ACCIDENT

Aircraft Type and Registration:	Rotorsport UK Calidus, G-CIYU
No & Type of Engines:	1 Rotax 914-UL piston engine
Year of Manufacture:	2016 (Serial no: RSUK/CALS/029)
Date & Time (UTC):	11 September 2017 at 1135 hrs
Location:	RAF Scampton, Lincolnshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damaged beyond economic repair
Commander's Licence:	Private Pilot's Licence
Commander's Age:	68 years
Commander's Flying Experience:	11,800 hours (of which 106 were on type) Last 90 days - 20 hours Last 28 days - 5 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and enquiries made by the AAIB

Synopsis

A loss of control during takeoff led to the gyroplane pitching nose-up rapidly and the retreating rotor blade struck the runway. The gyroplane rolled onto its left side and skidded to a halt on the runway. The occupants were unable to open the canopy to escape. Rather than attempt to break out using their emergency hammer, they awaited the arrival of the airfield's Rescue and Fire Fighting Service (RFFS), who righted the gyroplane, allowing the canopy to be opened.

History of the flight

The pilot was cleared to take off from Runway 22 at RAF Scampton, with the wind from 240º at 10 kt. After pre-rotating the rotor to approximately 200 rpm he released the brakes and the gyroplane accelerated quickly. At an estimated speed of 40-50 mph the machine pitched nose-up rapidly, rolled onto its left side and skidded along the tarmac until it came to a halt at the eastern edge of the runway. The occupants were uninjured and they quickly unlatched the canopy but could not open it because it was bearing some of the gyroplane's weight.

An emergency hammer was available to break the canopy but the pilot reported afterwards that he was not confident he could exert enough force to achieve this while trapped on his side. As there was no obvious danger he waited for assistance, and his recollection was that the RFFS arrived quickly and righted the gyroplane, allowing the canopy to be opened and for himself and his passenger to climb out uninjured.

Figure 1

G-CIYU after righting and with the canopy open
(Photograph MoD/Crown Copyright)

After the accident, both the pilot and his experienced passenger recalled that the control stick was positioned fully back in the normal manner before the takeoff run commenced. The pilot suspected that the rapid pitch-up was caused by a problem with the flight controls so, at his request, the manufacturer recovered the gyroplane and checked the systems, but no fault was found.

Recorded information

A video recording of the takeoff attempt suggested that the gyroplane was pre-rotated normally before the brakes were released and engine power was increased. It was apparent that the rotor did not tilt back until immediately prior to the gyroplane pitching nose-up. Before that happened, the groundspeed increased quickly, something the pilot attributed at the time to being on a damp asphalt runway which sloped downhill slightly, rather than the grass strip he normally used. After studying the video, he realised that the rotor was not tilted back during the takeoff roll so the resulting drag force was absent, allowing the gyroplane to accelerate more quickly than normal but without the rotor rpm increasing as a result of autorotation.

When the gyroplane began to pitch nose-up, the rotor was not rotating with sufficient speed to produce the lift needed to support the machine's weight, while extra drag would have resulted from the pitch-up. At this stage the video recording showed the gyroplane pitching nose-up until only the trailing edge of the tailplane was touching the ground. The gyroplane

then began to roll left; probably due to dissymmetry of lift, with the advancing blade on the right side producing more lift than the retreating blade on the left side.

When the gyroplane began to roll left it was in such a nose-high attitude that the retreating blade struck the ground, to the left and rear of the machine. This caused the rate of roll to increase, while the nose dropped and hit the runway, resulting in separation of the nose landing gear. Next, the rotor which had been deformed, struck the propeller, causing debris to scatter across the runway before the gyroplane fell onto its left side and started to decelerate. After travelling approximately 50 m on its side, the gyroplane came to rest at the eastern edge of the runway, eight seconds after the accident sequence began and with its nose pointing left of the runway orientation.

The first RFFS vehicle was on the scene 2 minutes and 30 seconds later, by which time the crew had unlatched the canopy and one person had approached the gyroplane but had been unable to do anything to help. Approximately one minute after arrival, five firefighters manually righted the gyroplane onto its mainwheels, allowing the canopy to open normally and the occupants to step out.

Pilot's assessment

The pilot had logged more than 100 hours in gyroplanes but most of his previous flying experience (11,700 hours) had been on conventional, fixed-wing aircraft. He was confident that he always followed the correct takeoff procedure in a gyroplane and pulled the control stick back after pre-rotating the rotor and before releasing the brakes. However, having seen the video evidence, he realised that on this occasion he apparently released the brakes and then applied power. The video shows that the rotor disc did not begin to tilt back until the accident sequence began; suggesting that the pilot may have attempted to rotate the gyroplane, as if it was a fixed-wing aircraft, by moving the control stick back once the gyroplane had gained groundspeed.

The pilot noted that he normally flew his gyroplane from a grass strip, rather than a large asphalt runway but that, several years previously, he had been based at RAF Scampton and had flown military aircraft from there. He surmised that, given the environment, his "muscle memory" may have subconsciously caused him to revert to a fixed wing takeoff technique.

When he viewed the video, the pilot was surprised to realise how much time elapsed between the gyroplane coming to rest and the arrival of the RFFS.

Previous accidents

This accident was the result of inappropriate control movement during an attempted takeoff. The AAIB has reported eight previous accidents that involved Calidus gyroplanes toppling onto one side, while attempting to takeoff or land, and in general these all appear to have been caused by an inappropriate control input.

Only one serious injury was reported in any of these accidents (G-ETOJ, AAIB Bulletin 1/2013) and there have been no reports of a post-accident fire. However, there is evidence that the

pilots of four of these gyroplanes could not open the canopy normally[1]. Two of these were righted by rescuers, allowing the canopies to be opened. The two people who arrived at G-CGMD were unable to right it, so the pilot used the emergency hammer to create a hole and, with the help of his rescuers, a space was cleared for him to crawl through. The pilot later stated that he found it difficult to use the hammer while on his side in the confined space and learnt through trial and error that a wrist action, rather than a whole arm action was needed. He estimated that without external assistance it might have taken more than two minutes to break his way out.

Survivability

This Calidus was operating on a UK CAA Permit to Fly, issued in accordance with British Civil Airworthiness Requirements, Section T Light Gyroplanes, with the cockpit '*designed as to provide occupants with unimpeded and rapid escape in emergency*'. The plexiglass 'bubble' canopy has a latch mechanism with a locking handle on the right side of the cockpit. The handle is lifted to unlock the latch and the canopy opens towards the left side, where it is hinged. An emergency hammer is available on the right side of the cockpit, for use by either occupant, and the Pilot's Handbook states that this can be used to break the plexiglass.

In 2011, as part of demonstrating compliance to Section T, the UK manufacturer proved the emergency hammer's effectiveness when an employee broke his way out of a test machine that was placed on its right side with the canopy closed. A video recording showed the employee knock a hole in the canopy and crawl through it.

The manufacturer acknowledged that if a Calidus topples over, because of an accident, some of the gyroplane's weight is likely to be borne by the canopy and the occupants may have difficulty escaping. This is why an emergency hammer is provided. Consideration has been given to incorporating a 'quick release' mechanism for the canopy hinges but such a modification is assessed to be impractical and it might not be effective in all possible post-accident attitudes.

In light of this accident, and comments from the pilot of G-CGMD, the manufacturer intends to provide additional information concerning the emergency hammer in the '*Emergency Procedure*' section of the Pilot's Handbook.

Footnote

[1] G-CGMD AAIB Bulletin 9/2013, G-PCPC AAIB Bulletin 7/2015, G-GRYN AAIB Bulletin 9/2017, G-CPTR AAIB Bulletin 12/2017.