AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:		CA18/2/3/10351	
Aircraft Registration	ZS-GMD	**Date of Accident**		15 July 2023		**Time of Accident**	1030Z
Type of Aircraft	UFM-13 Lambada			**Type of Operation**		Private (Part 94)	
Pilot-in-command Licence Type	National Pilot Licence (NPL)			**Age**	60	**Licence Valid**	No
Pilot-in-command Flying Experience		**Total Flying Hours**		2 708.3		**Hours on Type**	5.5
Last Point of Departure	Orient Airfield (FAOI) in Magaliesburg, Gauteng Province						
Next Point of Intended Landing	Orient Airfield (FAOI) in Magaliesburg, Gauteng Province						
Damage to Aircraft	Substantial						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
Approximately 100 metres (m) south-west of Runway 36 at GPS 26°02'42.70" South 027°35'47.66" East, at an elevation of 5 122 feet (ft)							
Meteorological Information	Surface Wind: 260V360 at 9 knots, Visibility: 9999m, Temperature: 13°C, Dew Point: 3°C: QNH 1029 hPa						
Number of People On-board	1+0	**Number of People Injured**	0	**Number of People Killed**	1	**Other (On Ground)**	0

Synopsis

On Saturday afternoon, 15 July 2023, a pilot on-board a UFM-13 Lambada Touring Motor Glider (TMG) with registration ZS-GMD took off on a private flight from Runway (RWY) 36 at Orient Airfield (FAOI) in Gauteng province with the intention to land back at the same airfield. The flight was conducted under visual meteorological conditions (VMC) by day and under the provisions of Part 94 of the Civil Aviation Regulations (CAR) 2011 as amended.

The eyewitnesses who were at the aerodrome near Row B hangars stated that the pilot taxied the TMG to the threshold of Runway 36, however, they were unable to see where it had stopped prior to the take-off roll. *At the time, the wind was blowing from the west at a speed of approximately 10 knots*. After a few minutes, the eyewitnesses observed the TMG accelerating on the runway and, after approximately 100 metres, it got airborne in a very steep nose-up attitude. Shortly thereafter, the nose dropped and then pitched up again before the left wing dropped. The TMG then turned approximately 90° to the left in a nose-down attitude and disappeared behind Row B hangars and out of the eyewitness's line of sight. A loud noise was heard thereafter. The eyewitnesses rushed to the area where the glider had disappeared. The pilot was found fatally injured, and the glider was substantially damaged.

It is likely that during take-off the TMG was pitched at a high nose-up attitude which resulted in the decrease of airspeed before it entered a stall from which the pilot could not recover.

Probable Cause

During a climb, the TMG's attitude reached a high critical angle-of-attack which resulted in a stall from which the pilot could not recover.

Contributory factors

Excessive control inputs.

SRP Date	11 June 2024	Publication Date	9 September 2024

Occurrence Details

Reference Number	**:** CA18/2/3/10351
Occurrence Category	**:** Category 1
Type of Operation	**:** Private (Part 94)
Name of Operator	**:** Magalies Gliding Club, Gauteng Province
Aircraft Registration	**:** ZS-GMD
Aircraft Make and Model	**:** UFM-13 Lambada Touring Motor Glider
Nationality	**:** South African
Registration Marks	**:** ZS-GMD
Place	**:** Orient Airfield (FAOI)
Date and Time	**:** 15 July 2023 at 1030Z
Injuries	**:** Fatal
Damage	**:** Substantial

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.

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.

Investigation Process

The Accident and Incident Investigations Division (AIID) of the South African Civil Aviation Authority (SACAA) was notified of the occurrence on 15 July 2023 at 1030Z. The occurrence was classified as an accident according to the CAR 2011 Part 12 and ICAO STD Annex 13 definitions. Notifications were sent to the State of Registry, Operator, Design and Manufacturer in accordance with CAR 2011 Part 12 and the International Civil Aviation Organisation (ICAO) Annex 13 Chapter 4. The State appointed an accredited representative. Investigators were dispatched to the accident site.

Notes:

1. *Whenever the following words are mentioned in this report, they shall mean the following:*
   Accident — this investigated accident
   Aircraft — the UFM-13 Lambada 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 were taken from various sources and may have been adjusted from the original for the sole purpose of improving clarity of the report. Modifications to images used in this report were limited to cropping, magnification, file compression; or enhancement of colour, brightness, contrast; or addition of text boxes, arrows, or lines.*

Disclaimer

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Abbreviation	Description
°	Degrees
°C	Degrees Celsius
ACCID	Accident
AGL	Above Ground Level
AIID	Accident and Incident Investigations Division
AP	Approved Person
ARCC	Aeronautical Rescue Coordination Centre
ATF	Authority to Fly
C of R	Certificate of Registration
CAA	Civil Aviation Authority
CAVOK	Cloud and Visibility OK
CRS	Certificate of Release to Service
EMS	Emergency Medical Services
FAOI	Orient Aerodrome
FDR	Flight Data Recorder
FLARM	Flight Alarm
ft	Feet
GLD	Glider
GPL	Glider Pilot Licence
GPS	Global Positioning System
hPa	Hectopascal
kt	Knots
m	Metres
METAR	Meteorological Routine Aerodrome Report
MSG	MeteoSat Second Generation
NOSIG	No Significant Weather
NPL	National Pilot Licence
POH	Pilot Operating Handbook
QNH	Barometric Pressure Adjusted to Sea level
SACAA	South African Civil Aviation Authority
SACATS	South African Civil Aviation Technical Standards
SAPS	South Africa
SASAR	Search and Rescue South African
SAWS	South African Weather Service
TBA	To be Advised
TMG	Touring Motor Glider
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
VML	Valid only with correction for defective distant, intermediate and near vision
Vx	Best Angle of Climb
Vy	Best Rate of Climb
Z	Zulu (Term for Universal Co-ordinated Time - Zero Hours Greenwich)

1. FACTUAL INFORMATION

1.1. History of Flight

1.1.1. On Saturday afternoon, 15 July 2023, a pilot on-board a UFM-13 Lambada Touring Motor Glider (TMG) with registration ZS-GMD took off on a private flight from Runway (RWY) 36 at Orient Airfield (FAOI) in Gauteng province with the intention to land at the same airfield. The flight was conducted under visual meteorological conditions (VMC) by day and under the provisions of Part 94 of the Civil Aviation Regulations (CAR) 2011 as amended.

1.1.2. The eyewitnesses who were at the aerodrome saw the TMG moments before the accident. Eyewitnesses 1 and 2 were standing together near row 'B' hangars, whilst eyewitness 3 was positioned in the eastern side near row 'J' hangars, approximately 400 metres (m) from row 'B' hangars.

1.1.3. Eyewitness 1 stated that he was standing with his back facing the runway when he heard the power being applied on the TMG for take-off and, eyewitness 2 turned around to focus his attention on the TMG to witness the last phase of the take-off run on Runway 36. Approximately 200 metres (m) from the threshold of the runway, the TMG nose pitched up whilst maintaining level wings and tracking the runway centreline. The estimated nose-up attitude was approximately between 50° and 70° from the horizontal plane. Eyewitness 1 stated that the TMG's engine sound remained constant (as when it took off), adding that it "*climbed to between 80m to 150m* (262 to 590 feet) *above the runway and seemed to run out of energy*". The left wing dropped, and the TMG yawed to the left; it then pitched steeply nose-down towards the ground whilst accelerating. At this point, the TMG faced west, and the wings appeared to have levelled. At approximately 10m to 30m (32 feet (ft) to 98ft) above ground, the TMG pitched up again and climbed at a steep nose-up attitude of between 50° and 70°. Whilst at a height of approximately 100m (328 ft) above ground, the left wing dropped again. The TMG rolled to the left and pitched nose-down, it accelerated towards the ground in a southerly direction; the wings rolled level again. Thereafter, the TMG impacted the ground in a nose-down attitude.

Eyewitness 2 stated that when the TMG commenced with the take-off, he turned to look and saw the TMG getting airborne quickly approximately 100 to 150m from the threshold. It then pitched upwards past a 30° attitude and that is when he suspected that something was wrong. The TMG continued to pitch in a steep near vertical position, thereafter, the climb stopped, and the left wing dropped with the nose pointing vertically downwards in the westerly direction. The dive and the pull-up of the TMG nearly resulted in an impact with the terrain before it climbed up into a nearly vertical position, just above the hangars' height, with the apex of the climb estimated to be between 60m and 91m (200ft to 300 ft) above ground level

(AGL). The engine sounded like it was running at full power and was consistent throughout the flight. Eyewitness 2 stated that he noticed that the elevator was positioned up (as if the stick was aft). According to eyewitness 2, during the second climb, the nose dropped and pointed vertically downwards with the TMG facing south towards row 'B' hangars and in their direction; they then ran towards the boma located east of the hangars to avoid being in the flight path. Eyewitness 2 further stated that as they were running, he glanced back and saw the TMG as it disappeared in front of row 'B' hangars; thereafter, he heard the impact with the ground. He then ran to the scene together with the eyewitness 1.

Eyewitness 3 stated that he was standing alone near the eastern end of row 'J' hangars. The sound of the engine caught his attention and that is when he saw the TMG above the hangars and the tree line in the south. The TMG climbed in a nose-up attitude before it rapidly dropped its right wing and pitched nose-down into a vertical attitude and disappeared from his line of sight. He stated that the engine sounded normal, but he had heard high revolutions at take-off. After impact, he rushed to the scene and, shortly after, the other two eyewitnesses arrived and found the pilot still strapped to the left seat and unconscious. They called for help. One of the eyewitnesses sprayed a fire extinguishing dry chemical powder (BCF) on the engine to prevent a possible fire from erupting. He had retrieved the fire extinguisher from a nearby launch pad. The glider was substantially damaged, and the pilot was fatally injured.

1.1.4. The Aeronautical Rescue Coordination Centre (ARCC) was notified of the accident, and they notified the Emergency Medical Services (EMS) at Gauteng Provincial Services, the South African Police Service (SAPS) and the South Africa Search and Rescue (SARZA). The SAPS arrived first at the scene followed by the EMS and SARZA.

1.1.5. The TMG accident occurred during the day at FAOI at Global Positioning System (GPS) co-ordinates determined to be 26°02'42.70" South 027°35'47.66" East, at an elevation of 5 122 feet (ft).

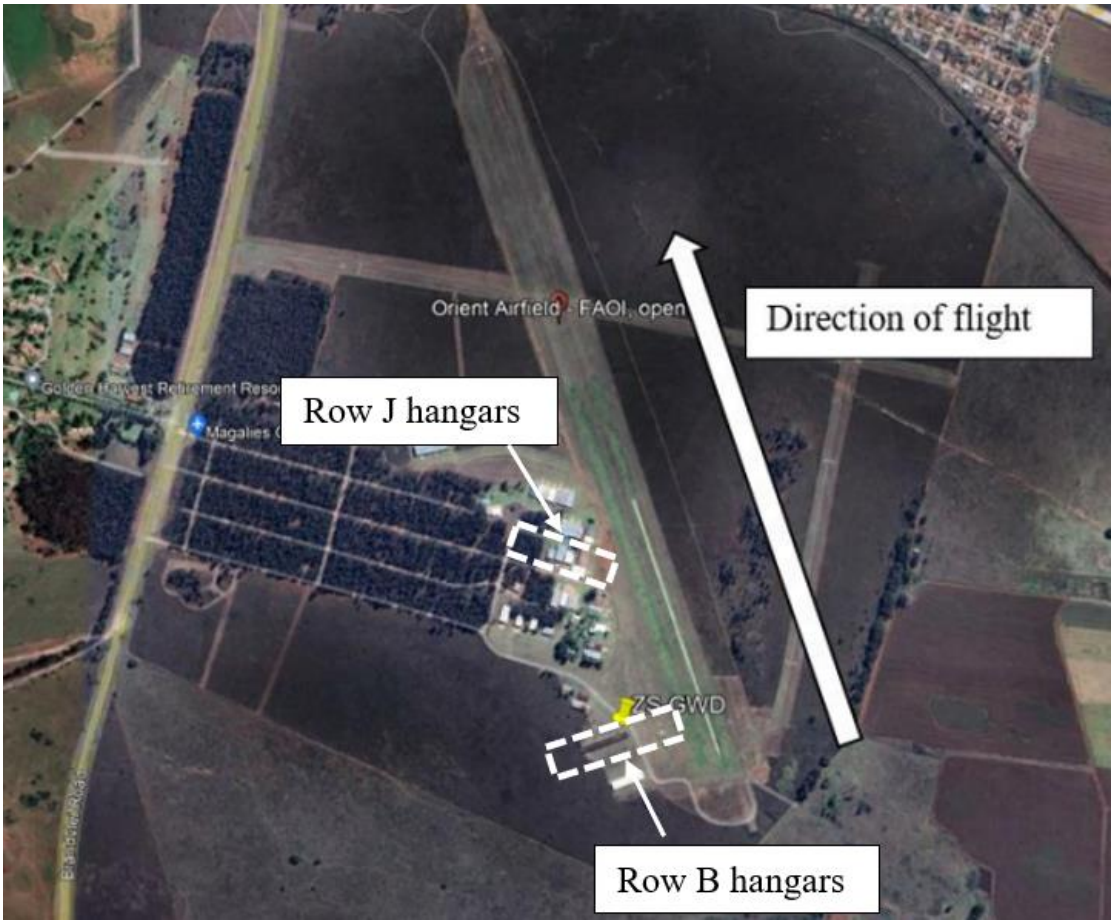

Figure 1: Overview of the accident site. (Source: Google Earth)

1.2. Injuries to Persons

Injuries	Pilot	Crew	Pass.	Total On-board	Other
Fatal	1	-	-	1	-
Serious	-	-	-	-	-
Minor	-	-	-	-	-
None	-	-	-	-	-
Total	**1**	**-**	**-**	**1**	**-**

Note: Other means people on the ground.

1.3. Damage to Aircraft

1.3.1. The TMG sustained substantial damage.

Figure 2: The damaged TMG after the accident.

1.4. Other Damage

1.4.1. None.

1.5. Personnel Information

Nationality	South African	Gender	Male	Age	60
Licence Type	National Pilot Licence (NPL)				
Licence Valid	No	Type Endorsed	Yes		
Ratings	TMG Instructor Grade A, GLD and TMG				
Medical Expiry Date	31 August 2025				
Restrictions	VML				
Previous Accidents	None				

Note: Previous accidents refer to past accidents the pilot was involved in, when relevant to this accident.

Flying Experience:

Total Hours	2 708.3
Total Past 24 Hours	0.5
Total Past 7 Days	0.5
Total Past 90 Days	0.5
Total on Type Past 90 Days	0.5
Total on Type	5.5

Note: The pilot's logbook that was shared with the investigators was last updated on 10 December 2022. The total hours used on the table (above) were taken from the last competency renewal and the hours on type were calculated from the pilot's logbook entries ending 10 December 2022.

1.5.1. The pilot was initially issued a Glider Pilot Licence (GPL) by the Regulator (SACAA) on 24 November 2011, and it was renewed on 4 June 2022 with an expiry date of 3 June 2024. The pilot also had a National Pilot Licence (NPL) that was issued on 2 July 2022 with an expiry date of 1 July 2023. The NPL had expired at the time of the accident. This was not in line with the provisions of Part 68.01.2 of the CAR 2011 as amended.

1.5.2. The pilot was issued a Class 4 medical certificate on 23 August 2022 with an expiry date of 31 August 2025 with a restriction to wear correction lenses for defective distant, intermediate and near vision (VML).

1.5.3. The TMG was endorsed on the pilot's NPL on 2 July 2022 with an expiry date of 1 July 2023. The pilot also had an Instructor Rating A on the TMG. The TMG instructor Grade A rating was issued by the Regulator on 2 July 2022 with an expiry date of 1 July 2024. The TMG rating had expired at the time of the accident.

1.5.4. *The CAR Part 62.01.2 Authority to act as pilot;*

(1) No person shall act as the pilot of an aircraft whilst in or over any part of the Republic or the territorial waters thereof unless such person—

(a) holds a valid appropriate pilot licence and rating issued in terms of this part or part 61; or

(b) holds a valid pilot licence and rating validated in terms of this part or part 61; or

(c) if the aircraft is of a foreign nationality, either—

(i) holds a valid pilot licence and rating issued by the appropriate authority of the State of Registry, provided such State is a Contracting State; or

(ii) has obtained the permission of the Director, if the State of Registry is not a Contracting State.

(2) The holder of a national pilot licence shall not exercise any privileges other than the privileges granted by the appropriate licence and rating or validation held by such holder.

(3) The holder of a validation of a foreign pilot licence shall adhere to all the requirements and limitations prescribed by this part in respect of the holder of a national pilot licence when exercising the privileges of his or her validation as a national pilot.

1.5.5. Competency Part 62.01.9

(1) No holder of a national pilot licence or rating shall exercise the privileges granted by the licence or rating unless such holder maintains competency by complying with the appropriate requirements prescribed in these regulations.

(2) (a) The holder of a national pilot licence shall undergo a general proficiency check for each category rating he or she may hold no later than 12 months from the initial issue, and thereafter within a period of 24 months of each previous proficiency check.

1.5.6. Logging of flight time Part 62.01.12

(1) (a) The holder of a national pilot licence shall maintain a record of all his or her flight time and instruction time.

(b) Electronic logbooks may be used, provided that the electronic data is printed onto paper at least every 90 days and the printed pages are filed sequentially in a binder.

(2) The form and information to be contained in the logbook referred to in subregulation (1), and the manner in which such logbook shall be maintained, are as prescribed in Document SA-CATS 62.

(3) (a) Entries in pilot logbooks shall be made within seven days after the completion of the flight to be recorded.

(b) Where a pilot is engaged in flight operations away from the base where the pilot logbook is normally kept, the periods specified in paragraph (a) may be extended to 48 hours after return to base.

(4) Pilot logbooks shall be retained by their holders for at least 60 months from the date of the last flight recorded therein.

(5) Flight time during which the holder of a national pilot licence is—

(a) receiving dual instruction, shall be logged as dual flight time and shall include a record of the air exercises undertaken;

(b) the designated PIC, shall be logged as pilot-in-command time.

1.5.7. According to the pilot's logbook, the last entry was recorded on 10 December 2022. This was not in line with the provisions of Part 62.01.12 of the CAR 2011.

1.5.8. The pilot had an approved person (AP) licence that was issued by the Regulator on 23 November 2021 with an expiry date of 22 November 2023. The AP was authorised to conduct repairs and maintenance work on gliders, including power-assisted and touring gliders, as well as normal aspirated piston engines.

1.6. Aircraft Information

(Source: Aircraft Flight Manual [AFM])

1.6.1 *The UFM-13 ultralight aeroplane is intended for recreational and cross-country flying. It is not approved for aerobatic operation. UFM-13 is a single, all-fiberglass aeroplane with two side-by-side seats. The aeroplane is equipped with two main wheel undercarriage with a steerable tail wheel. The fuselage is made from fiberglass. Safety belts are attached to the seats and to a shelf intended for placing lightweight objects (headphones, maps, etc). The wing is of a monospar construction with a sandwich skin composed of two layers of fiberglass and special foam. The aeroplane is controlled by dual push-pull control system, only the rudder drive is controlled by cable. The ailerons and elevator are control by a control stick located between the pilot's leg (co-pilot's). The rudder is controlled by rudder pedals, and flaps are operated by a control lever located on the fuselage main spar.*

1.6.2 According to the available information from the manufacturer, the aircraft was sold in a kit format with production number 55/13; and was manufactured by Urban Air (which is no longer in operation). The aircraft was assembled in South Africa by an approved person (AP) under the supervision of the owner. It was initially issued an Authority to Fly (ATF) on 18 August 2021 by the Regulator (SACAA).

Airframe:

Manufacturer/Model	UFM-13 Lambada	
Serial Number	55/33	
Year of Manufacture	2004	
Total Airframe Hours (At Time of Accident)	662	
Last Inspection (Date & Hours)	13 July 2023	661.5
Airframe Hours Since Last Inspection	0.5	
CRS Issue Date	5 May 2022	
ATF (Issue Date & Expiry Date)	31 August 2022	31 August 2023
C of R (Issue Date) (Present Owner)	22 October 2020	
Operating Category	Part 94	
Type of Fuel Used	Unleaded fuel 95 Octane	
Previous Accidents	None	

Note: Previous accidents refer to past accidents the aircraft was involved in, when relevant to this accident.

Engine:

Manufacturer/Model	Rotax 912 UL
Serial Number	5644038
Hours Since New	662
Hours Since Overhaul	TBO not yet reached

Propeller:

Manufacturer/Model	Wood Comp
Serial Number	PA029922617013
Hours Since New	662
Hours Since Overhaul	TBO not yet reached

1.6.3 According to the TMG logbook, it underwent an annual inspection on 13 July 2023 at 661.5 Hobbs meter, however, there were no records found of the Certificate of Release to Service (CRS). At the time of the accident, the TMG had accrued a total of 0.5 hours since the last annual inspection. According to the logbook entry, the last annual inspection on the TMG was conducted by the AP. The airframe logbook was duly signed and stamped by the AP, and an entry for the annual inspection was recorded in the flight folio as required by the South African Civil Aviation Technical Standards (SACATS) 44.01.13 (1) which states that: *The release to service for a non-type certificated aircraft shall either; be an entry in the flight folio; or be a separate form contained in the aircraft document folder.*

1.6.4 According to available information, the re-weighing of the TMG was last conducted on 17 April 2021. The re-weigh entry was not recorded in the logbook as required by regulation, however, the mass and balance certificate was made available to the investigators. The re-weigh entry that was not recorded in the logbook was not in line with the provisions of Part 44.01.9 (3).

1.6.5 Mass and balance (Source: Part 44.01.9)
(3) The person who is responsible for establishing the mass and the computing of the centre of gravity of the aircraft shall make an appropriate entry in the airframe logbook of the aircraft concerned.

1.6.6 At the time of the accident, the TMG had a valid Authority to Fly (ATF) certificate which was initially issued by the Regulator on 18 August 2021. It was renewed on 31 August 2022 with an expiry date of 31 August 2023.

1.6.7 Record Keeping and Audits (Source: SACATS 44.01.14)

1) An owner shall ensure that the following records are kept for the periods mentioned:

(a) The total time in service for the aircraft and all components.

(b) The current status of compliance with all service bulletins.

(c) Details of modifications and repairs to the aircraft and its major components.

(d) The time in service (hours, calendar time and cycles, as appropriate) since last overhaul of the aircraft or its components.

(e) The current aircraft status of compliance with its maintenance schedule.

(f) The detailed maintenance records to show that all requirements for signing or a release to service have been met.

1.6.8 Logbooks (Source: CAR Part 44.01.2 [10])

The logbook(s) shall be kept up to date and maintained in a legible and permanent manner and in accordance with the instructions for use as prescribed in Document SACATS 44.

1.7 Meteorological Information

1.7.1 The weather information was obtained from the Meteorological Aerodrome Report (METAR) that was issued by the South African Weather Service (SAWS), recorded on 15 July 2023 at 1000Z for Lanseria International Aerodrome (FALA). FALA is located 41 kilometres (22 nautical miles) from the accident site.

FALA 151000Z 33009KT 260V360 9999 FEW030 13/03 Q1029 NOSIG=

Wind Direction	260°V360°	Wind Speed	9 kt	Visibility	9999m
Temperature	13°C	Cloud Cover	FEW	Cloud Base	3000ft
Dew Point	3°C	QNH	1029hPa		

1.7.2 Satellite Image

A Satellite imagery (Day Natural Colours) of the MeteoSat Second Generation (MSG) taken at 1030Z (time of the accident) indicated that there was no significant weather over FAOI. The weather condition was Ceiling and Visibility OK (CAVOK).

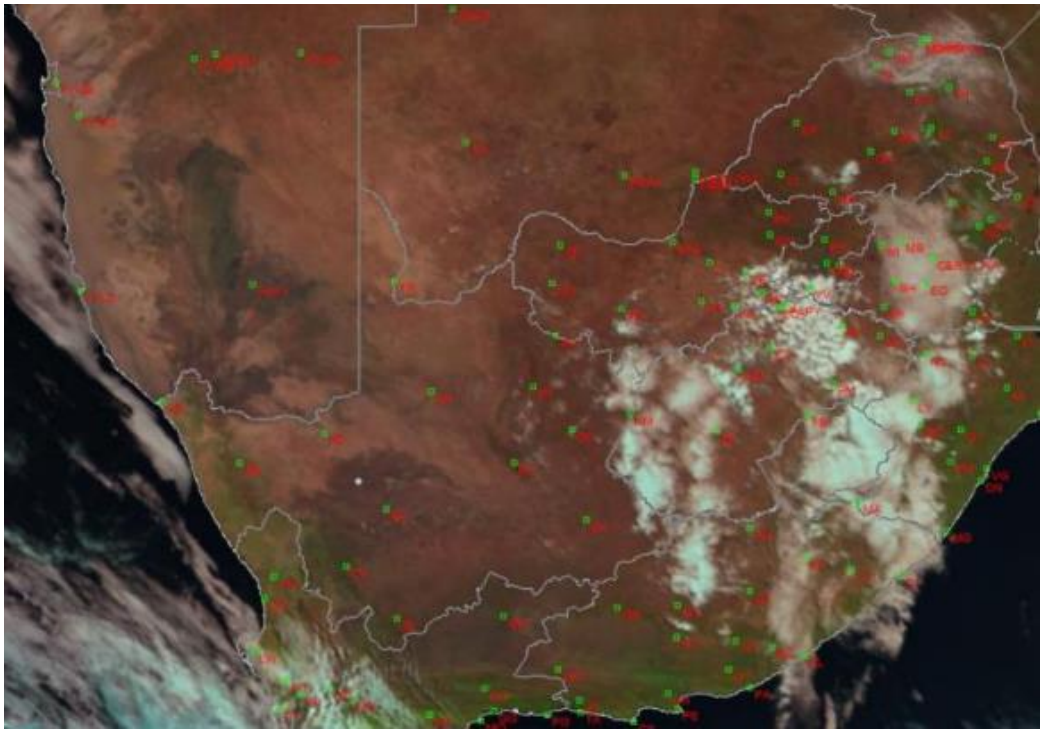

Figure 3: Day Natural Colours imagery. (Source: SAWS report, Day Natural Colours report)

1.8 Aids to Navigation

1.8.1 The TMG was equipped with standard navigational equipment as approved by the Regulator (SACAA). There were no records indicating that the navigational equipment was unserviceable prior to the flight.

1.9 Communication

1.9.1 The TMG was equipped with standard communicational equipment as approved by the Regulator. There were no records indicating that the communication equipment was unserviceable prior to the flight.

1.10 Aerodrome Information

Aerodrome Name	Orient Airfield (FAOI)		
Aerodrome Location	Magaliesburg, Gauteng Province		
Aerodrome Status	Unlicensed		
Aerodrome GPS co-ordinates	26°02'42.70" South 027°35'47.66" East		
Aerodrome Elevation	5 122 ft		
Runway Headings	18/36	11/29	03/21
Dimensions of Runway Used	1 171m x 21m	950m x 20m	400m x 20m
Heading of Runway Used	36		

Surface of Runway Used	Paved
Approach Facilities	None
Radio Frequency	123.4 MHz

1.10.1 The TMG accident occurred at FAOI in Gauteng province at GPS co-ordinates 26°02'42.70" South 027°35'47.66" East, at an elevation of 5 122ft.

1.11 Flight Recorders

1.11.1 The TMG was neither equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR), nor was it required by regulation to be fitted to the TMG type.

1.12 Wreckage and Impact Information

1.12.1 The accident occurred after take-off, approximately 162m from the edge of RWY 36 at FAOI. The TMG's resting position was at the front of row B hangars; it faced north-westerly about 8m from the hangars. The wreckage distribution was contained in an approximate 10m radius. The nose section was heavily damaged with twists to the right. The TMG was found resting in a left-wing low position due to the damaged main landing gear assembly.

Figure 4: The view of the accident site from Runway 36.

1.12.2 The main fuselage:

The fuselage structure was heavily disturbed, and the wings were still attached to the fuselage. The empennage was attached to the frame, however, the tail wheel suffered impact damage. The Perspex canopy shattered, and pieces of Perspex material were found in front

of the TMG. The wings outboard section exhibited signs of contact with the ground as dirt and grass was visible on the leading edges. A large piece of the left-wing outboard leading-edge skin was missing as a result of impact; cracks were observed on the upper surface skin chordwise. The grass around the left wing was moist with a strong smell of fuel, consistent with Unleaded 95 Octane. The main landing gear had dislodged from the attachment points and was found under the TMG. Carbon fibre split spanwise on the strut surface; however, the strut did not separate although the left main wheel hub was damaged.

The instrument panel was destroyed because of impact. Most of the instruments on the left side were dislodged from their respective positions, and some were suspended by their wires whilst others were on the floor of the TMG. The right side of the instrument panel sustained minor damage and the instruments were still in their respective positions. The key was still in the ignition hole. The fuel shut off valve was still in the ON position. The right-side wing contained ample fuel; during recovery, fuel seeped from the delivery pipe.

Figure 5: The damaged fuselage.

Figure 6: Dirt and grass on the outboard section leading edge of the left wing.

Figure 7: Damage on the right-side wing leading edge.

1.12.3 The flight controls:

The primary flight controls were all accounted for, and no damage was observed apart from impact damage. The flaperons were still intact and were found retracted. The speed brakes were still inside the wing. The rudder was still attached to the vertical stabiliser with deformation (bending) near the tail wheel due to impact. The rudder was difficult to move by hand due to deformation after impact. The elevators were still attached to the horizontal stabiliser. The elevator was removed to verify security of attachment, and no anomalies were

found. The movement of the flight controls was only achievable after the TMG's nose section was repositioned. Continuity was confirmed and the movement of the stick in relation to the movement of the flight controls was confirmed on site. Due to the damage sustained on the underside of the TMG, the movement of the rudder pedals was not possible; however, the control cables were still attached to the rudder pedals.

1.12.4 The engine:

The engine was still intact in the cradle. The throttle control cables were still attached to the carburettor. External examination of the engine did not reveal any anomalies prior to impact. Two of the propeller blades exhibited signs of rotational damage, the first blade had dislodged from the hub and had broken mid-section, whilst the second blade broke off at mid-section at an almost similar distance as the first blade. The one piece was located forward of the main wreckage and the other piece was not found. The third blade was found still intact. The spinner was intact but was flattened during the accident. The carburettors were still attached to the engine; they were removed by the AP in the presence of the investigators. During the removal of the fuel pipe, fuel leaked from it. The bowls contained ample fuel, and the floats were still present inside the bowls (see Figures 11 and 12).

Figure 8: The damaged nose section.


Figures 9 and10: Damage sustained by the propeller blades.


Figures 11 and 12: Carburettor (left) and bowl with fuel (right).

1.12.5 A detachable flight alarm (FLARM) instrument (attached using a Velcro) located behind the pilot's seat was on-board the TMG. The FLARM was not switched on before the flight. After it was removed from its position, it was switched on and the battery was serviceable (see Figure 13).

Figure 13: FLARM unit after being switched on.

1.13 Medical and Pathological Information

1.13.1 A post-mortem examination was performed, and the results of the postmortem were made available to the investigators; the cause of death was attributed to blunt force injuries. The toxicology test results were not available at the time of completion of this report. Should the toxicology test results have a bearing to this accident after being released, the information will be treated as new evidence and the investigation will be re-opened.

1.14 Fire

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

1.15 Survival Aspects

1.15.1 The accident was considered not survivable as the cockpit structure was damaged due to impact forces which caused fatal injuries to the pilot. The pilot had made use of the TMG's safety harnesses.

1.16 Tests and Research

1.16.1 Lift/Drag Ratio (Source: PHAK Chapter 5 (faa.gov))

The lift-to-drag ratio (L/D) is the amount of lift generated by a wing or airfoil compared to its drag. A ratio of L/D indicates airfoil efficiency. Aircraft with higher L/D ratios are more efficient than those with lower L/D ratios. In unaccelerated flight with the lift and drag data steady, the proportions of the coefficient of lift (CL) and coefficient of drag (CD) can be calculated for specific AOA. [Figure 14] The coefficient of lift is dimensionless and relates the lift generated by a lifting body, the dynamic pressure of the fluid flow around the body, and a reference area associated with the body. The coefficient of drag is also dimensionless and is used to quantify the drag of an object in a fluid environment, such as air, and is always associated with a particular surface area. The L/D ratio is determined by dividing the CL by the CD, which is the same as dividing the lift equation by the drag equation as all of the variables, aside from the coefficients, cancel out. The lift and drag equations are as follows (L = Lift in pounds; D = Drag; CL = coefficient of lift; ρ = density (expressed in slugs per cubic feet); V = velocity (in feet per second); q = dynamic pressure per square foot (q = 1⁄2 ρv2); S = the area of the lifting body (in square feet); and CD = Ratio of drag pressure to dynamic pressure): D = CD . ρ . V2 . S 2 Typically at low AOA, the coefficient of drag is low and small changes in AOA create only slight changes in the coefficient of drag. At high AOA, small changes in the AOA cause significant changes in drag. The shape of an airfoil, as well as changes in the AOA, affects the production of lift. Notice in Figure 14 that the coefficient of lift curve (red) reaches its maximum for this particular wing section at 20° AOA and then rapidly decreases. 20° AOA is therefore the critical angle of attack. The coefficient of drag curve (orange) increases very rapidly from 14° AOA and completely overcomes the lift curve at 21° AOA. The lift/drag ratio (green) reaches its maximum at 6° AOA, meaning that at this angle, the most lift is obtained for the least amount of drag. Note that the maximum lift/drag ratio (L/DMAX) occurs at one specific CL and AOA. If the aircraft is operated in steady flight at L/DMAX, the total drag is at a minimum. Any AOA lower or higher than that for L/DMAX reduces the L/D and consequently increases the total drag for a given aircraft's lift. Figure 15 depicts the L/DMAX by the lowest portion of the blue line labelled "total drag." The configuration of an aircraft has a great effect on the L/D.

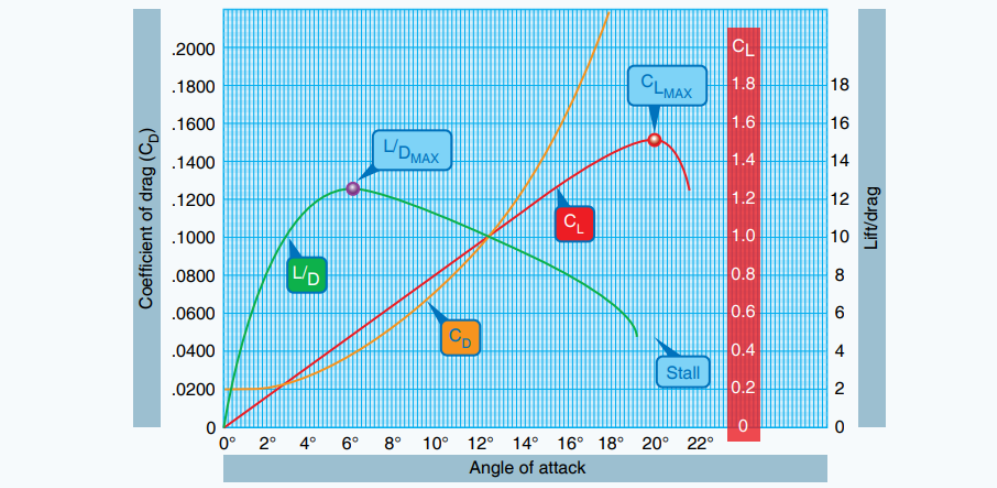

Figure 14: Coefficients of lift and drag at various angles-of-attack. (Source: PHAK Chapter 5 [faa.gov])

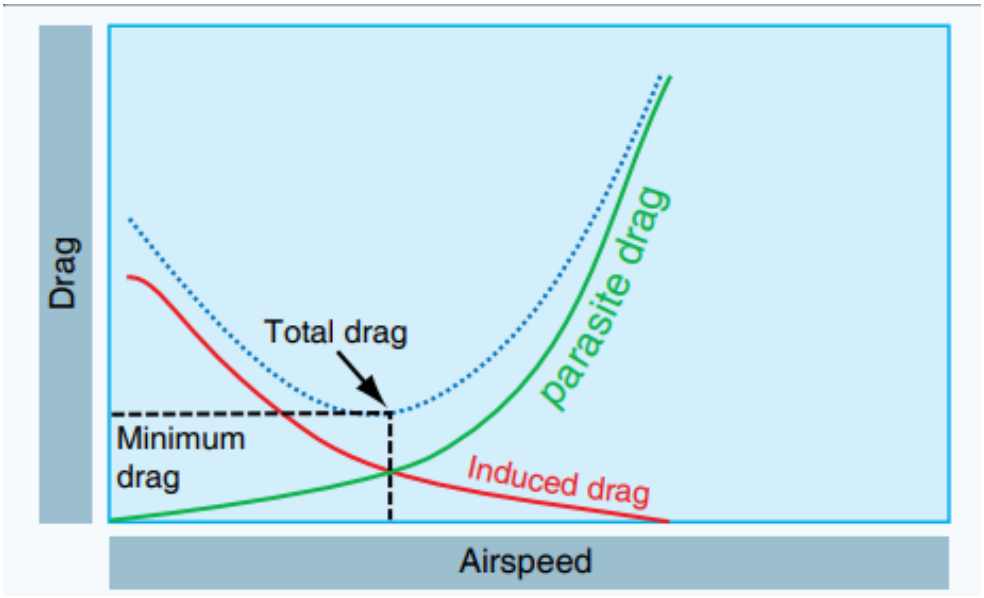

Figure 15: Drag versus speed. (Source: PHAK Chapter 5 [faa.gov])

1.16.2 Maximum crosswind component (AFM)

Demonstrated crosswind performance:

Max. permitted cross wind velocity for take-off and landing	*5m/s*
Max. permitted head wind velocity for take-off and landing	*12m/s*

1.17 Organisational and Management Information

1.17.1 This was a private flight conducted under the provisions of Part 94 of the CAR 2011 as amended.

1.17.2 The TMG was registered to the current owner on 22 October 2020.

1.17.3 The AP (who was also the pilot and owner of the aircraft) had conducted the last maintenance on the TMG; he had an AP certificate that was issued by the Regulator on 23 November 2021 with an expiry date of 22 November 2023.

1.18 Additional Information

1.18.1 Stall speeds (Source: Flight Manual)

Stall	Flaps position	Engine Power	Warning speed		Stalling Speed	
			IAS [km/h]	CAS [km/h]	IAS [km/h]	CAS [km/h]
Wing level stall	RETRACTED	idling	85	82	80	77
	"TAKE-OFF“	idling	75	70	70	65
	"LANDING“	idling	75	70	70	65

Note

When the stall develops the aeroplane moves downward without pitching, is fully controllable and level flight may be recovered without excessive loss of altitude.

Note: The above information is an extract from the manufacturer's Flight Manual which meets the airworthiness requirements in accordance with the Czech Republic's Light Aircraft Association Certification.

1.18.2 Stall Recognition and Recovery (Source: FAA-Glider Flight Manual)

All pilots must be proficient in stall recognition and recovery. A stall can occur at any airspeed and at any attitude. In the case of the self-launching glider under power, a stall can also occur with any power setting. A stall occurs when the smooth airflow over the glider's wing is disrupted and the wings stop producing enough lift. This occurs when the wing exceeds its critical AOA. The practice of stall recovery and the development of stall awareness are of primary importance in pilot training. The objectives in performing intentional stalls are to familiarize the pilot with the conditions that produce stalls, to assist in recognizing an

approaching stall, and to develop the habit of taking prompt preventive or corrective action. Intentional stalls should be performed so the manoeuvre is completed by 1,500 feet above the ground with a landing area within gliding distance, in the event lift cannot be found. Although it depends on the degree to which a stall has progressed, most stalls require some loss of altitude during recovery. The longer it takes to recognize the approaching stall, the more complete the stall is likely to become, and the greater the loss of altitude to be expected. Pilots must recognize the flight conditions that are conducive to stalls and know how to apply the necessary corrective action since most gliders do not have an electrical or mechanical stall warning device. Pilots should learn to recognize an approaching stall by sight, sound, and feel.

The following cues may be useful in recognizing the approaching stall.

1. Vision—useful in detecting a stall condition by noting the attitude of the glider versus the horizon.

2. Hearing—also helpful in sensing a stall condition. In the case of a glider, a change in sound due to loss of airspeed is particularly noticeable. The lessening of the noise made by the air flowing along the glider structure as airspeed decreases is quite noticeable, and when the stall is almost complete, the pilot starts to feel airframe buffeting or aerodynamic vibration as the stall occurs.

3. Feeling

a. Kinesthesia, or the sensing of changes in direction or speed of motion, is an important intuitive indicator to the trained and experienced pilot. If this sensitivity is properly developed, it warns of a decrease in speed or the beginning of a settling, or mushing, of the glider.

b. The feel of control pressures is also very important. As speed is reduced, the resistance to pressure on the controls becomes progressively less. Pressures exerted on the controls tend to become movements of the control surfaces. As the airflow slows and stalls, the aerodynamic controls (ailerons, elevator, and rudder) have significantly less authority and require much more movement to create the same amount of directional change as compared to the normal flight regime responses. As the wing airflow stalls and the stalling strongly affects the controls, the controllability of the glider can become questionable. Properly designed and certificated gliders should retain marginal control authority when the wing is stalled. The lag between these movements and the response of the glider becomes greater until in a complete stall.

Signs of an impending stall include the following:

- *Nose-high attitude for higher wing loading with possible increasing trend.*
- *Low airspeed indication with a decreasing trend.*

• Low airflow noise and decreasing.

• Back pressure increasing, requiring more elevator trimming and/or not having aft trim anymore.

• Poor control responses from the glider and decreasing feedback pressures from control movements.

• Wing (airframe) buffeting as stalling begins.

• Yaw string (if equipped) movement from normal flight position.

Always make clearing turns before performing stalls. During the practice of intentional stalls, the real objective is not to learn how to stall a glider, but to learn how to recognize an approaching stall and take prompt corrective action. The recovery actions must be taken in a coordinated manner.

Secondary Stalls

A secondary stall occurs after a recovery from a preceding stall. It is caused by attempting to hasten the completion of a stall recovery with abrupt control input before the glider has regained sufficient flying speed and the critical AOA is again exceeded. When this stall occurs, the back-elevator pressure should again be released as in a normal stall recovery. When sufficient airspeed has been regained, the glider can then be returned to wings-level, straight flight.

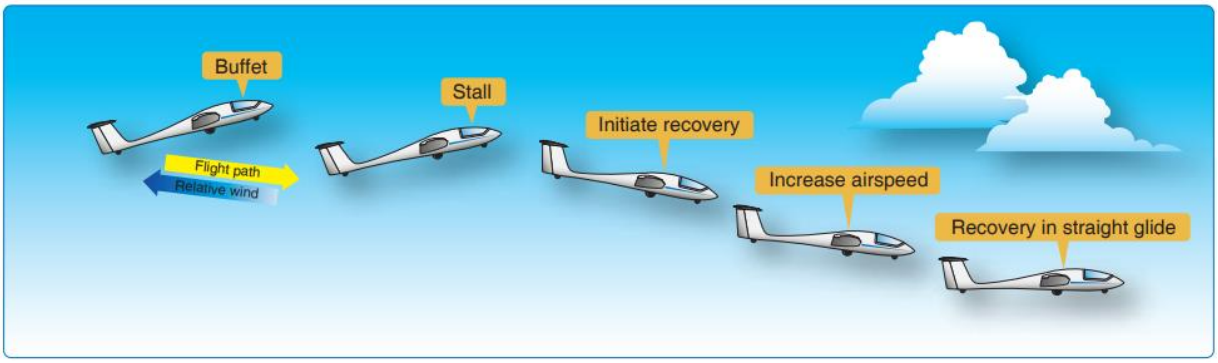

Figure 16: Stall recovery. (Source: FAA-Glider Flight Manual)

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

2.1. General

From the available evidence, the following analysis was made with respect to this accident. This shall not be read as apportioning blame or liability to any organisation or individual.

2.2. Analysis

2.2.1. Man

The pilot was initially issued a National Pilot Licence (NPL) by the Regulator on 2 July 2022 with an expiry date of 1 July 2023. At the time of the accident, the pilot's TMG rating had lapsed on 1 July 2023. The pilot also had a Glider Pilot Licence (GPL) which was initially issued on 24 November 2011; it was renewed on 4 June 2022 with an expiry date of 3 June 2024.

The pilot exercised the privileges of a pilot-in-command (PIC) on the TMG with an expired NPL and TMG rating. This was not in line with the provisions of Part 62.01.2 of the CAR 2011 as amended. The pilot was issued a Class 4 medical certificate on 23 August 2022 with an expiry date of 31 August 2025 with a restriction to wear correction lenses for defective distant, intermediate and near vision (VML).

2.2.2. Machine

The review of the aircraft documentation revealed that the TMG had a valid Authority to Fly (ATF) certificate which was issued on 31 August 2022 with an expiry date of 31 August 2023. The last annual inspection on the aircraft was conducted on 13 July 2023 at 661.5 airframe hours. The TMG had accrued 0.5 hours at the time of the accident flight since the last annual inspection.

The last re-weigh of the TMG was not recorded in the airframe logbook as required by the Regulator, however, the weight and balance certificate was made available to the investigators. However, the non-recording of the re-weigh of the TMG on the airframe logbook was not in line with the provisions of Part 44.01.9 (3). The TMG was not considered airworthy as the Certificate of Release to Service (CRS) for the last annual inspection was not found. The examination of the engine revealed that the engine was producing sufficient power at the time of impact. The propeller blade damage was consistent with rotational impact. The fuel was clean and of the correct grade, and the supply to the carburettors was sufficient. There were no faults found with the flight control Teleflex cables; they were verified during the continuity check.

2.2.3. Conclusion

During the climb after take-off, the TMG was pitched nose-up at a high angle-of-attack. This resulted in the significant decrease in airspeed which was below the stalling speed of 37 knots (70km/h). The pilot would have likely felt the fuselage buffeting with vibrations felt on the control stick, which would signal a stall as stipulated in the Glider Flight Manual. The pilot would have also recognised that the glider's attitude was higher than the required angle-of-attack.

The pilot's action to increase airspeed suggested an attempt to recover from a stall, followed by a maximum aft control stick movement to pull out of the dive and level the wings. The pilot aimed to stabilise the TMG's forward motion. Eyewitnesses observed the TMG descend rapidly towards the ground and pitched up sharply on the opposite side of the runway. Reports indicated a nose-up attitude of between 50º and 70º surpassing the critical angle-of-attack necessary for a sustained flight.

Notably, the Glider Flight Manual indicates that the lift-to-drag ratio peaks at a 6º angle-of-attack, optimising lift whilst minimising drag. However, beyond 14º angle-of-attack, the coefficient of drag increases rapidly, eventually surpassing the lift curve at 21º angle-of-attack. It appears that the glider may have fallen behind the drag curve, which led to insufficient lift to sustain the flight. This likely resulted in a secondary stall from which recovery was unattainable and, thus, the crash.

3. CONCLUSION

3.1. General

From the available evidence, the following findings, causes and contributing factors were made with respect to this accident. 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 conclusion heading:

- **Findings —** are statements of all significant conditions, events, or circumstances in this accident. The findings are significant steps in this accident sequence, but they are not always causal or indicate deficiencies.
- **Causes —** are actions, omissions, events, conditions, or a combination thereof, which led to this accident.
- **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 occurring, or would have mitigated the severity of the consequences of the accident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil, or criminal liability.

3.2. Findings

3.2.1. The pilot was initially issued a National Pilot Licence (NPL) by the Regulator on 2 July 2022 with an expiry date of 1 July 2023. The TMG rating was issued under the NPL, it expired on 1 July 2023.

3.2.2. The pilot had a Glider Pilot Licence (GPL) which was initially issued on 24 November 2011 by the Regulator. It was renewed on 4 June 2022 with an expiry date of 3 June 2024.

3.2.3. At the time of the flight, the pilot's NPL and TMG rating had lapsed. The pilot exercised the privileges of pilot-in-command (PIC) on the TMG with an expired type rating. This was not in line with the provisions of Part 62.01.2 of the CAR 2011 as amended.

3.2.4. The pilot had a Class 4 medical certificate that was issued on 23 August 2022 with an expiry date of 31 August 2025. The licence had a VML restriction.

3.2.5. The pilot's logbook was last updated on 10 December 2022. The logbook was not maintained as required by the CAR 2011 (Part 62.01.12.).

3.2.6. The pilot was issued an AP certificate by the Regulator with an expiry date of 22 November 2023.

3.2.7. The TMG had a valid Certificate of Registration (C of R) which was initially issued on 22 October 2020.

3.2.8. The latest annual inspection on the TMG was conducted on 13 July 2023 at 661.5 Hobbs meter. At the time of the accident, the TMG had accrued 0.5 Hobbs meter.

3.2.9. The annual inspection on the TMG was duly signed in the logbook by the AP, and the entry of the annual inspection was recorded in the flight folio as required by the South African Civil Aviation Technical Standards SACATS 44.01.13 (1) a.

3.2.10. The TMG was initially issued an Authority to Fly (ATF) certificate by the Regulator on 18 August 2021; it was renewed on 31 August 2022 with an expiry date of 31 August 2023.

3.2.11. The weighing of the TMG was last conducted on 17 April 2021. The re-weighing was not recorded in the logbook as required by Regulation. This was not in line with the provisions of the CAR 2011 Part 44.01.9 (3).

3.2.12. The flight was conducted in accordance with the provisions of Part 94 of the CAR 2011 as amended. This was the first flight after the annual inspection was conducted.

3.2.13. The weather conditions were not considered a factor to this accident.

3.2.14. It is likely that during the climb, the pilot pitched the TMG at a high nose-up attitude which resulted in the decrease in airspeed and the TMG entered a stall from which the pilot could not recover.

3.3. Probable Cause/s

3.3.1. During climb, the TMG's attitude reached a high critical angle-of-attack from which the pilot could not recover.

3.4. Contributory Factor/s

3.4.1. Excessive control inputs.

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 Message

4.2.1. In the interest of safety, pilots flying this type of aircraft are urged to fly within the limitations as stipulated in the flight manual.

5. APPENDICES

5.1. None.

This report is issued by:
Accident and Incident Investigations Division
South African Civil Aviation Authority
Republic of South Africa