficient pedal input to stop yaw combined with pilot input to decrease altitude could result in the helicopter rolling to the side and contacting the ground.

Post-accident activities

There was no recorded data to determine the flight control inputs and their effect on the motion of YHS during the accident. The pilot's account, a partially obscured witness video, and photographs of the wreckage were the main sources of evidence.

The maintenance organisation for YHS carried out an examination at the accident site before moving the wreckage to its maintenance facility. This examination found no evidence of airworthiness issues that could have resulted in the accident. It was also determined that the helicopter was within its performance envelope and had sufficient fuel for the planned flight.

The ATSB sought the manufacturer's input for this accident and was advised that as no technical (mechanical or control) issues with YHS had been identified by the maintenance organisation, the accident was probably the result of a handling error.

In July 2019, about 6 months after the accident, Airbus Helicopters published safety information notice 3297-S-00 to highlight unanticipated yaw. The notice warned that an unanticipated yaw can be rapid and is most often toward the left (where the main rotor rotates clockwise). It further noted that even if the pilot's response was prompt, the yaw might not immediately subside and lead to the pilot thinking that the input was ineffective.

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6 The function of the helicopter tail rotor/Fenestron is to counteract the torque produced by the main rotor to maintain directional control.

7 Pedals: a primary helicopter flight control. Left and right pedal input moves the helicopter in the corresponding direction to maintain control for directional flight (yaw).

Similar accident

In October 2015, an EC130 helicopter was departing Megève altiport, France, for a sightseeing flight when the pilot lost control of the aircraft, which collided with the ground (BEA2015-0647 report). The helicopter was destroyed and the seven occupants were injured.

The pilot had 300 flight hours in helicopters, including 9.5 hours in an EC130 and 74 in the similar AS350 helicopter. The investigation found that while stabilised in the hover, the pilot initiated a left turn to face the climb out direction. However, the pilot was unable to stop or slow the yaw and decided to land, lowering the collective. The helicopter yawed through several more revolutions before colliding with the ground. No technical issues to explain the accident were identified.

As part of the investigation, a flight in a helicopter of the same type in similar conditions was undertaken, and it was found that pushing the right pedal to 70 per cent of its travel stopped a yaw rate of 100° per second to the left in 3 seconds.

Safety analysis

The earlier flight made by VH-YHS (YHS) that day indicated the helicopter was operating normally with no defects. The high-performance helicopter was also operating well below its maximum capacity with only three occupants.

In preparing to take-off, the pilot lifted YHS more rapidly than he normally did without first letting it rest lightly on the skids and applying control inputs to lift it gently into a balanced, controlled hover for the climb out. The higher-than-normal application of control inputs resulted in the torque from the main rotor not being balanced by the anti-torque from the Fenestron tail rotor. Consequently, once the helicopter was off the ground it yawed significantly to the left. The wind from the right may also have initially increased the yaw rate.

The pilot's pre-take-off checks did not confirm that everyone and everything was ready for the flight. As a result, he had to delay the take-off while a passenger put on her headset. He then noticed the elevated temperature and turned on the air-conditioning. These interruptions may have influenced his actions in lifting off more rapidly than he normally did.

The rate of left yaw offered limited time to regain control. The pilot reported that he principally applied cyclic control rather than the required full application and maintenance of opposing right, tail rotor pedal input. When his applied inputs did not arrest the yaw rate, the pilot assessed that the best option was to land the helicopter.

Similar accidents in the same or comparable helicopters, together with manufacturer's guidance, provide information for pilots to manage unanticipated yaw and avoid accidents. These show that the outcome of YHS's attempted landing with a significant yaw rate was somewhat predictable - a skid contacting the ground, the helicopter rolling over and the main rotor blades striking the ground. The rapid development of the accident sequence (about 5 seconds) also illustrates the limited time for pilot actions/decisions in such hazardous situations, which fortunately did not result in serious injury in this case.

The maintenance organisation's examination found no evidence of airworthiness issues with YHS to explain the accident. The pilot's account and the manufacturer's comments also support a conclusion that a mechanical issue and the light wind did not contribute to the accident.

Findings

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

- The pilot was unable to control VH-YHS yawing to the left after lifting off and decided to land. When the left skid of the descending helicopter contacted the ground, it rolled over and the main rotor blades struck the ground, destroying the aircraft with the pilot sustaining minor injury.

- No mechanical issue with the helicopter was identified and the prevailing light wind did not contribute to the loss of control and subsequent collision.

General details

Occurrence details

Date and time:	19 January 2019 – 1505 EDT	
Occurrence category:	Accident	
Primary occurrence type:	Collision with terrain	
Location:	Authorised landing area 19 km south-south-east of Mansfield, Victoria	
	Latitude: 37° 13.57' S	Longitude: 146° 10.67' E

VH-YHS

Manufacturer and model:	Eurocopter EC130	
Registration:	VH-YHS	
Serial number:	4080	
Type of operation:	Private	
Departure:	Authorised landing area 19 km south-south-east of Mansfield, Victoria	
Destination:	Moorabbin Airport, Victoria	
Persons on board:	Crew – 1	Passengers – 2
Injuries:	Crew – 1	Passengers – 0
Aircraft damage:	Substantial	

About the ATSB

The 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; 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 the ATSB's 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.

Purpose of safety investigations

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