SOUTH AFRICAN CIVIL AVIATION AUTHORITY

Section/division **Accident and Incident Investigations Division** Form Number: CA 12-12a

AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/9211		
Aircraft Registration	ZU-CVH	**Date of Accident**	19 August 2013		**Time of Accident**	12:15Z	
Type of Aircraft	Magni M16 Gyro		**Type of Operation**		Hire & Fly (Private)		
Pilot-in-command Licence Type	Recreational Pilots Licence		**Age**	45	**Licence Valid**	Yes	
Pilot-in-command Flying Experience	Total Flying Hours		70.5		Hours on Type	70.5	
Last point of departure	Fisantekraal Airfield (FAFK, Western Cape Province)						
Next point of intended landing	Fisantekraal Airfield (FAFK, Western Cape Province)						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
At the intersection of runway 05 and 32 at GPS coordinates S33˚46'299 E018˚44'408" at an elevation of 410 ft.							
Meteorological Information	Temperature: 19 ˚C, Visibility: CAVOK, Wind direction: 230˚, Wind speed: ± 5 kts						
Number of people on board	1 + 1	**No. of people injured**	1	**No. of people killed**	0		

Synopsis

The pilot, accompanied by a passenger, intended to depart from runway 23 at FAFK on a private flight.

A few metres into the take-off run the pilot stated that he felt severe left and right movement on the cyclic. He immediately reduced the power to idle and the aircraft flipped onto its left side and slid for approximately 120 m down the runway before coming to rest.

The aircraft sustained substantial damage and only the pilot sustained minor injuries.

The accident sequence was due to the rotor rpm being too low in relation to the forward speed of the gyro during the take-off roll, which resulted in the blade flapping and a subsequent loss of control during the take-off roll.

Probable Cause

Incorrect technique employed during take-off.

Contributory factors

Loss of control of the aircraft during take-off, due to blade flapping.

IARC Date		Release Date	

AIRCRAFT ACCIDENT REPORT

Name of Owner	**:**	L van Wyk
Name of Operator	**:**	Aerosport
Manufacturer	**:**	Magni Gyro
Model	**:**	Magni M16 Gyro
Nationality	**:**	South African
Registration Marks	**:**	ZU-CVH
Place	**:**	Fisantekraal Airfield
Date	**:**	19 August 2013
Time	**:**	12:15Z

All times given in this report is 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 (1997) this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and ***not to establish legal liability****.*

Disclaimer:

This report is produced without prejudice to the rights of the CAA, which are reserved.

1. FACTUAL INFORMATION

1.1 History of Flight

1.1.1 The pilot and passenger arrived at the hangar at FAFK Airfield and completed the necessary paperwork for the flight. The aircraft had been refuelled on the pilot's request prior to his arrival.

1.1.2 The pilot and passenger proceeded to the aircraft where a thorough pre-flight and passenger briefing was carried out prior to departure.

1.1.3 After all the necessary checks were carried out, the aircraft was taxied to the runway where it was lined up on Runway 23 for pre-rotation and take-off. An aircraft departed ahead of ZU-CVH and another was already in the circuit.

1.1.4 The pilot stated that he pre-rotated to 130 RPM, came back on the cyclic and continued pre-rotation to 170 RPM, at which point he let go of the pre-rotator and started the forward roll.

1.1.5 The manifold pressure gauge indicated 35 inches and he waited for the Rotor RPM to increase to 190 RPM. The pilot stated that it was slower than normal and that the RPM did not reach 190 RPM.

1.1.6 A few metres into the take-off at a low airspeed the pilot stated that he felt severe left and right movement on the cyclic. He immediately reduced the power to idle and the aircraft rolled onto its left side. The aircraft slid for approximately 120 m

down the runway, where it came to rest at the intersection of runways 05 and 32 at GPS coordinates S33˚46'299 E018˚44'408".

1.1.7 The pilot communicated with traffic in the vicinity on the designated frequency announcing his emergency. He turned all switches to the OFF position and removed his harness. He assisted his passenger and they evacuated the aircraft.

1.2 Injuries to Persons

Injuries	Pilot	Crew	Pass.	Other
Fatal	-	-	-	-
Serious	-	-	-	-
Minor	1	-	-	-
None	-	-	1	-

1.3 Damage to Aircraft

1.3.1 The aircraft was substantially damaged.

1.4 Other Damage

1.4.1 No other damages resulted due to the accident.

1.5 Personnel Information

Nationality	South African	Gender	Male	Age	45
Licence Number	0279006233	Licence Type	Recreational Pilot's Licence		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	Gyrocopters				
Medical Expiry Date	30 April 2014				
Restrictions	Nil				
Previous Accidents	Nil				

Flying Experience:

Total Hours	70.5
Total Past 90 Days	3.8
Total on Type Past 90 Days	3.8
Total on Type	70.5

1.6 Aircraft Information

Airframe:

Type	Magni M16 Gyrocopter	
Serial Number	16021984	
Manufacturer	Magni Gyro	
Date of Manufacture	2002	
Total Airframe Hours (At time of Accident)	1762.7 hours	
Last Annual Inspection (Date & Hours)	12 October 2012	1626.6 hours
Hours since Last Annual	136.1 hours	
Authority to Fly (Issue Date)	19 October 2012	
Authority to Fly (Expiry Date)	12 October 2013	
C of R (Issue Date) (Present owner)	19 November 2004	
Operating Categories	NTCA Commercial	

Engine:

Type	Rotax 914UL
Serial Number	4419304
Hours since New	517.6
Hours since Overhaul	Not Applicable

Propeller:

Type	Arplast Ecoprop
Serial Number	N/A
Hours since New	1762.7
Hours since Overhaul	Not Applicable

1.7 Meteorological Information

Wind direction	230˚	Wind speed	± 5 kts	Visibility	10 km
Temperature	19˚C	Cloud cover	Sky clear	Cloud base	Nil
Dew point	-				

1.8 Aids to Navigation

1.8.1 The aircraft was equipped with standard navigational equipment as approved by the regulator for the aircraft type. There were no recorded defects indicating that the navigation system was unserviceable prior to, or during the flight.

1.9 Communications

1.9.1 The aircraft was equipped with standard communication equipment as approved by the regulator for the aircraft type. There were no recorded defects prior to, or during the flight.

1.9.2 Immediately after the accident occurred, the pilot made a radio transmission on frequency 131.1, stating that he had had an accident.

1.10 Aerodrome Information

1.10.1 Fisantekraal Airfield is a licensed, private airfield.

1.10.2 The runway was poorly maintained and had poor infrastructure in place. There are no boundary fences, people were seen walking across the runway to get to neighbouring settlement areas and a dog was also seen on the runway.

Figure 1: Condition of the runway and area surrounding the runway.

10.2.3

Aerodrome Location	Fisantekraal - FAFK	
Aerodrome Co-ordinates	S33˚46'299" E18˚44'00"	
Aerodrome Elevation	400 ft	
Runway Designations	05 / 23	14 / 32
Runway Dimensions	900 m	700 m
Runway Used	05/23	
Runway Surface	Concrete	
Approach Facilities	Lights available on request from Cape Town Flight Training Centre	

Figure 2: Google Map Image of FAFK aerodrome.

1.11 Flight Recorders

1.11.1 The aircraft was not equipped with a Flight Data Recorder (FDR) or a Cockpit Voice Recorder (CVR) nor was either required by the regulations.

1.12 Wreckage and Impact Information

1.12.1 It had been planned that the aircraft would take off from Runway 23 at GPS co-ordinates S33˚46'032" E018˚44'534".

1.12.2 A few metres into the take-off run the pilot stated that he felt severe left and right movement on the cyclic. He immediately reduced the power to idle and the aircraft flipped onto its left side.

1.12.3 The aircraft slid approximately 120 m down the runway, where it came to rest at the intersection of runways 05 and 32 at GPS coordinates S33˚46'299 E018˚44'408" at an elevation of 410 ft.

1.12.4 The fuel tank ruptured and fuel leaked onto the ground.

1.12.5 During the onsite investigation the following was observed:-

- Distance from take-off to first markings was 425 m
- Distance between the wheel marks and debris was 15 m
- Distance from the take-off to where the aircraft came to rest was 539 m.
- The wheel was found a further 126 m away at GPS co-ordinates S33˚46'333" E018˚44'342".

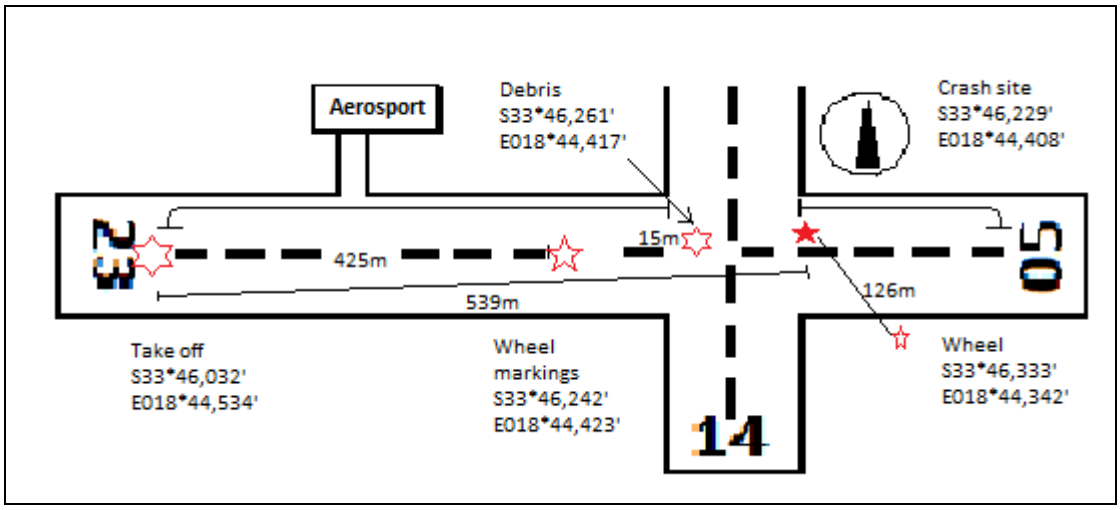

Figure 3: Wreckage diagram.

Figure 4: Aircraft in the position it came to rest.

Figure 5: Missing left wheel.

Figure 6: Both sides of the left wheel.

1.13 Medical and Pathological Information

1.13.1 The pilot sustained minor injuries to his left arm.

1.13.2 The pilot went to the hospital for a check-up after the accident. No other injuries were reported.

11.14 Fire

1.14.1 There was no evidence of pre- or post-impact fire.

1.15 Survival Aspects

1.15.1 The accident was considered survivable, due to the fact that the pilot and passenger made use of the safety harnesses fitted to the aircraft as well as the fact that each had worn a helmet.

1.15.2 The accident was also considered survivable because of the low impact forces experienced.

1.16 Tests and Research

1.16.1 "**Blade Flap or Rotor Blade Flapping"** is a term commonly used to describe excessive, violent rotor blade motion. This most often occurs when rotor rpm is too low in relation to the forward speed of the gyro during take-off roll. The word "Flapping" by itself is used to refer to the normal in-flight teetering or articulation of a rotor, which helps reduce dissymmetry of lift.

1.16.2 **"Rotor Blade Flapping:"** in traditional **"Flapping Hinge"** rotor systems, **"flapping"** refers to the normal action of the rotor to allow cyclic action of the rotor – similar to **"Teeter"** for semi-rigid 2-blade rotor systems. The flapping amplitude of the rotor increases with increasing airspeed (forward cyclic input) in order to compensate for the increasing dissymmetry of lift between the advancing blade and the retreating blade. Flapping action also allows cyclic maneuvering inputs to the rotor. In semi-rigid 2-blade rotor systems, the term "flapping" is commonly used to refer to the abnormal excessively forceful teeter action of the rotor impacting the teeter stops upon significant dissymmetry of lift or retreating blade stall – such as on take-off.

1.16.3 **"Rotor Systems – Semi-rigid rotor system"** – Any rotor system capable of auto-rotation may be utilised in a gyroplane. Because of its simplicity, the most widely used system is the semi-rigid, teeter-head system. This system is found in most amateur-built gyroplanes. In this system, the rotor head is mounted on a spindle, which may be tilted for control. The rotor blades are attached to a hub bar that may or may not have adjustments for varying the blade pitch. A coning angle, determined by projections of blade weight, rotor speed, and load to be carried, is built into the hub bar. This minimizes hub bar bending moments and eliminates the need for a coning hinge, which is used in more complex rotor systems. A tower block provides the undersling and attachment to the rotor head by the teeter bolt. The rotor head is comprised of a bearing block in which the bearing is mounted and

onto which the tower plates are attached. The spindle (commonly, a vertically oriented bolt) attaches the rotating portion of the head to the non-rotating torque tube. The torque tube is mounted to the airframe through attachments, allowing both lateral and longitudinal movement. This allows the movement through which control is achieved.

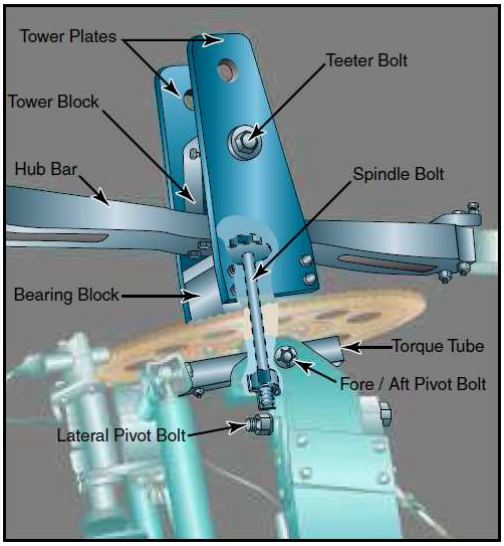

Figure 7: *The semi-rigid, teeter-head system is found on most amateur-built gyroplanes. The rotor hub bar and blades are permitted to tilt by the teeter bolt.*

1.16.4 Blade Flap – On a gyroplane with a semi-rigid, teeter-head rotor system, blade flap may develop if too much airflow passes through the rotor system while it is operating at low r.p.m. This is most often the result of taxiing too fast for a given rotor speed. Unequal lift acting on the advancing and retreating blades can cause the blades to teeter to the maximum allowed by the rotor head design. The blades then hit the teeter stops, creating a vibration that may be felt in the cyclic control. The frequency of the vibration corresponds to the speed of the rotor, with the blades hitting the stops twice during each revolution. If the flapping is not controlled, the situation can grow worse as the blades begin to flex and bend. Because the system is operating at low r.p.m., there is not enough centrifugal force acting on the blades to keep them rigid. The chock of hitting the teeter stops combined with uneven lift along the length of the blade causes an undulation to begin, which can increase in severity if allowed to progress. In extreme cases, a rotor blade may strike the ground or propeller. Refer to figure 7.

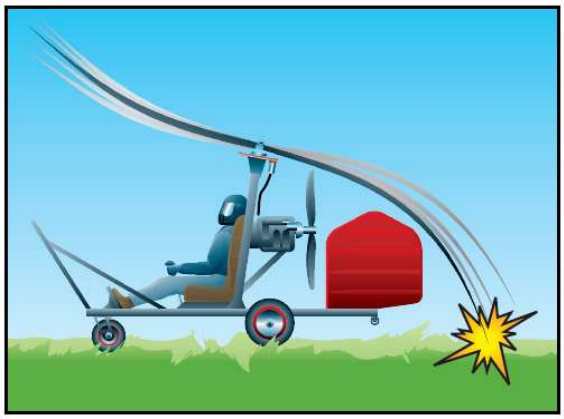

Figure 8: *Taxiing too fast or gusting winds can cause blade flap in a slow-turning rotor. If not controlled, a rotor blade may strike the ground.*

To avoid the onset of blade flap, always taxi the gyroplane at slow speeds when the rotor system is at low r.p.m. Consideration must also be given to wind and direction. If taxiing into a 10-knot headwind, for example, the airflow through the rotor will be 10 knots faster than the forward speed of the gyroplane, so the taxi speed should be adjusted accordingly. When pre-rotating the rotor to accelerate slowly and smoothly, in the event blade flap is encountered, apply forward cyclic to reduce the rotor disc angle and slow the gyroplane by reducing throttle and applying the brakes, if needed. Refer to figure 8.

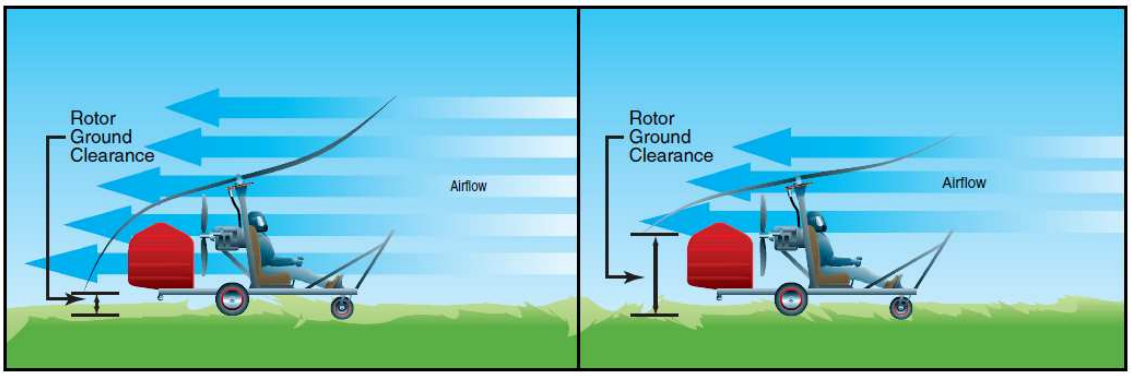

Figure 9: *Decreasing the rotor disc angle of attack with forward cyclic can reduce the excessive amount of airflow causing the blade flap. This also allows clearance between the rotor blades and the surface behind the gyroplanes, minimizing the chances of a blade striking the ground.*

1.17 Organisational and Management Information

1.17.1 This was a private flight.

1.17.2 The aircraft was operating under a valid Authority to Fly (ATF).

1.17.3 The aircraft was maintained by an Approved Person (AP39) who works for an Aircraft Maintenance Organisation (AMO) approved by SACAA.

1.18 Additional Information

1.18.1 None.

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

2.1 Pilot (Man)

The pilot was appropriately licensed for the flight. His flying medical was also valid and issued without any restrictions. He had a total of 70.5 hours, with all 70.5 hours of those hours being on type. The pilot flew this particular aircraft on a regular basis.On a gyroplane with a semi-rigid, teeter-head rotor system, blade flap may develop if too much airflow passes through the rotor system while it is operating at

low r.p.m. This is most often the result of taxiing too fast for a given rotor speed. The pilot may have employed the incorrect technique during take-off, which resulted in blade flapping.

2.2 Aircraft (Machine)

The aircraft had a valid Certificate of Airworthiness and had been maintained in compliance with the regulations. The aircraft was in a serviceable condition when dispatched for flight. The last Mandatory Periodic Inspection was carried out on 12 October 2012 at 1626.6 hours.

2.3 Environment

The weather conditions at the airfield did not contribute to the accident.

3. CONCLUSION

3.1 Findings

3.1.1 The aircraft had a valid Authority to Fly and had been maintained in compliance with the regulations.

3.1.2 The aircraft was airworthy when dispatched for the flight.

3.1.3 There was no evidence of any defect or malfunction in the aircraft that could have contributed to the accident.

3.1.4 The aircraft was severely damaged in the accident sequence.

3.1.6 The pilot was licensed and qualified for the flight in accordance with existing regulations.

3.1.7 The airfield conditions did not comply with the regulatory requirements of SACAA.

3.1.8 The pilot and passenger made use of the safety harnesses fitted to the aircraft and each had worn a helmet.

3.1.9 The accident was considered survivable due to the low impact forces experienced.

3.1.10 The pilot lost control of the aircraft as a result of blade flapping, which may be attributed to poor technique employed by the pilot during take-off.

3.1.11 The pilot executed full power when rotor RPM was not sufficient.

3.2 Probable Cause/s

3.2.1 Incorrect technique employed during take-off.

3.3 Contributory factors

3.3.1 Loss of control of the aircraft during take-off, due to blade flapping.

4. SAFETY RECOMMENDATIONS

4.1 It is recommended to the Director of Civil Aviation that a full audit be carried out on the Fisantekraal Aerodrome to ensure compliance with the Civil Aviation Regulations.

5. APPENDICES

5.1 None