AIRCRAFT ACCIDENT SHORT REPORT

CA18/2/3/9651, ZU-RCA, AutoGyro Calidus, unsuccessful recovery with high-speed blade flap on take-off

Date and time	**:** 26 May 2018, 0700Z
Occurrence type	**:** Accident
Aircraft registration	**:** ZU-RCA
Aircraft manufacturer and model	**:** AutoGyro GMBH, Calidus
Last point of departure	**:** Tedderfield Airpark, Gauteng Province (elevation: 5 200 ft) (GPS: S26°21'8,76" E027°58'7,99")
Next point of intended landing	Tedderfield Airpark, Gauteng Province (elevation: 5 200 ft) (GPS: S26°21'8,76" E027°58'7,99")
Location of accident site with reference to easily defined geographical points (GPS readings if possible)	**:** Tedderfield Airpark, Gauteng Province (elevation: 5 200 ft) (GPS: S26°21'8,76" E027°58'7,99")
Meteorological information	**:** Surface wind: 090°/3 kt, temperature: 14°C, pressure altitude: 1026 hPa, dew point: 0°C, CAVOK
Type of operation	**:** Private (Part 94)
Persons on board	**:** 1 + 1
Injuries	**:** Both occupants sustained minor injuries
Damage to aircraft	**:** Substantially

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 of the Investigation:

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (2011) this report was compiled in the interests of the promotion of aviation safety and the reduction of the risk of aviation accidents and ***not to apportion blame or liability****.*

Disclaimer:

1. SYNOPSIS

1.1 The pilot accompanied by a passenger, took off from Tedderfield Airpark in the Gauteng Province for a scenic flight, with the intention to remain in the circuit.

1.2 As the pilot commenced with the take-off roll on runway 29, the aircraft experienced a violent roll to its left side and the pilot attempted to control the aircraft but was unsuccessful. The aircraft rolled over onto its left-hand side, skidding 25m down the runway and came to rest on the left side of the runway on a grassy patch.

1.3 The investigation determined that it is likely that on take-off, the pilot applied throttle and releasing the brake, building up forward speed on the runway and forgot to pull the control stick back, and then doing this late. The torque caused by the sudden increase in lift of the advancing blade against the retreating blade threw the gyro onto its left side, this phenomenon is known as high-speed blade flap.

Figure 1: Example of an AutoGyro Calidus
(Source: pilotspost.com/arn0000930)

2. FACTUAL INFORMATION

2.1 On 26 May 2018, the pilot, accompanied by a passenger on an AutoGyro Calidus with registration ZU-RCA, departed from FATA in the Gauteng Province at approximately 0700Z (UTC) on a pleasure flight, with the intention to return to FATA.

2.2 Good weather conditions prevailed for the full duration of the flight.

2.3 On the take-off roll, the aircraft gained forward airspeed on runway 29. Upon reaching the middle of the runway, the pilot stated that the aircraft experienced a phenomenon known as high-speed blade flap.

2.4 The aircraft then flipped onto its left-hand side and began to skid; it skidded for a distance of 25 m.

2.5 The aircraft experienced substantial damage during the accident sequence, to the main rotor blades, propellers, canopy and landing gears.

2.6 The pilot and the passenger sustained minor injuries. Both occupants received medical attention at the hospital.

2.7 The accident occurred during daylight conditions at a geographical position determined to be S26°21'8,76" E027°58'7,99", at an elevation of 5 200 ft AMSL.

2.8 Causes of a blade flap

2.8.1 The following response was received from the manufacturers airworthiness department from AutoGyro discussing how a high-speed blade flap occurs:

"This is usually caused on take-off by the pilot applying throttle and releasing the brake, building up forward speed on the runway before realizing he has forgotten to pull the stick back, and then doing this retrospectively. The torque caused by the sudden increase in lift of the advancing blade against the retreating blade tends to throw the gyro onto its left side. Hence the repeated practice of routine during the instruction phase. This is common in fixed-wing pilots who fly gyros, as the take-off routine is the opposite of that for fixed wing.

Blade flap alone can be induced at standstill with a strong wind on the nose and the stick pulled back at low rotor RPM (typically below 200 RPM). For the same reason as above, the advancing blade will rise abruptly and the retreating blade will 'flap' down, possibly through the prop and tail plane/rudder if it is strong enough, as the rotational (gyroscopic) force in the system is not yet strong enough to counter the difference in lift of the opposing blades." [1]

2.9 What is blade flapping and how can blade flapping arise?

With each rotor blade system, more lift is generated at the leading rotor blade than when the rotor blade is falling back, provided there is wind or the unit is in motion. This applies equally to helicopters and gyroplanes. This can be better understood if it becomes clear that the incoming air is stronger in the forward flight on the leading sheet than in the falling leaf. More inflowing air causes a higher buoyancy.

This difference is very pronounced at low rotor speeds and is therefore very important during pre-rotation (pre-rotor rotation) and after landing, and must be taken into account during these phases. When the rotational speed of the rotor system is low (below 200 RPM) and at the same time wind is passing through the rotor blades, the point where the wind hits 90° on the rotor blade is greatest. Accordingly, the buoyancy is lowest on the opposite rotor blade.

The rotor blades are freely suspended in the gyrocopter in the impact joint and can move freely up and down a few centimetres. This is limited only by rubber bumpers next to the hinge against which the leaves hit.

If the buoyancy is so strong that the rotor blades press against the ends of the impact joint, this is called blade flapping. Since, after a further 180° of rotation of the rotor blades, the forces act exactly opposite, this can continue to swell with each revolution and lead to deformation and strong and undesired forces.

Therefore, it is very important to keep the control stick in the wind at a suitable angle during take-off and after landing. This is constantly practiced during training and the student gets a quick sense of the right situation.

Since the helicopter rotor system is usually addressed by a swashplate and does not have a ball joint, blade flapping is not an issue." [2]

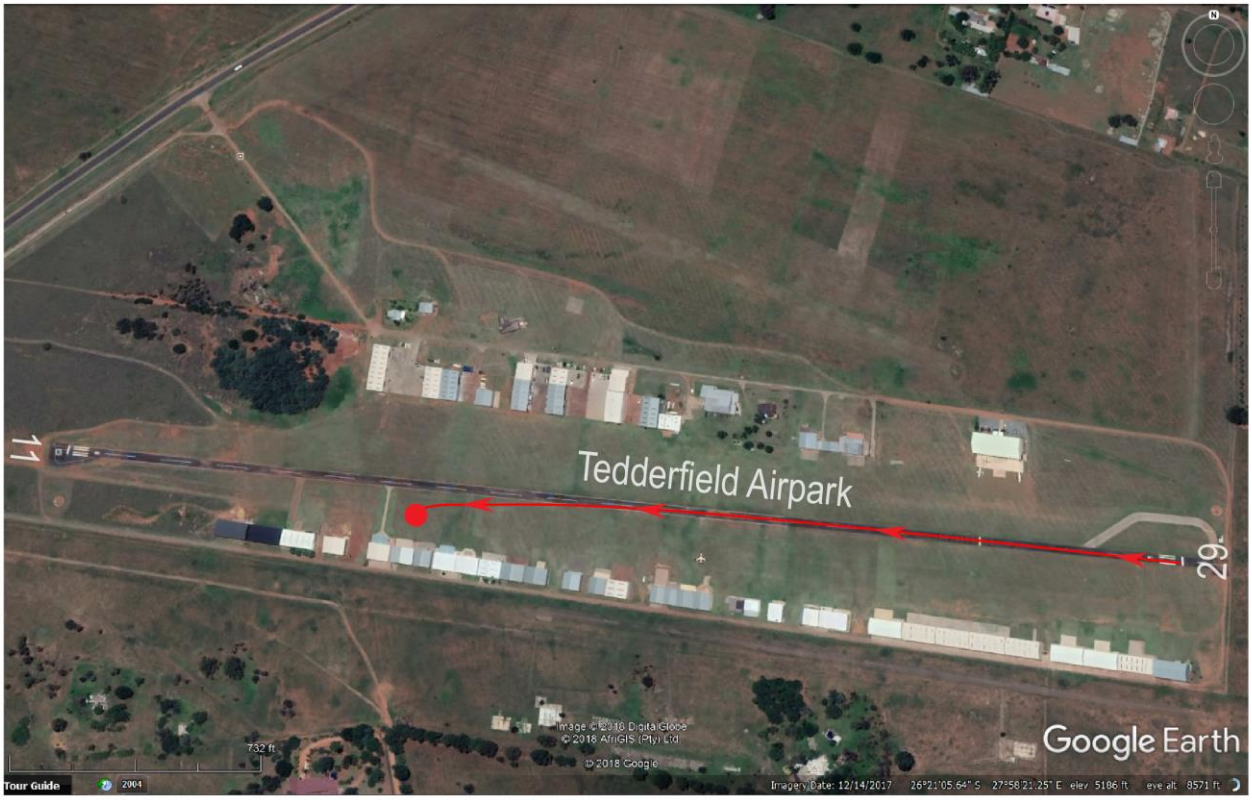

Figure 2: Google Earth map of FATA and the path to the final location of the accident (red dot)

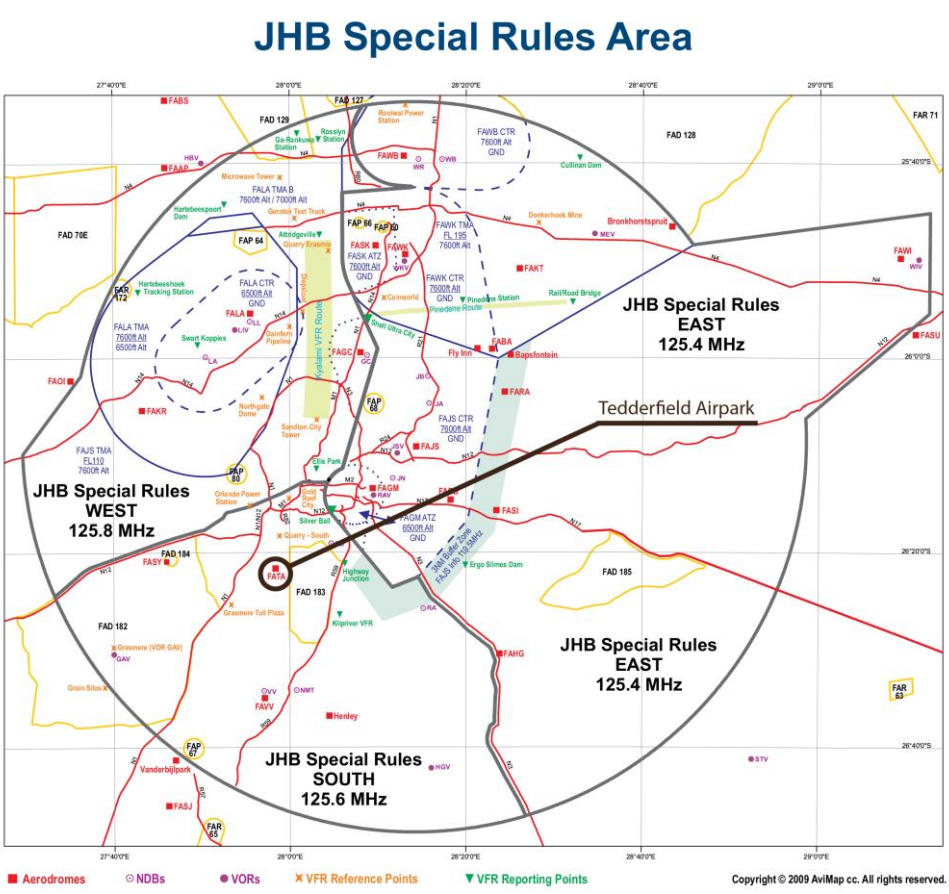

Figure 3: Map of the JHB Special Rules Area showing FATA

Figure 4: The arrow indicates the path that the autogyro slid after the high-speed blade flap.

Figure 5: The damage to the autogyro due to the high-speed blade flap

3. FINDINGS

3.1 The pilot was issued with a Class 2 medical on the 17 May 2018 and expires on the 31 May 2020.

3.2 The pilot was issued with a National pilots licence on the 17 May 2018 and expired on the 31 May 2020.

3.3 The pilot had the appropriate type rating.

3.4 The pilot had flown a total of 38.6 hours and all these hours had been on this type.

3.5 The aircraft is owned by the pilot and operated in terms of Part 94 of CARs 2011.

3.6 The aircraft was issued with an ATF certificate in terms of Part 24 of CARs 2011 on the 08 September 2017 and expires on the 07 September 2018.

3.7 The aircraft had flown a total of 112.6 hours up to the accident.

3.8 A 100-hour service was performed on 8 September 2017 for the ATF.

3.9 The aircraft flipped over onto its left side on take-off due to high-speed blade flap.

3.10 The aircraft was substantially damaged during the accident sequence, namely to the main rotor blades, propellers, canopy and landing gear.

3.11 The accident occurred during daylight at FATA in the Gauteng Province, at a geographical position determined to be S26°21'8.76" E027°58'7.99", at an elevation of 5 200 ft AMSL.

3.13 Aerodrome conditions were as follows: Wind: 090^0/9kts and Visibility: 10km or greater. The weather at the time had no bearing on this accident.

3.13 The investigation determined that it is likely that on take-off, the pilot applied throttle and releasing the brake, building up forward speed on the runway and forgotten to pull the control stick back, and then doing this late. The torque caused by the sudden increase in lift of the advancing blade against the retreating blade threw the gyro onto its left side

4. PROBABLE CAUSE/CONTRIBUTING FACTOR

4.1 It is likely that on take-off, the pilot applied throttle and releasing the brake, building up forward speed on the runway and forgotten to pull the control stick back, and then doing this late. The torque caused by the sudden increase in lift of the advancing blade against the retreating blade threw the gyro onto its left side.

5. REFERENCES USED ON THE REPORT

[1] airworthiness@auto-yyro.com
[2] gyrocopter-hamburg.de/index.php/das-blade-flapping.html

6. SAFETY RECOMMENDATIONS

6.1 None.