AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/9665		
Aircraft Registration	**ZU-CIU**	**Date of Accident**	18/11/2017		**Time of Accident**	1530Z	
Type of Aircraft	Windlass Aquila		**Type of Operation**		Private (Part 94)		
Pilot-in-command Licence Type		National Pilot Licence (NPL)	**Age**	37	**Licence Valid**	Yes	
Pilot-in-command Flying Experience		Total Flying Hours	108,2		Hours on Type	108,2	
Last point of departure	Potgietersrus Airport (FAQR), Limpopo Province						
Next point of intended landing	Microland airport, Gauteng Province						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
On the Mokopane mountains 7,8 nm from Mokopane town at the following GPS co-ordinates: S 24° 08' 31.3" E028° 52' 42.9" elevation 5655 ft							
Meteorological Information	Wind direction: 320°, wind speed: 05 kts, temperature 27,6 °C, dew point: 5.5 °C, visibility: 10 km						
Number of people on board	1+1	**No. of people injured**	1	**No. of people killed**	1		

Synopsis

The pilot, accompanied by a passenger, took off from FAQR on a return leg to Microland airport via a scenic route over the Mokopane mountains. The flight was conducted under visual flight rules (VFR) and weather was fine.

According to the pilot of ZU-ICI, the two aircraft were flying along the mountain valley using thermals to gain height and continued to climb over mountains which reach an elevation of approximately 5655 feet. As they were using thermals to gain height, they reduced engine power to idle. Once they had sufficient height they decided to turn to the left, towards the west, heading towards the dam to the south. ZU-CIU was lower than ZU-ICI and turned left towards a valley. ZU-ICI observed ZU-CIU losing altitude rapidly and impacting the mountain edge. The pilot was fatally injured and the passenger was seriously injured. The aircraft was substantially damaged.

The investigation revealed that the aircraft were flying using thermals to gain height with the engine power reduced to idle. The aircraft flew towards the mountain along the valley in a northerly direction and turned west between the mountain valleys. It encountered rotor turbulence which led to loss of height, and the aircraft impacted the side of the mountain in a nose down attitude.

Probable Cause 7.41 & 7.36

The aircraft encountered rotor turbulence which led to loss of height and the aircraft impacted the side of the mountain in a nose down attitude. Poor technique and lack of experience

Contributory factors

- The aircraft was flying with engine power selected to idle.
- Lack of experience flying in mountainous areas and using thermals

SRP Date	13 November 2018	Release Date	

AIRCRAFT ACCIDENT REPORT

Name of Owner /Operator : Daniels N.R.J.
Manufacturer : Solo Wings CC
Model : Windlass Aquilla
Nationality : South African
Registration Marks : ZU-CIU
Place : Mokopane, Limpopo Province
Date : 18 November 2017
Time : 1530Z

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 interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and ***not to apportion blame or 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 On 18 November 2018 at about 1530Z, a Windlass Aquilla model with registration marks ZU-CIU was involved in an accident at the Mokopane mountains in Limpopo province of South Africa. The flight was conducted under visual flight rules (VFR) and the weather was reported to be fine on the day of the accident.

1.1.2 The pilot and a passenger were part of a group invited by Limpopo flying school for an annual breakfast held at Potgietersrus airport (FAQR). They departed on 17 November 2017, the day before the accident, from Microland Airport in Gauteng to

Eland Quad Camp with the intention to rest for the night. The following day they proceeded with their flight to FAQR and upon arrival, they reported to the airport manager that they had no problems with their flights.

1.1.3 According to the airport manager, they do not promote scenic flying since the airport is unmanned and more than 100 aircraft in the same vicinity can be dangerous. Later in the afternoon, at about 1515Z, the pilot and passenger of ZU-CIU and another aircraft, ZU-ICI, took off for the return flight to Microland airport via the scenic route around the Mokopane Mountains.

1.1.4 According to the statement made by the pilot of ZU-ICI, they took off in a northerly direction and flew towards the Mokopane mountain ridge in order to catch the thermals and the northerly winds pushing against the ridge, giving them more lift with the engines at reduced power. Once they were above the plateau, ZU-ICI was approximately 500 feet above ZU-CIU's altitude and positioned behind. He stated that he advised ZU-CIU that they needed to fly towards the dam, south-west of their present position. Since ZU-CIU was in front but lower; he made a left turn through a valley crossing their northerly track from east to west. ZU-CIU was closer to the northern ridge and at a lower altitude, when the aircraft was seen by ZU-ICI suddenly losing height rapidly and crashing against the mountain ridge leading to two separate clouds of dust rising up.

1.1.5 ZU-ICI said they assessed the situation and concluded that it would be unsafe to approach the accident site, since they did not know the cause. ZU-ICI relayed the message to the airport manager, who advised ARCC (Aviation Rescue Coordination Centre) as per their emergency response plan. The airport manager passed the wreckage location on to the search and rescue unit, which was dispatched to assist. They could not reach the accident site and requested assistance from South African National Defence Force (SANDF). The SANDF helicopter landed at FAQR at 1940Z, and the passenger and the deceased pilot were airlifted to the nearest hospital at 2130Z.

1.1.6 The SANDF was not available for the Investigator and therefore could not reach the accident site. It happened on a mountain in Mokopane with the following coordinates: GPS S 24° 08' 31.3" E028° 52' 42.9", elevation 5655 ft. It was a clear day without clouds at the site.

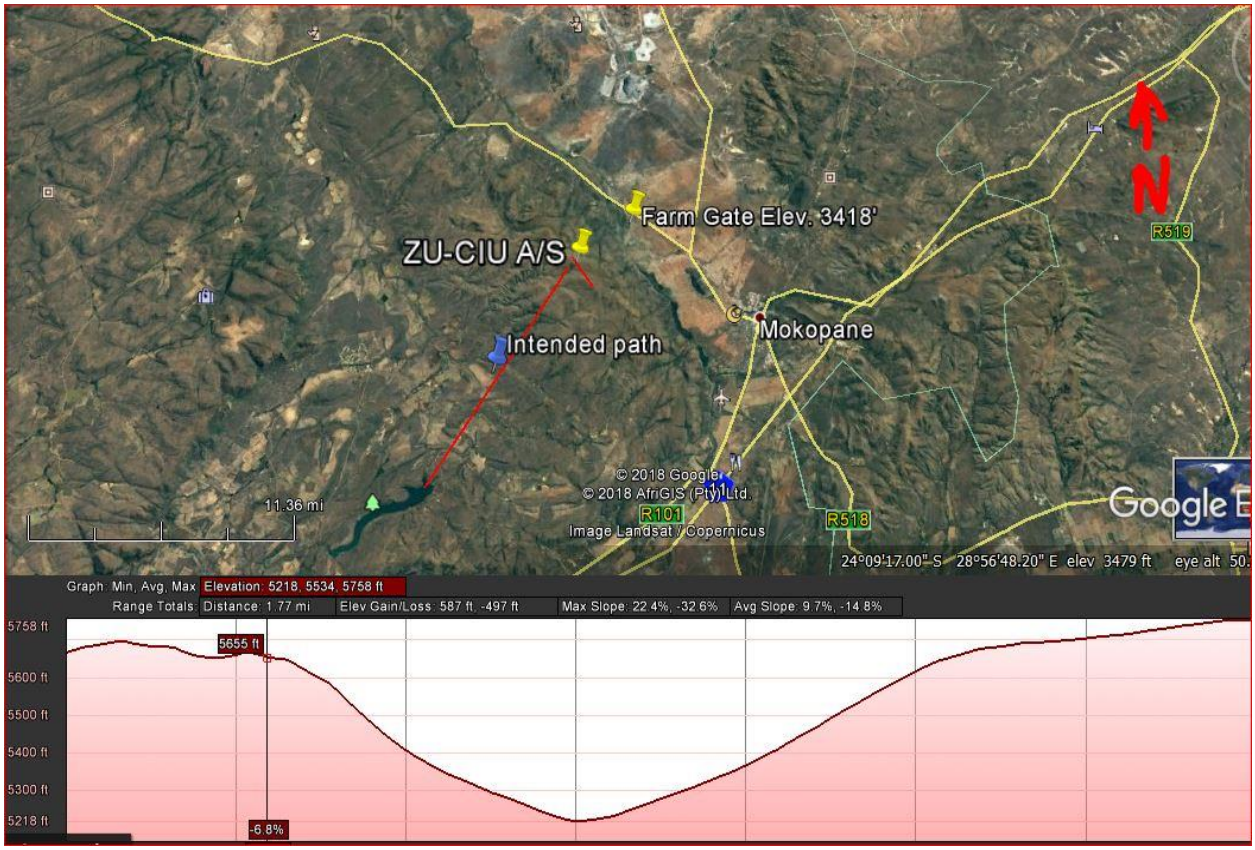

Figure 1: Cross section of valley's elevation profile where the accident happened.

1.2 Injuries to Persons

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

1.3 Damage to Aircraft

1.3.1 The aircraft was substantially damaged.

1.4 Other Damage

1.4.1 None

1.5 Personnel Information

Nationality	South African	Gender	Male	Age	37
Licence Number	0279035133	Licence Type	NPL		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	None				
Medical Expiry Date	30/06/2021 (Class 4)				
Restrictions	Corrective lenses				
Previous Accidents	None				

Flying Experience:

Total Flying Hours	108,2
Total Past 90 Days	18
Total on Type Past 90 Days	18
Total on Type	108,2

1.5.1 The pilot's NPL licence was first issued on 11 May 2017. His last entry in the logbook and flight folio is dated 09 September 2017 with a total of 103 total flying hours. He did not fly until 17 and 18 November 2017. His total flying time for the two days was 5.2 hours.

1.6 Aircraft Information

Airframe:

Type	Weight shift microlight	
Serial Number	WA 902	
Manufacturer	Solo Wings CC	
Date of Manufacture	2000	
Total Airframe Hours (At time of Accident)	812	
Last ATF (Date & Hours)	03/11/2017	807
Hours since Last ATF	5	
A to F (Issue Date)	08/11/2017	
C of R (Issue Date) (Present owner)	25 October 2017	
Operating Categories	Part 94	

Engine:

Type	Rotax 582 UL
Serial Number	5430101
Hours since New	302
Hours since Overhaul	TBO not reached

Propeller:

Type	ATAO
Serial Number	660-661-662
Hours since New	302
Hours since Overhaul	TBO not reached

1.6.1 A new engine and propeller were fitted on 02 May 2007, but no reason is known since the current flight folio starts on 22 November 2009.

1.7 Meteorological Information

Wind direction	315°- 324°	Wind speed	05	Visibility	10 km
Temperature	27,6 °C	Cloud cover	FEW	Cloud base	4000 ft
Dew point	5,5 °C				

1.7.1 The weather information above was obtained from South African Weather Services (SAWS). The METAR message was recorded at Mokopane (closest reporting station at 1500 UTC

1.8 Aids to Navigation

1.8.1 The aircraft was equipped with the standard navigation equipment, which was serviceable at the time of the accident.

1.9 Communications

1.9.1 The microlight was equipped with standard communication systems and none were reported unserviceable prior to the accident.

1.10 Aerodrome Information

1.10.1 The accident did not happen at an aerodrome, but 7.8 nm north-west of Mokopane town with the following GPS coordinates: S 24° 08’ 31.3” E028° 52’ 42.9”, elevation 5655 ft.

1.11 Flight Recorders

1.11.1 The microlight was not equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR), nor was it required by regulation to be fitted to this microlight type.

1.12 Wreckage and Impact Information

1.12.1 Both ZU-ICI and ZU-CIU flew in a northerly direction and in loose formation towards Mokopane Mountains. They climbed along a mountain ridge with ZU-CIU ahead and lower than ZU-ICI, at about 500 ft. ZU-ICI had turned left to the west earlier; ZU-CIU continued along the ridge and turned left, heading to the west through a valley. The ZU-ICI pilot then observed ZU-CIU aircraft losing height and impacting the mountain in a nose-down attitude. There was no communication from ZU-CIU to indicate whether they had a problem pulling out of danger until the aircraft impacted the mountains. The main wreckage remained intact and there was no post-impact fire.

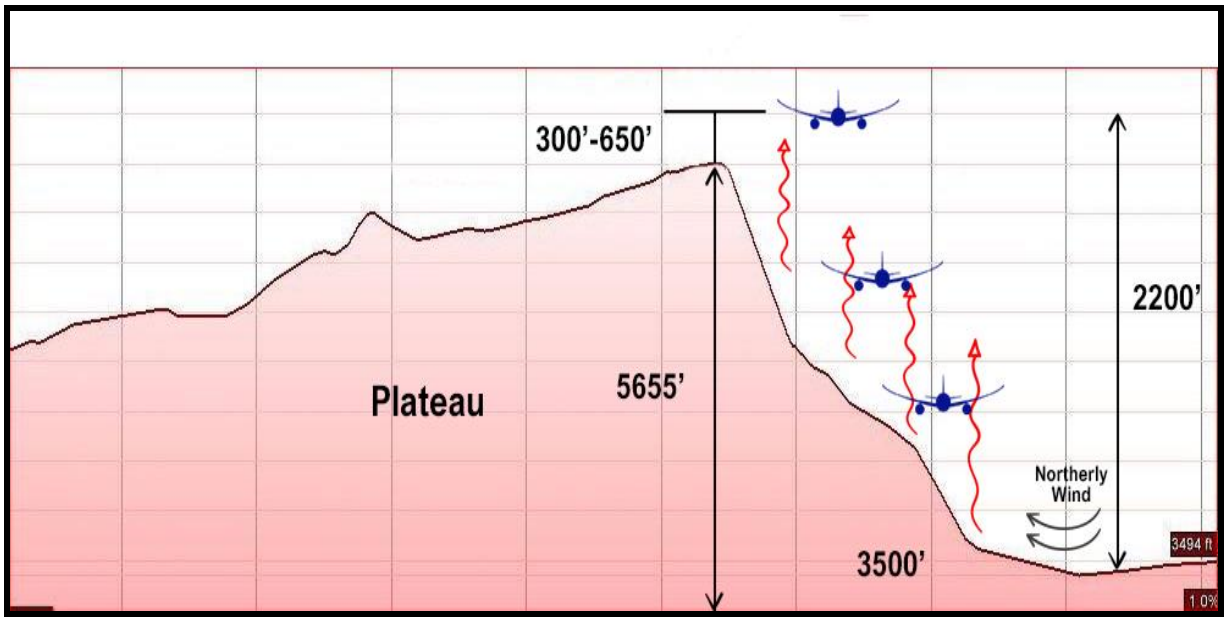

Figure 2: Altitude levels, thermals and wind direction on the mountain before the accident occurred. The three aircraft illustrate an aircraft climbing along the mountain ridge.

1.12.2 The main wreckage was found at GPS co-ordinates GPS S24° 08’ 31.3” E028° 52’ 42.9” at an elevation of 5655 ft. The main wreckage was intact and lying on its back facing west.

1.12.3 The left wing sustained damage due to impact with the mountain and right wing sustained minor damage. The left wheel was still intact with no damage, the right wheel and nose wheel sustained damage due to impact with the mountain. The engine was still intact and the propeller blades had sustained damage at the tips.

Figure 3: Damage sustained by the aircraft.

Figure 4: Damage to the left-hand side of the wing

1.13 Medical and Pathological Information

1.13.1 The post-mortem and blood toxicology reports were still outstanding at the time of compiling this report. Should any of the results have a bearing on the circumstances leading to the accident, they will be treated as new evidence that will necessitate the reopening of the investigation. The passenger who suffered severe injuries was admitted to Linmed Hospital and was released a few days later.

1.14 Fire

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

1.15 Survival Aspects

1.15.1 The chances of surviving this accident were small due to the force of the impact with the rocks on the mountain. The passenger survived because he was seated behind the pilot. The accident location was inaccessible, at the top of a steep mountain. The South African National Defence Force (SANDF) helicopter was requested and assisted with the rescue of the passenger.

1.16 Tests and Research

1.16.1 The aircraft engine was recovered and fitted to a test bench to determine whether it was operational or not. The outcome of the engine test indicated that the engine was still operational, with no fault.

1.17 Organisational and Management Information

1.17.1 The maintenance records indicated that the aircraft was equipped and maintained in accordance with existing regulations and approved procedures.

1.17.2 The last annual inspection was carried out on 03 November 2017 by approved person 156 at 807 airframe hours. The aircraft had flown a further 5 hours after the last annual inspection was carried out.

1.18 Additional Information

1.18.1 The investigating team forwarded the final draft report to Solo Wings, manufacturer of the Windlass Aquilla for comments and to ascertain if the aircraft can be operated at reduced power while climbing assisted by thermals. His response was that it was general practice to reduce power and use thermals to climb. He said the benefit was good forward visibility since the nose is lower. The statement is attached as annexure A below.

1.18.2 Mountain Waves Turbulence Information:

https://www.atsb.gov.au/publications/2005/mountain_wave_turbulence/

Mountain wave and associated turbulence

In Australia, mountain waves are commonly experienced over and to the lee of mountain ranges in the south-east of the continent. They often appear in the strong westerly wind flows on the east coast in late winter and early spring.

Mountain waves are a different phenomenon to the mechanical turbulence found in the lee of mountain ranges, and can exist as a smooth undulating airflow or may contain clear air turbulence in the form of breaking waves and 'rotors'. Mountain waves are defined as 'severe' when the associated downdrafts exceed 600 ft/min and/or severe turbulence is observed or forecast.

'Breaking waves' and 'rotors' associated with mountain waves are among the more hazardous phenomenon that pilots can experience. Understanding the dynamics of the wind is important in improving aviation safety.

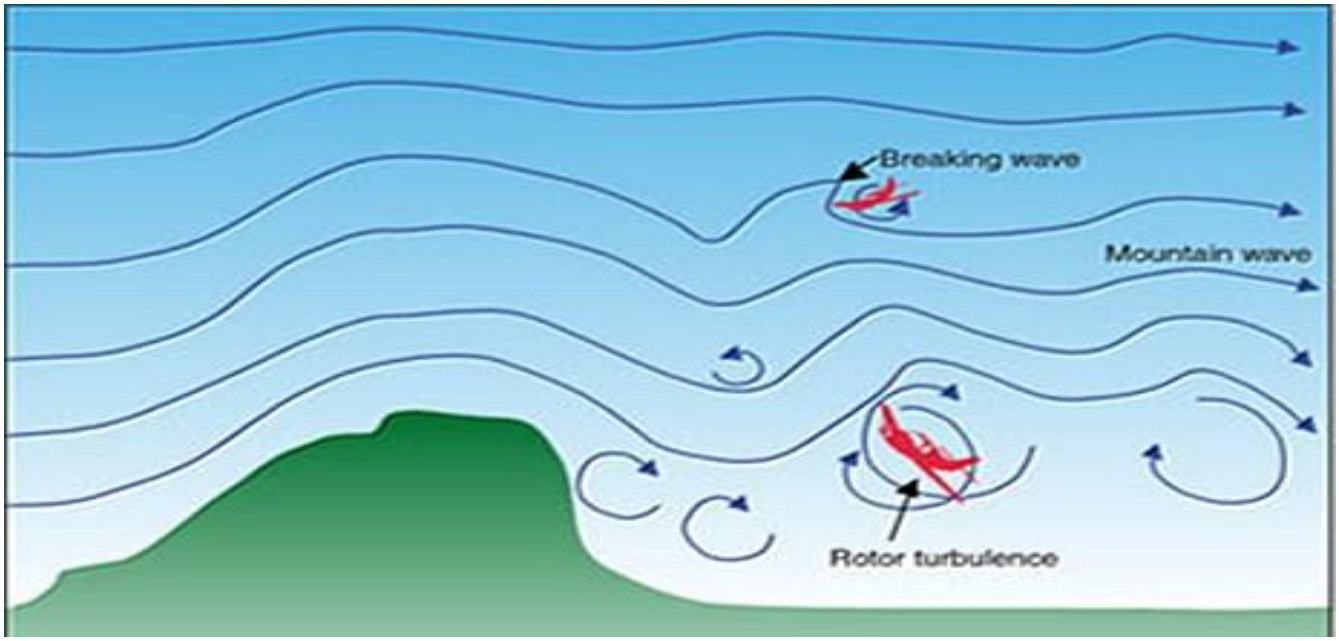

Figure 5: Aircraft encountering rotor turbulence

Glider pilots learn to use these mountain waves to their advantage; typically to gain altitude. However, some aircraft have come to grief in those conditions. Encounters have been described as similar to hitting a wall. In 1966, clear air turbulence associated with a mountain wave ripped apart a BOAC Boeing 707 while it flew near Mt. Fuji in Japan. In 1968, a Fairchild F-27B lost parts of its wings and empennage, and in 1992 a Douglas DC-8 lost an engine and wingtip in mountain wave encounters.

Mountain waves are the result of flowing air being forced to rise up the windward side of a mountain barrier, then as a result of certain atmospheric conditions, sinking down the leeward side. This perturbation develops into a series of standing waves downstream from the barrier, and may extend for hundreds of kilometres over clear areas of land and open water.

Mountain waves are likely to form when the following atmospheric conditions are present:

- *the wind flow at around ridge height is nearly perpendicular to the ridge line and at least 25 kts*
- *the wind speed increases with height*
- *there is a stable layer at around ridge height.*

If the wave amplitude is large enough, then the waves become unstable and break, similar to the breaking waves seen in the surf. Within these 'breaking waves', the atmospheric flow becomes turbulent.

The crests of the waves may be identified by the formation of lenticular clouds (lens-shaped), if the air is sufficiently moist. Mountain waves may extend into the stratosphere and become more pronounced as height increases. Some pilots have reported mountain waves at 60,000 feet. The vertical airflow component of a standing wave may exceed 8,000 ft/min.

Rotors or eddies can also be found embedded in mountain waves. Formation of rotors can also occur as a result of down slope winds. Their formation usually occurs where wind speeds change in a wave or where friction slows the wind near to the ground. Often these rotors will be experienced as gusts or wind shear. Clouds may also form on the up-flow

side of a rotor and dissipate on the down-flow side if the air is sufficiently moist.

Many dangers lie in the effects of mountain waves and associated turbulence on aircraft performance and control. In addition to generating turbulence that has demonstrated sufficient ferocity to significantly damage aircraft or lead to loss of aircraft control, the more prevailing danger to aircraft in the lower levels in Australia seems to be the effect on the climb rate of an aircraft. General aviation aircraft rarely have performance capability sufficient to enable the pilot to overcome the effects of a severe downdraft generated by a mountain wave or the turbulence or wind shear generated by a rotor. In 1996, three people were fatally injured when a Cessna 206 encountered lee (mountain) waves. The investigation report concluded, "It is probable that the maximum climb performance of the aircraft was not capable of overcoming the strong downdrafts in the area at the time".

Crossing a mountain barrier into wind also reduces the groundspeed of an aircraft and has the effect of keeping the aircraft in the area of downdraft for longer, while an aircraft flying downwind on the upwind side of a mountain range is likely to initially encounter updrafts as it approaches rising ground. Rotors and turbulence may also affect low level flying operations near hills or trees. In 1999, a Kawasaki KH-4 hit the surface of a lake during spraying operations at 30 feet. The lack of sufficient height to overcome the effects of wind eddies and turbulence was a factor in the accident.

Research into 'braking waves' and 'rotors' or eddies continues but there is no doubt that pilots need to be aware of the phenomenon and take appropriate precautions. Although mountain wave activity is usually forecast reasonably well by the Bureau of Meteorology, many local factors may affect the formation of 'breaking waves' and 'rotors'. When planning a flight a pilot should take note of the winds and the terrain to assess the likelihood of waves and rotors. There may be telltale signs in flight, including the disturbances on water or wheat fields and the formation of clouds, provided there is sufficient moisture for cloud to form.

Prudent flight planning may include allowing for the possibility of significant variations in the aircrafts altitude if updrafts and downdraughts are encountered. A margin of at least the height of the hill or mountain from the surface should be allowed, and consideration given to the need to adopt a maneuvering airspeed appropriate to the circumstances. Ultimately, it may be preferable for pilots to consider diverting or not flying, rather than risk flying near or over mountainous terrain in strong wind conditions conducive to mountain waves containing 'breaking waves' and 'rotors'.

1.19 Useful or Effective Investigation Techniques

1.19.1 None

2. ANALYSIS

2.1 The pilot held a valid national pilot licence (NPL) with the aircraft type rating endorsed on it, and his medical aviation certificate was valid with a restriction to wear corrective lenses. He had accumulated a total of 108,2 flying hours and it was his first experience of flying in the mountains.

2.2 The aircraft was in possession of a valid Certificate of Registration (C of R) and

Authority to Fly (ATF) at the time of the accident. The aircraft documents and maintenance records were found to be valid and current. No defects or malfunctions were recorded in the flight folio, and last maintenance was carried out at total of 807 airframe hours on 03 November 2017. The aircraft engine was subjected to a bench test and was found operational.

2.3 The weather conditions at the time of the accident were generally fine. The temperature was 27,6 °C and the wind speed was about 5 knots at 320°. A few minutes before the accident the two aircraft were cruising at 2200 feet above Mokopane town with reduced power. The winds at that level were not the same as those on the ground. It is also an open space, which gives the wind an opportunity to increase speed and sometimes change direction.

2.4 ZU-CIU made a left turn towards the lee side of the mountain and encountered downward forces from rotors created by the northerly wind. ZU-CIU was probably caught by surprise, since the same conditions that were favourable to them earlier were now the complete opposite. The wind was now pushing down against the aircraft, and if the pilot had tried to lift the nose to get out of that situation, the aircraft would have stalled because of the low airspeed. The only possible solution was to keep the nose pointed down and increase speed, but that option was not available to them since they were too close to the mountain side.

2.5 The investigation revealed that the aircraft could not overcome the rotor turbulence, since the engine was at reduced power and it would have taken some time before the power available was greater than the downward rotors encountered.

3. CONCLUSION

3.1 Findings

3.1.1 The pilot held a valid national pilot licence (NPL) with the correct aircraft type rating endorsed. His licence was valid until 10 May 2018.

3.1.2 The pilot held a valid class 4 aviation medical certificate with restrictions. He had to wear corrective lenses all the time. The medical certificate expires on 30 June 2021.

3.1.3 The aircraft had both a valid certificate of registration (C of R) and authority to fly (ATF).

3.1.4 The maintenance records were reviewed and found to be current. The certificate of release to services lapses at 907 hours or on 03 November 2018.

3.1.5 No defects or malfunctions were recorded in the flight folio. The last entry was on 09 September 2017.

3.1.6 The aircraft was properly maintained in accordance with existing regulations and the aircraft maintenance manual.

3.1.7 The engine was subjected to a test and was found operational. The engine started and ran properly through different power settings.

3.1.8 The aircraft encountered rotors on the lee side of the mountain side and was unable to overcome the rotor forces which pushed it against the mountain edge.

3.1.9 The passenger, who was seated behind the pilot in a tandem set-up, survived the accident and was rescued by SANDF a few hours after the accident.

3.1.10 The airport manager stated that they had advised the invited group not to fly close to the mountains, as they are unpredictable.

3.1.11 The aircraft manufacturer indicated that they advised pilots to avoid flying near the mountains.

3.2 Probable Cause/s

3.2.1 The aircraft encountered rotor turbulence which led to loss of height and the aircraft impacted the side of the mountain in a nose down attitude. Poor technique and lack of experience.

3.3 Contributory factors

3.3.1 The aircraft was flying with engine power selected to idle.
3.3.2 Lack of experience flying in mountainous areas and using thermals

Contributory factors

4. SAFETY RECOMMENDATIONS

4.1 None

5. APPENDICES

5.1 Annexure A – Comments from Solo Wings CC

Annexure A

MICRO CRAFTS AFRICA CC
Unit 1 Acacia Park, 1 Falcon Road, Imbonini
Shakashead, 4381
Contact No: [redacted]

Vat: 4210258770
CK NO: 1990/011262/23
Email: [redacted] info@solowings.co.za

Hi Robert

Thank you for your email.

Under normal powered flight, the additional ridge lift and thermals would certainly enable a pilot to reduce power to climb, and also to avoid a dangerous high nose up attitude.

However, flying close to mountains can be very dangerous if you are not an experienced pilot. An acute awareness of winds, and up and down drafts is crucial to safe flying.

I hope the above information helps.