

ACCIDENT

Aircraft Type and Registration:	Rotorsport UK Calidus, G-CGMD	
No & Type of Engines:	1 Rotax 914-UL piston engine	
Year of Manufacture:	2010 (Serial no: RSUK/CALS/015)	
Date & Time (UTC):	10 April 2013 at 1125 hrs	
Location:	Wickenby Aerodrome, Lincolnshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - 1 (Minor)	Passengers - N/A
Nature of Damage:	Damage to rotor, mast, propeller, tail fin and nosewheel	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	56 years	
Commander's Flying Experience:	132 hours (of which 86 were on type) Last 90 days - 0 hours Last 28 days - 0 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

Synopsis

Whilst attempting to take off the pilot applied aft control stick in order to raise the nosewheel. A 'hammering' vibration occurred and the aircraft veered to the left, off the runway, coming to rest on its side. It was concluded that the rotor rpm may have reduced as a result of the pilot not having held the stick fully aft during the takeoff roll; this may then have caused retreating blade stall.

Circumstances of the accident

After pre-rotating the rotor to approximately 220 rpm, in accordance with the Flight Manual procedure, the pilot lined up the gyroplane on the runway, applied a moderate rearward position of the control stick and applied full throttle. After reaching a speed of approximately 30 mph the pilot applied additional

back-pressure on the stick in order to raise the nosewheel. A 'hammering' vibration occurred, which the pilot attributed to a rough patch on the runway surface. The aircraft then veered sharply to the left, leaving the paved surface and causing the pilot to lose his grasp on the throttle and hence his ability to close it. The main rotor blades dug into the ground on the left and the aircraft was thrown over onto its right side before coming to a halt. The pilot switched off the ignition and the electrics and waited for assistance to arrive so that he could escape via the unbroken canopy. In the event the rescue crew asked the pilot to break the canopy and they assisted his egress. He found that a yaw pedal had impacted his right leg, causing a minor injury.

In a subsequent statement, the pilot considered he had been *“too cautious with [the] rearward position of the stick to avoid excessive nose wheel lift”* during the takeoff roll.

Takeoff technique

In common with most gyroplanes, G-CGMD is equipped with a pre-rotator system that, when activated, connects a drive system from the engine to the main rotor so that the latter spins up prior to starting the takeoff roll. This serves to reduce the takeoff distance that otherwise would be required. In order to avoid unintended engagement in flight, the pre-rotator can only be activated with the control stick in its fully forward position.

The following is an extract from the aircraft Flight Manual Take-off procedure:

- *While holding wheel brake adjust 1800 [engine] RPM with throttle*
- *Activate and hold pre-rotator*
- *Let pneumatic clutch fully engage (stabilization at about 110 rotor RPM). There may be a little throttle required to prevent engine RPM from dropping below 1800 RPM*
- *Carefully increase throttle to achieve 200 – 220 rotor RPM*
- *Release pre-rotator button*
- *Bring control stick fully aft*
- *Release wheel brake with throttle unchanged*
- *Monitor rotor speed and adequately increase throttle to take-off power*

A series of Warnings, Cautions and Notes then ensues, including the following:

WARNING

Prior to releasing the wheel brake make sure that the control stick is fully aft. A take-off run with flat rotor system may have fatal consequences.

The Flight Manual deals with the take-off run thus:

- *Check min. 5400 [engine] RPM for take-off. Otherwise, abort takeoff*
- *Minimize lateral drift by applying appropriate lateral control stick input into cross wind direction*
- *Maintain directional control i.e. runway alignment with sensitive pedal input*
- *When nose comes up allow nosewheel to float at about 10 – 15 cm above the runway by a balanced reduction of control stick back pressure*
- *Maintain attitude until speed increases and gyroplane lifts off*
- *Allow gyroplane to build up speed in ground effect*

Discussion

In any gyroplane, the main rotor relies on an upwards flow of air through the rotor disc in order to provide the autorotative force on the blades, which in turn provides the lift. The rotor rpm, and hence the lift, will be reduced in the event of a reduction in the airflow passing upwards through the rotor disc. This could occur as a result of, for example, a delay between de-activating the pre-rotator and commencing the takeoff roll, and/or not holding the stick fully aft during the takeoff roll. The pilot's statement suggested that the latter may have been a factor in this accident, especially as he moved the stick aft in order to raise the nosewheel, rather than wait for

the nosewheel to lift before checking forward with the stick in order to balance the aircraft on the main wheels, as advised in the Flight Manual.

The main rotor on this gyroplane rotates counter-clockwise when viewed from above. In the event of the rotor disc angle suddenly being increased as a result of an aft stick input, at low rotor rpm, it is likely that retreating blade stall would occur, and at the same time

the advancing blade will rise due to the increased lift generated. This would result in a loss of lift and an increase in drag on the left side, causing the aircraft to roll and yaw to the left. In addition the motion of the rotor disc so caused is likely to result in the rotor head reaching the limit of travel and contacting the teeter stops. This may have been responsible for the 'hammering' vibration described by the pilot.