SOUTH AFRICAN CIVIL AVIATION AUTHORITY

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

AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/9735		
Aircraft Registration	ZU-CBR	**Date of Accident**	6 October 2018		**Time of Accident**	0645Z	
Type of Aircraft	Windlass Aquilla		**Type of Operation**		Private (Part 94)		
Pilot-in-command Licence Type	NPL (National Pilot Licence)		**Age**	32	**Licence Valid**	Yes	
Pilot-in-command Flying Experience	Total Flying Hours		60		Hours on Type	60	
Last Point of Departure	Mlala Game Farm Private Airstrip in Limpopo Province						
Next Point of Intended Landing	Mlala Game Farm Private Airstrip in Limpopo Province						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
Mlala Game Farm is 5.4nm north-east of Marble Hall at GPS co-ordinates S24˚54'56,8" E029˚21'34,2", at an field elevation of 2 815ft							
Meteorological Information	Wind: 135˚ at 05kt; Visibility: 9999m; Temperature: 17˚C						
Number of People On-board	1+1	**No. of People Injured**	0	**No. of People Killed**	2		
Synopsis							

On 6 October 2018, a microlight aircraft with a pilot and a passenger on-board departed Mlala Game Farm private airstrip near Marble Hall in Limpopo Province on a scenic flight over Marble Hall area.

The flight was uneventful and lasted approximately 30 minutes. The microlight returned to the Mlala Game Farm, approaching from the east of the private airstrip.

According to an eye witness, a strange noise attracted his attention to the microlight which was flying at a height of about 500 feet (ft) above ground level (AGL). He stated that the microlight's wing separated from the body. The microlight's body then rotated forward three times along its longitudinal axis before the wing settling on a tree and the body impacted the ground.

Both occupants were thrown off the microlight and were both fatally injured during the accident. The microlight was destroyed by impact forces.

The investigation revealed that the pilot conducted the first stall exercise/manoeuvre with no incident and, on the second manoeuvre, the microlight exceeded its angle of attack (AOA) and entered a whip stall, which the pilot could not recover from.

SRP Date	10 March 2020	Publication Date	04 May 2020

TABLE OF CONTENTS	PAGE NO

ABBREVIATION	DESCRIPTION
°	Degree
AMSL	Above mean sea level
AOA	Angle of Attack
AP	Approved Person
ATF	Authority to Fly
CAVOK	Ceiling and Visibility OK
CG	Centre of Gravity
cm	Centimetre
CVR	Cockpit Voice Recorder
FDR	Flight Data Recorder
ft	Feet
kg	kilograms
km	kilometre
kts	knots
m	Metres
NPL	National Pilot Licence
WCM	Weight Shift Controlled Microlight
WSC	Weight Shift Control

Reference Number	**:** CA18/2/3/9735
Name of Owner/Operator	**:** Erasmus L
Manufacturer	**:** Solo Wings CC
Model	**:** Windlass Aquilla
Nationality	**:** South African
Registration Marks	**:** ZU-CBR
Place	**:** Mlala Game Farm, Limpopo Province S24°54'56.8" E29°21'34.2", elevation: 2 815ft
Date	**:** 6 October 2018
Time	**:** 0645Z

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 (CAR) 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 liability****.*

Investigations Process:

The accident was notified to the Accident and Incident Investigations Division (AIID) on 6 October 2018 at about 0715Z. The investigator/s went to Mlala Game Farm on 6 October 2018. The investigator/s co-ordinated with all authorities on site by initiating the accident investigation process according to CAR Part 12 and investigation procedures. The AIID of the South African Civil Aviation Authority (SACAA) is leading the investigation.

Notes:
1. Whenever the following words are mentioned in this report, they shall mean the following:

- *Accident – this investigated accident*
- *Aircraft – the Windlass Aquilla involved in this accident*
- *Investigation – the investigation into the circumstances of this accident*
- *Pilot – the pilot involved in this accident*
- *Report – this accident report*

2. Photos and figures used in this report are taken from different sources and may be adjusted from the original for the sole purpose of improving clarity of the report. Modifications to images used in this report are limited to cropping, magnification, file compression; or enhancement of colour, brightness, contrast; or addition of text boxes, arrows or lines.

Disclaimer:

1. FACTUAL INFORMATION

1.1. History of Flight

1.6.1 On 6 October 2018, the pilot accompanied by a passenger, took off from Mlala Game Farm private airstrip near Marble Hall in Limpopo Province on a scenic flight over Marble Hall area. The pilot was the owner of the microlight involved in the accident. The pilot's logbook indicated that the pilot's last flight before the accident flight was on 30 September 2018.

1.6.2 The accident flight on 6 October 2018 was uneventful and lasted approximately 30 minutes. The microlight was on its return leg for a landing at Mlala Game Farm. As the microlight approached the airstrip at approximately 0.5 nautical miles (nm) north of the airstrip, an eyewitness positioned 956 metres (m) to the north of the airstrip, stated that he saw the aircraft at an approximate height of 500 feet (ft) passing him to the east of his position, flying from the south heading north. The eyewitness was entering the farm from the west side and heard a strange noise coming from the approaching aircraft.

1.6.3 According to the eyewitness, a strange noise attracted his attention to the microlight. He then saw the microlight's wing separate from its body. The microlight's body rotated three times before impacting the ground while the wing settled on a tree 75 metres (m) from the fuselage. The pilot and the passenger were thrown off the microlight during the accident sequence and were fatally injured. The safety harnesses that they had worn failed during the accident sequence. Medical personnel removed the pilot and the passenger from the accident site.

1.6.4 The pilot had worn a Garmin watch which was downloaded after the accident (see Figure 1 and Test and Research 1.16).

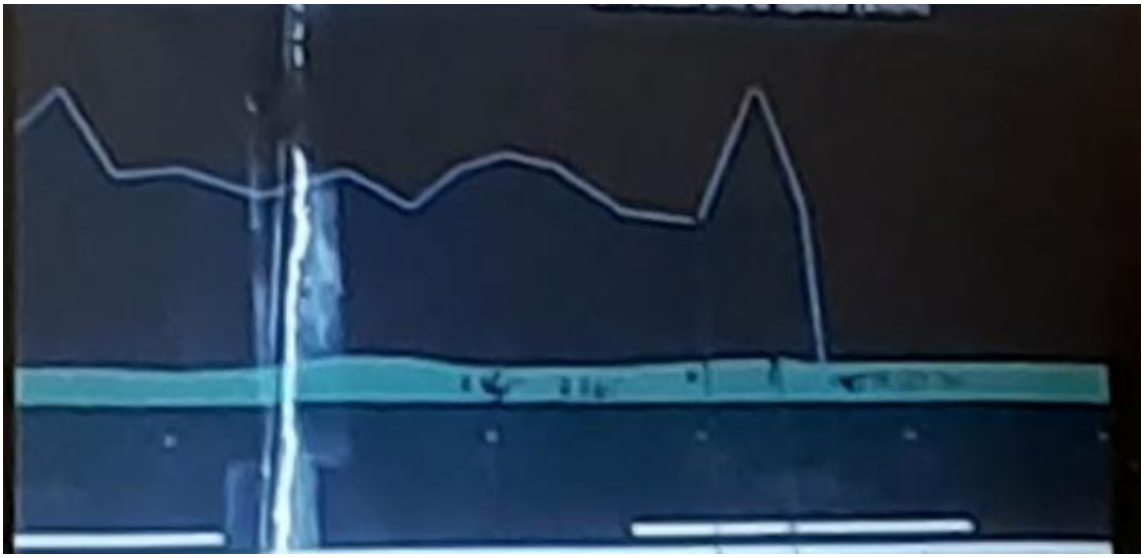

Figure 1: The downloaded graph from the Garmin watch which the pilot was wearing.

1.6.5 The accident occurred during daylight. Fine weather conditions prevailed at the time of the accident. The fuselage's Global Positioning System (GPS) was determined to be at S24°54'56.8" E29°21'34.2" 5, 1nm north-east of Marble Hall in Limpopo Province. The wing position was determined to be at GPS S24°54'54.9" E29°21'35.57" at an elevation of 2 815ft above mean sea level (AMSL).

Figure 2: The location of the aircraft wing, fuselage, eye witness and private airstrip. Source: Google Earth

1.2. Injuries to Persons

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

1.3. Damage to Aircraft

1.3.1 The microlight was destroyed.

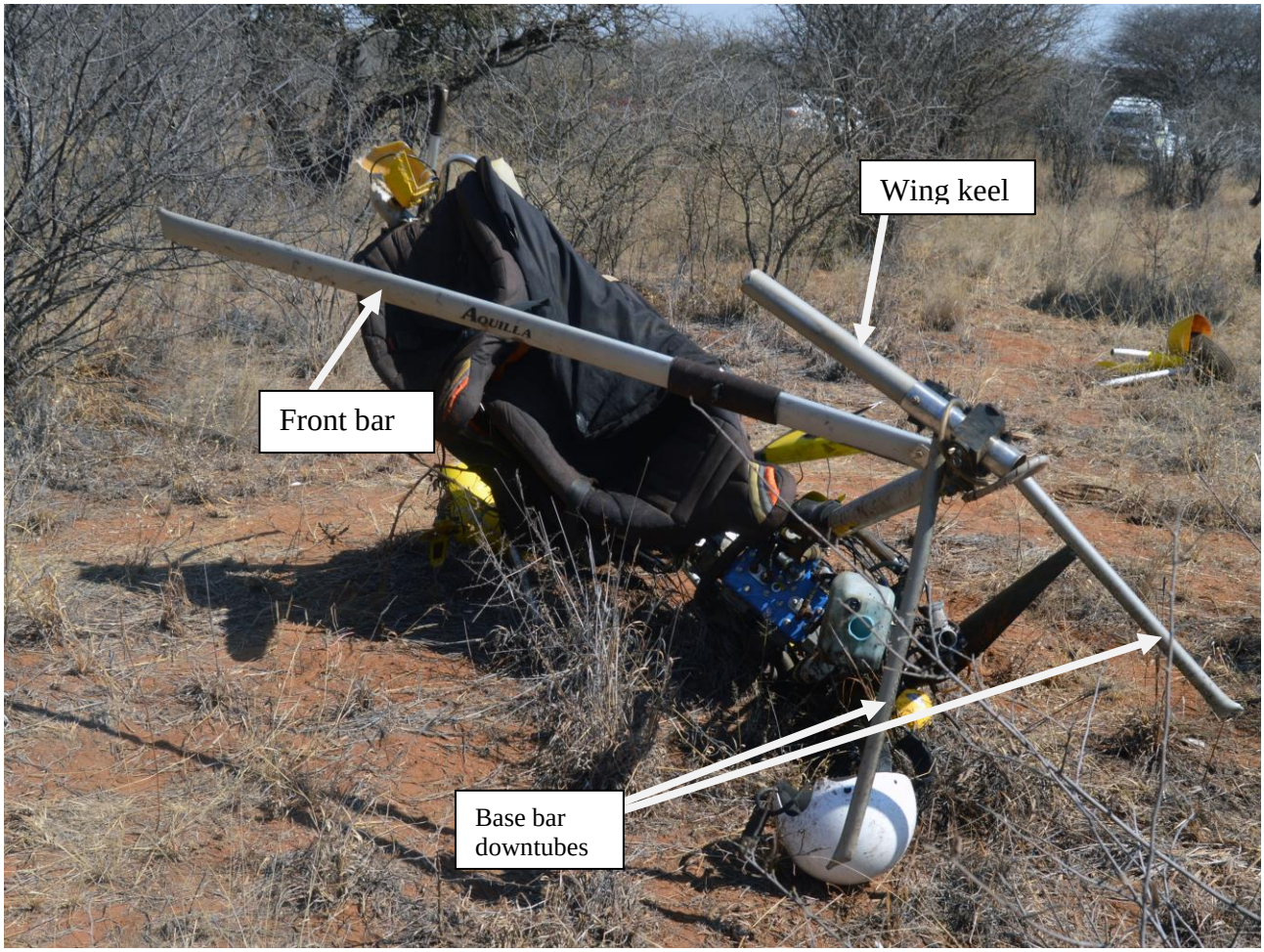

Figure 3: The damaged body of the microlight after the accident.

Figure 4: The wing came to rest on a tree after separating from the body of the microlight.

1.4. Other Damage

1.4.1 None.

1.5. Personnel Information

Nationality	South African	Gender	Male	Age	32
Licence Number	**********	Licence Type	National Pilot Licence (NPL)		
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	WCM (Z127 & Z159)				
Medical Expiry Date	31/05/2022				
Restrictions	None				
Previous Accidents	None				

Flying Experience:

Total Hours	60,0 hours
Total Past 90 Days	40.8 hours
Total on Type Past 90 Days	40.8 hours
Total on Type	60,0 hours

1.5.1 The pilot received his training between June and July 2018 at Limpopo Flight School. Records showed that he had completed his training.

1.6. Aircraft Information

Airframe:

Type	Windlass Aquilla	
Serial Number	WA 828	
Manufacturer	Solo Wings	
Date of Manufacture	2000	
Total Airframe Hours (At time of Accident)	498.31 hours	
Last MPI (Date & Hours)	23 June 2018	440.18 hours
Hours Since Last Annual Inspection	58.13 hours	
Authority to Fly (Issue Date)	28 May 2018	
C of R (Issue Date) (Present owner)	24 May 2018	
Operating Categories	Part 94	

Engine:

Type	Rotax 582
Serial Number	5306813
Hours Since New	440.18
Hours Since Overhaul	TBO not reached

Propeller:

Type	Warp
Serial Number	N/A
Hours Since New	440.18
Hours Since Overhaul	TBO not reached

1.6.1 **Mass & Balance:**

AIRCRAFT EMPTY WEIGHT:	177.0	kg	
PILOT:	118.7	kg	212.4kg (Combined Payload)
PAX:	93.7	kg	
FUEL (50l tank):	40.0	kg	
	428.5	kg	
MAX ALL UP WEIGHT:	450	kg (Manufacture)	

1.6.1.1 The calculation above indicates that the microlight was operated within its mass and balance limits.

1.7 Meteorological Information

1.7.1 Meteorological information on the day of the accident (06 October 2018 at 0600Z) was obtained from the South African Weather Service. The table indicates the most likely weather conditions at the time of the accident.

Wind direction	145˚	Wind speed	5kts	Visibility	9999m
Temperature	17˚C	Cloud cover	None	Cloud base	None
Dew point	Not known	QNH	Not known		

1.8 Aids to Navigation

1.8.1 The aircraft was equipped with standard navigational equipment as approved by the Regulator (SACAA). There were no recorded defects to navigational equipment prior to the flight.

1.9 Communication

1.9.1 The aircraft was equipped with standard communication equipment as approved by the Regulator. There were no recorded defects to communication equipment prior to the flight.

1.10 Aerodrome Information

1.10.1 The accident did not happen at an airport, but it occurred at a geographical position determined to be at S24°54'56.8" E29°21'34.2" for the airframe; and wing position at S24°54'54.9" E29°21'35.57" at an elevation 2 815ft above mean sea level (AMSL).

1.10.2 Nearest Airstrip (Mlala Game Farm)

Aerodrome Location	Mlala Game Farm private airstrip
Aerodrome Co-ordinates	S 24^0 55' 36.05" E029^0 21' 32.69"
Aerodrome Elevation	2818ft
Runway Designations	15/33
Runway Dimensions	406m x 15m
Runway Used	Not applicable
Runway Surface	Gravel
Approach Facilities	None
Aerodrome Status	Unregistered

1.11 Flight Recorders

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

1.12 Wreckage and Impact Information

1.12.1 The microlight similar to the accident microlight. source: https://solowings.co.za/#trikes

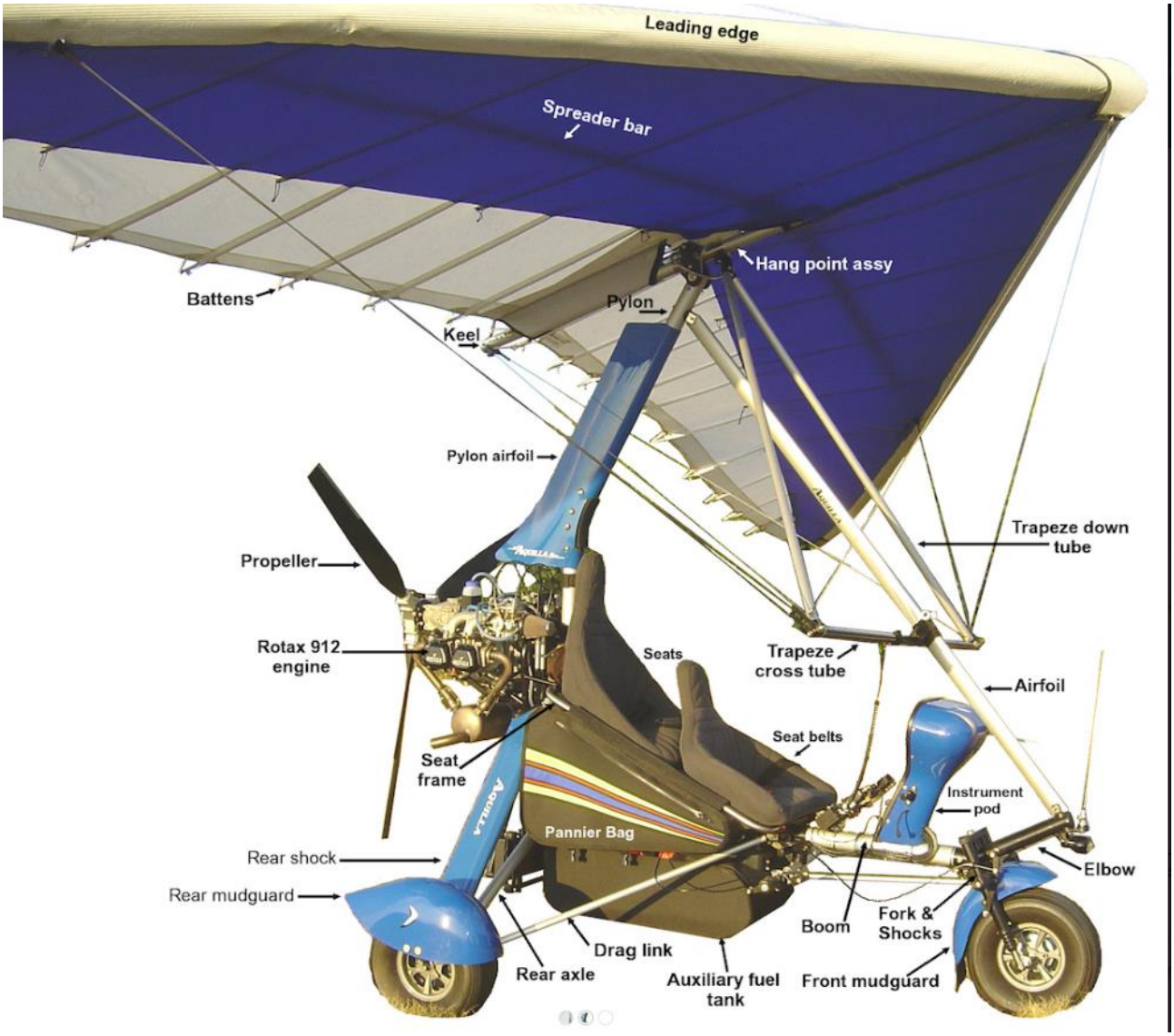

Figure 5: Windlass Aquila similar to the accident aircraft.

1.12.2 An eyewitness stated that he saw the microlight approaching from the south going north after he heard a strange noise which alerted him to it. He then saw the wing separating from the body and the body rotating forward three times on its longitudinal axis before impacting the ground. The wing came to rest 75m from the airframe impact.

Figure 6: Wing frame components.

1.12.3 The fuselage, the engine and the propeller were significantly damaged during the impact sequence.

Figure 7: The airframe and its components at the accident site.

1.12.4 The passenger was positioned 6m from the airframe and the pilot's position was 5m from the body. They were both ejected from the body of the microlight during the accident sequence.

1.13 Medical and Pathological Information

1.13.1 The pilot and the passenger were fatally injured. The Medico-Legal post-mortem report concluded that the cause of death was due to multiple blunt injuries.

1.14 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 not survivable as the microlight's wing separated from its body; the pilot had no means to slow down the aircraft. This resulted in a high velocity impact with the ground. Both occupants were thrown off the microlight and were fatally injured.

1.16 Tests and Research

1.16.1 The microlight had performed aerial manoeuvres which resulted in it entering a whip stall. It started tumbling and the airframe became a heavy pendulum under the wing and its propeller impacted the keel and sustained damages. The airframe swung forward and its base bar impacted the front bar and broke up into two pieces. The pendulum effect and the king post's resistance resulted in the keel breaking up into four pieces. The fuselage, which had now separated from the wing, continued to fall until it impacted the ground.

1.16.2 The following information was extracted from the FAA-H-8083-5 Weight-shift Control (WSC) aircraft flying handbook:

"A WSC aircraft can get to a high pitch attitude by flying outside its limitations or flying in extreme/severe turbulence. If the wing gets to such a high pitch attitude and the angle of attack (AOA) is high enough that the tips stall, a whip stall occurs. In a WSC wing, most of the area of the wing is behind the centre of gravity (CG) (about three-quarters). With the tips and aft part of the wing having the greatest drag, and the weight being forward, an immediate and strong nose-down moment is created and the WSC nose starts to drop. Since both the relative wind and the 2-20 wing is rapidly changing direction, there is no opportunity to re-establish laminar airflow across the wing. This rotational momentum can pull the nose down into several increasingly worse situations, depending on the severity of the whip stall. Figure 10 shows a whip stall and the phases that can result, depending on the severity.

> *<u>Phase 1</u> - Minor whip stall results in a nose-down pitch attitude at which the nose is at a positive AOA and the positive stability raises the nose to normal flight.*
> *<u>Phase 2</u> - If the rotational movement is enough to produce a vertical dive, the aerodynamic dive recovery might raise the nose to an attitude to recover from the dive and resume normal flight condition.*

<u>Phase 3</u> - The rotational momentum is enough to bring the nose significantly past vertical (the nose has tucked under vertical) but could still recover to a vertical dive and eventually resume a normal flight condition.
<u>Phase 4</u> - The rotational momentum is severe enough to continue rotation, bringing the WSC wing into a tumble from which there is no recovery to normal flight, and structural damage is probable.

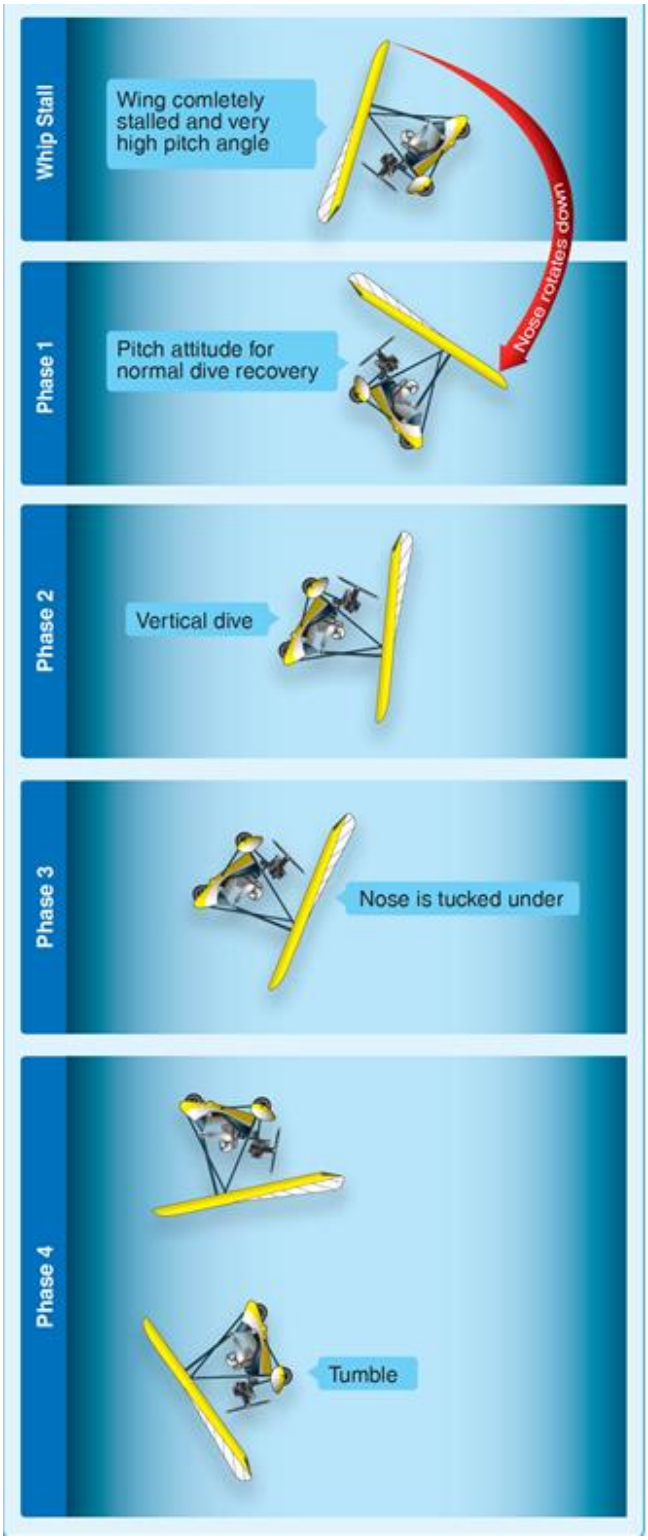

Figure 9: Demonstration of a whip stall.

1.16.3 The graphical representation of the download from the Garmin watch worn by the pilot and the analysis of the graph by the manufacturer (Solowings):

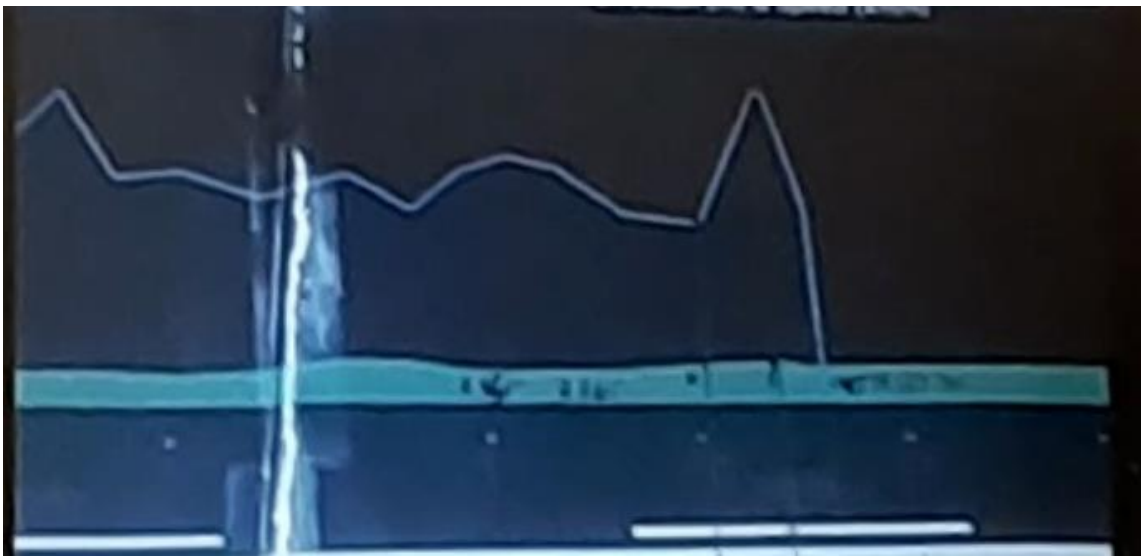

Figure 10: The graphical representation of the downloaded data from the pilot's Garmin watch.

1.16.3.1 The graph reveals a classic build up to a whip stall. On the far left, the pilot performs a moderate stall. By the sudden drop there was no recovery with power. This is followed by a loss of height and a gain in speed, which then results in a levelling off with a bit of a rollercoaster effect. This is a perfectly normal and safe exercise. In the middle of the graph, the pilot then applies power which shows a climb and he then increases the speed by pulling hard back on the bar, initially losing some height. The graph then shows a rapid steep increase in height showing that the pilot pushed the base bar forward. The result is an unsafe and very steep climb where the angle of attack is exceeded too far, resulting in a fatal whip stall. The graph shows an almost vertical trajectory to the ground.

1.16.3.2 The battens that are bent the opposite way whilst the undercarriage is still attached confirm a whip stall. A wing detached to the undercarriage does not have enough force to do that. Any broken cable would have been the result of the forces involved when the microlight tumbled.

1.17 Organisational and Management Information

1.17.1 The microlight was operated privately by the owner/pilot in accordance with the requirements of CAR 2011, Part 94 as amended.

1.18 Additional Information

1.18.1 None.

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2 ANALYSIS

2.1. Man (Pilot)

2.1.1 The pilot was the holder of a National Pilot Licence (NPL) with the appropriate rating endorsed. The pilot flew his solo flight on 4 July 2018 and, according to records, he had received adequate training. He had flown a total of 60 hours on type.

2.1.2 It seemed that during the flight, the pilot was doing stall exercises as indicated by the analysis of his Garmin watch. The first stall exercise was completed without any incident and, on the second stall exercise, the pilot exceeded his angle of attack (AOA) which resulted in the aircraft entering a whip stall. The way in which the microlight stalled resulted in it becoming inverted, damaging itself before the wing separated. The pilot was unable to recover the microlight from the stall.

2.1.3 The wing separated and landed on a tree and the airframe lost height before impacting the ground. The microlight was destroyed; the pilot and the passenger were thrown off the microlight after their harnesses failed. They were both fatally injured.

2.2. Machine

2.2.1 Records indicate that the microlight was maintained in accordance with CAR 2011 as amended and was issued with an Authority to Fly (ATF).

2.2.2 The microlight was within its mass and balance limitations.

2.3 Environment

2.3.1 The weather was no factor and did not contribute to this accident.

3. CONCLUSION

3.1 General

From the available evidence, the following findings, causes and contributing factors were made with respect to this incident. These shall not be read as apportioning blame or liability to any organisation or individual.

To serve the objective of this investigation, the following sections are included in the conclusions heading:

- **Findings –** are statements of all significant conditions, events or circumstances in this incident. The findings are significant steps in this incident sequence, but they are not always causal or indicate deficiencies.

- **Causes –** are actions, omissions, events, conditions or a combination thereof, which led to this incident.
- **Contributing factors –** are actions, omissions, events, conditions or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the accident or incident occurring, or mitigated the severity of the consequences of the incident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil or criminal liability.

3.2 Findings

3.1.1 The pilot had been issued with a National Pilot Licence (NPL) on 31 July 2018 with an expiry date of 17 July 2019. The aircraft type was endorsed on his licence. He had also been issued with a class 4 medical certificate on 18 May 2018 with an expiry date of 31 May 2023.

3.1.2 The pilot had conducted the first stall exercise/manoeuvre with no incident and, on the second manoeuvre, he exceeded the microlight's AOA and it entered a whip stall, which the pilot could not recover from.

3.1.3 The aircraft had been issued with an Authority to Fly (ATF) on 28 May 2018 with an expiry date of 22 May 2019.

3.1.4 The microlight's last annual inspection was carried out on 23 May 2018 at 440.3 hours and the 50-hour oil change was carried out on 25 September 2018 at 483.4 hours.

3.1.5 Both the pilot and the passenger were wearing safety harnesses and helmets. The safety harnesses failed during the accident sequence and both occupants were thrown off the microlight and were fatally injured.

3.1.6 The Garmin watch that the pilot was wearing was downloaded and analysed, bringing clarity as to what had happened during the accident.

3.1.7 The wing separated from the microlight body, resulting in the pilot losing control of the microlight before it crashed.

3.1.8 The weather was not a factor and did not contribute to this accident.

3.1.9 The investigation revealed that the pilot conducted the first stall exercise/manoeuvre with no incident and, on the second manoeuvre, he exceeded the microlight's AOA and entered a whip stall, which the pilot could not recover from.

3.1. Probable Cause/s

3.2.1 During a stall exercise/manoeuvre, the pilot exceeded the microlight's AOA and it entered a whip stall, which the pilot could not recover from.

4. SAFETY RECOMMENDATIONS

4.1 General

The safety recommendations listed in this report are proposed according to paragraph 6.8 of Annex 13 to the Convention on International Civil Aviation and are based on the conclusions listed in heading 3 of this report; the AIID expects that all safety issues identified by the investigation are addressed by the receiving States and organisations.

4.2 Safety Recommendation/s

4.2.1 None.

5. List of Appendices

5.1 Annexure A: Solowings manufacturer comments.

Annexure A: Solowings manufacturer comments.

MICRO CRAFTS AFRICA CC
Unit 1 Acacia Park, 1 Falcon Road, Imbonini
Shakashead, 4381
Contact No: Craig Couzens 0836538094
Manisha 032 9471998
Vat: 4210258770
CK NO: 1990/011262/23
Email: craig@solowings.co.za info@solowings.co.za

Good day Robert

With 0ver 5500 flying hours in Aquilla and Windlass trikes (Solo Wings products) I have uncounted almost every kind of weather phenomena. From the known weather conditions that morning, it is highly unlikely that turbulence was a factor.

The graph from the download of the garmin watch in fact reveals a classic build up to a whip stall. On the far left the pilot performed a moderate stall. By the sudden drop there was no recovery with power. This is followed by a loss of height and a gain in speed which then results in a levelling off with a bit of a rollercoaster effect. This was a perfectly normal and safe exercise. In the middle of the graph the pilot then applied power which shows the climb and he then increased the speed by pulling hard back on the bar initially losing some height. The graph then shows a rapid steep increase in height showing that the pilot pushed the base bar forward. This resulted in an unsafe very steep climb where the angle of attack was exceeded too far, resulting in a fatal whip stall. The graph shows an almost vertical trajectory to the ground.

Evidence of a whip stall is the battens that are bent the wrong way whilst the undercarriage is still attached. A wing detached from an undercarriage does not have enough force to do that. Any broken

cables would have been the result of the forces involved when tumbling.

The broken cable shown in the photograph has almost zero tension on it during flight, even in severe turbulence. With a 423 kg breaking strain (almost the all up weight of the aircraft), it is all but impossible that this broke in normal flight.

If you have any further queries please contact me.

Regards
Craig Couzens