SOUTH AFRICAN CIVIL AVIATION AUTHORITY

Section/division **Accident and Incident Investigations Division** Form Number: CA 12-57

LIMITED OCCURRENCE INVESTIGATION REPORT – FINAL

Reference Number	CA18/3/2/1404						
Classification	Serious Incident		**Date**	26 January 2023		**Time**	0745Z
Type of Operation	Training (Part 141)						
Location							
Place of Departure	Port Elizabeth Aerodrome (FAPE), Eastern Cape Province		Place of Intended Landing	Port Elizabeth Aerodrome (FAPE), Eastern Cape Province			
Place of Occurrence	Sunday River Mouth, south-east of Colchester in the Eastern Cape Province						
GPS Co-ordinates	Latitude	33°43'31.16" S	Longitude	025°50'8.44" E		Elevation	3 feet (ft)
Aircraft Information							
Registration	ZU-FUS						
Make; Model; S/N	Sling Aircraft, Sling 2 (Serial Number: 080)						
Damage to Aircraft	None		Total Aircraft Hours	6 677.7			
Pilot-in-command							
Licence Type	Commercial Pilot Licence (CPL)		Gender	Male		Age	27
Licence Valid	Yes	Total Hours	612	Total Hours on Type			517.1
Total Hours 30 Days	16.7		Total Flying on Type Past 90 Days	27.9			
People On-board	1+1	**Injuries**	0	**Fatalities**	0	**Other (on ground)**	0

What Happened

On Thursday morning, 26 January 2023 at 0500Z, an instructor and a student pilot (SP) on-board a Sling 2 aircraft with registration ZU-FUS took off on training flight from Port Elizabeth Aerodrome (FAPE) in the Eastern Cape province to the general flying area (GFA). The intention was to conduct the spiral dive and recovery exercises at the GFA. The flight was conducted under visual meteorological conditions (VMC) by day and under the provisions of Part 141 of the Civil Aviation Regulations (CAR) 2011 as amended.

The instructor reported that when they arrived at the GFA, they conducted the spiral dive and recovery exercises overhead the river mouth of Sunday River, which is located approximately 20 nautical miles (nm) from FAPE. During the recovery manoeuvre when the SP increased power, the engine RPM climbed to 3000 and no further; also, there was no indication from the sound of the engine that the aircraft was gaining power. (*The throttle lever was opened and felt restricted, and the RPM was not increasing*). Subsequently, the aircraft started to lose height. The instructor took over the control of the aircraft and applied full power to recover, but without success (engine RPM remained at 3 000 RPM). ***Note**: The maximum engine speed is 5 800 RPM and 5 500 RPM maximum continuous power, according to the Pilot's Operating Handbook (POH). Also, the POH states that the spiral dive exercises should be practised with the engine power set to idle (1400 revolution per minute) at 1 500 feet (ft) above ground level (AGL).*

The instructor elected to execute a forced landing at the beach on the river mouth of Sunday River. The aircraft landed safely without further incidents. The aircraft was not damaged, and both occupants were not injured.

Post-Incident:

An approved person (AP) who came to inspect the aircraft following the forced landing reported that one of the cable strands of the throttle cable snapped, preventing the cable from travelling fully as commanded, therefore, this resulted in the throttle cable being stuck on partial power (not advancing to full power). The throttle cable was replaced with a serviceable cable at the incident site. Thereafter, the engine ground run was conducted and indicated no anomalies with the RPM at different power settings. The aircraft was later flown back to FAPE without further anomalies.

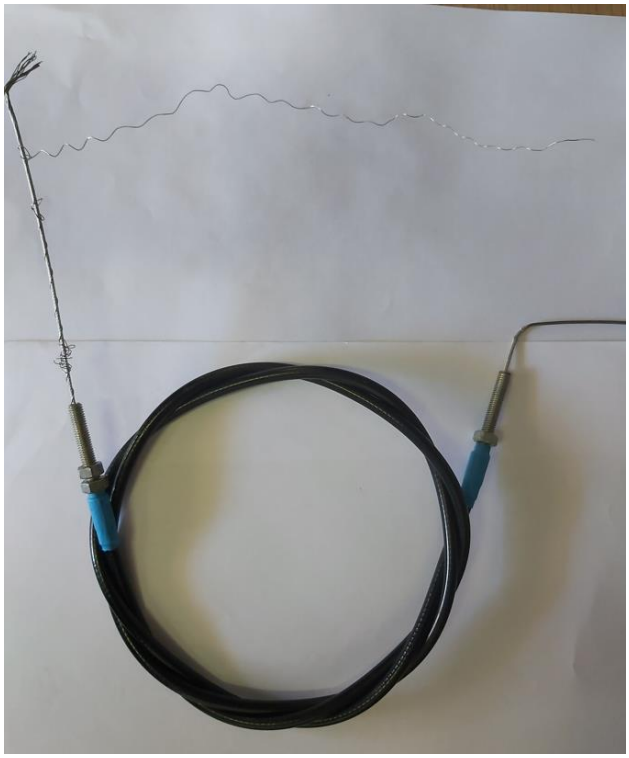

Figure 1: Throttle cable with broken/lose strands.

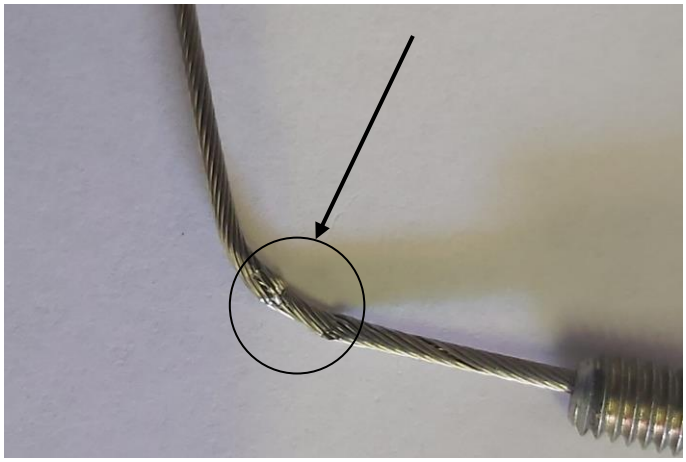

Figure 2: The indentation imprint caused by the washer.

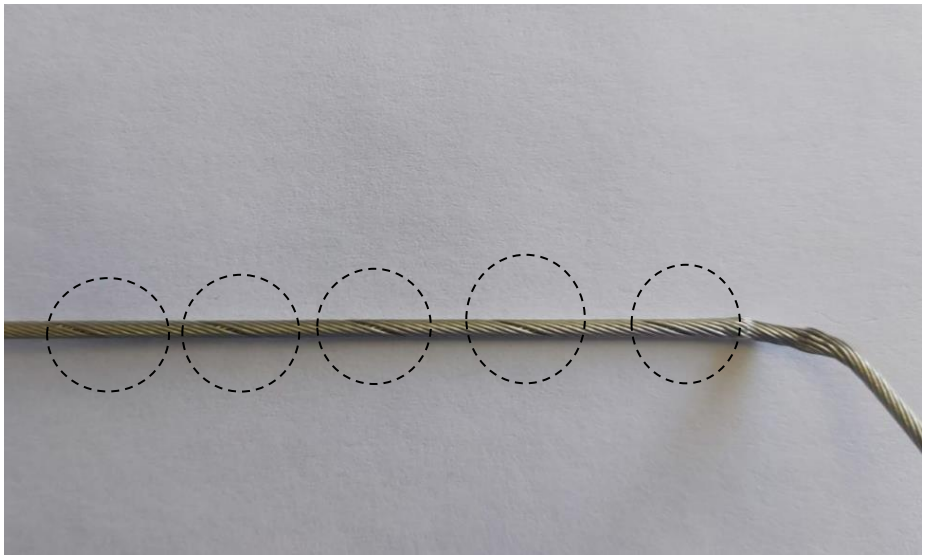

Figure 3: Circles showing the gap left by the missing cable strand.

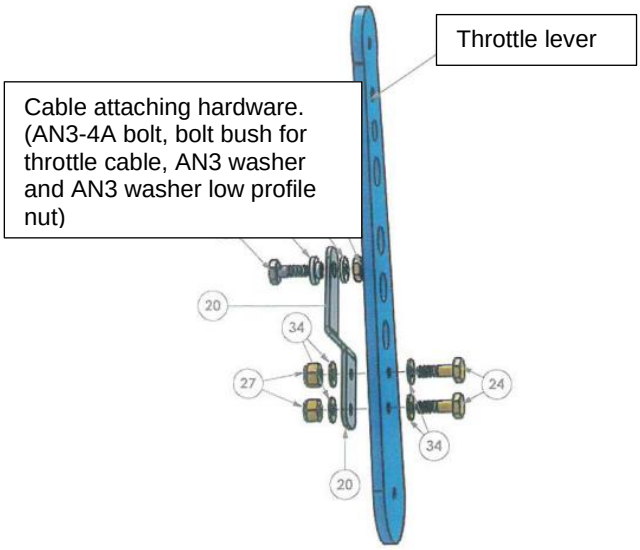

Illustration 1: The throttle lever with attaching hardware for the cable. (Source: Sling aircraft assembly drawing)

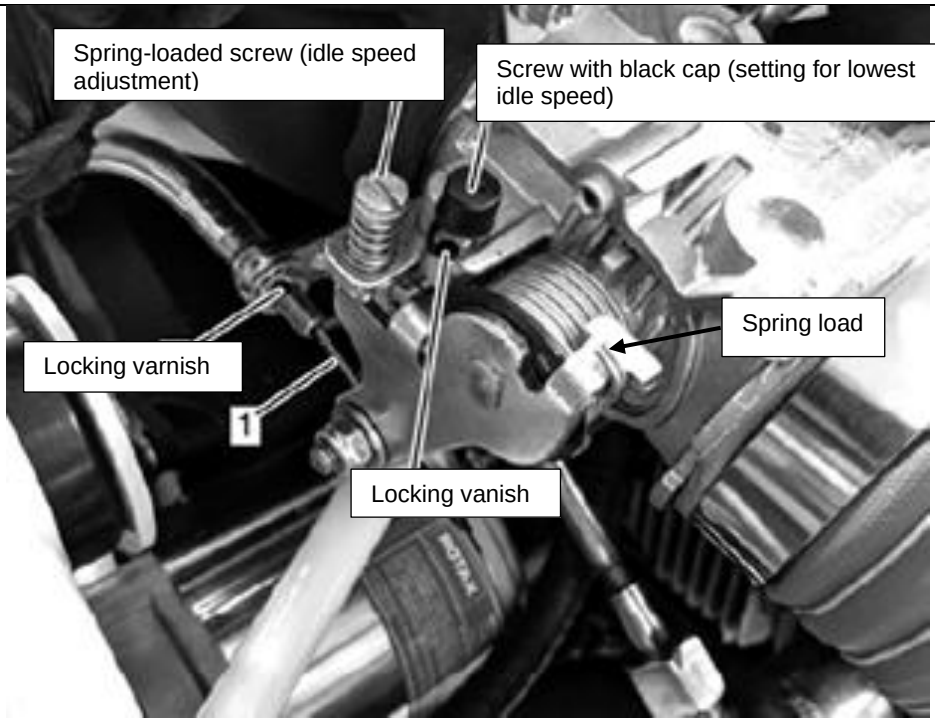

Illustration 2: The throttle body with the spring in idle position. (Source: Sling Manual)

Connection for Bowden cable throttle actuation and permissible load. (Source: Rotax Installation Manual)

Set screw	M6x12
Tightening torque	4 Nm (36 in.lb) (suitable for flexible cable, 1.5 mm (0.06 in.) steel rope or single-strand wire)
Cable travel	65 mm (2.56 in.)
Actuating force	Min. 7.5 N (1.69 lb-force) Max. 20 N (4.5 lb-force)
Max. permissible actuating force	20 N (4.5 lb-force)

Irregular engine RPM alternative for aircraft equipped with Rotax 912 ULS (Source: Sling 2 POH)

- *Ignition / Lanes..... ON (BOTH)*
- *Throttle ..... VERIFY POSITION*
- *ECU Backup Switch..... ON*
- *Fuel Quantity..... CHECK*
- *Fuel Selector..... CHANGE (UNLESS 2ND TANK DRY)*
- *Fuel Pumps..... ON (BOTH)*
- *Oil - Pressure ..... CHECK*
- *Oil - Temperature..... CHECK*
- *Coolant - Temperature..... CHECK*
- *EGT - Temperature ..... CHECK If engine continues to run rough*
- *Land..... AS SOON AS POSSIBLE*

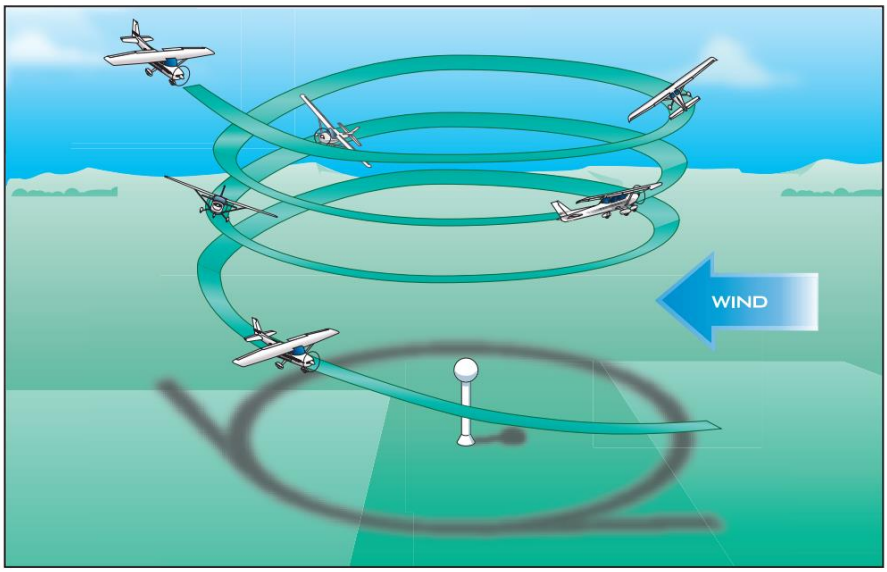

Illustration 3: The steep spiral turn. (Source: FAA-H8083-3B-Airplane Flying Handbook)

Spiral dive recovery (Source: FAA-H8083-3C-Airplane Flying Handbook)

- *Reduce power (throttle) to idle.*
- *Apply some forward elevator.*
- *Roll wings level.*
- *Gently raise the nose to level flight.*
- *Increase power to climb power.*

Figure 4: The aircraft as it came to a stop on the river mouth. (Source: Operator)

Airframe (Source: Pilot Operating Handbook)

The Sling LSA has an all-metal construction with single curvature stressed aluminium alloy skins riveted to stiffeners. Construction is of 6061-T6 aluminium alloy sheet metal riveted to angles, of the same material, with high quality blind rivets. This high strength aluminium alloy construction provided long life and low maintenance

costs, thanks to its durability and corrosion resistance characteristics. The wing has a high lift air foil (NACA 4415) and is equipped with semi slotted fowler type flaps.

Engine (Source: Pilot Operating Handbook)

The engine fitted as standard, is the Rotax 912 iS. This engine is a 4- stroke, 4-cylinder, horizontally opposed, spark ignition engine with one central camshaft - pushrod OHV and a displacement of 1211cc (1.2L/74 cubic inch). The engine makes use of liquid cooled cylinder heads with air cooled cylinders. The lubrication system could be described as sump forced lubrication and the ignition makes use of dual contactless capacitor discharge magneto type ignition system that is ECU controlled. The engine is fitted with an electric starter motor, two AC alternators and two electric fuel pumps. The propeller is driven through a reduction gearbox of ratio 2.43 and features an integrated shock absorber. The engine will continue to run after an alternator/battery failure.

Cable description (Source: Aircraft Accident Investigation book chapter 13 page 105, by Richard H. Wood & Robert W. Sweginnis)

Cables are popular method of transferring mechanical force somewhere else. Some systems are single cables which incorporate a spring or retraction device which brings the cable back to neutral or zero position. Cables are composed of bundles of individual strands of wire spiral wound. A number of these bundles, usually seven, are then spiral wound to form a cable. Typically, aircraft cable will have from 49 to 133 individual strands of wire. When it fails, the strands fail individually one at the time. Viewed with high magnification, each should show the necking down and cup and cone mode characteristics of ductile tension failure. If the cable did fail in-flight, it is likely that some individual strands had already failed and weakened the cable prior to the final failure.

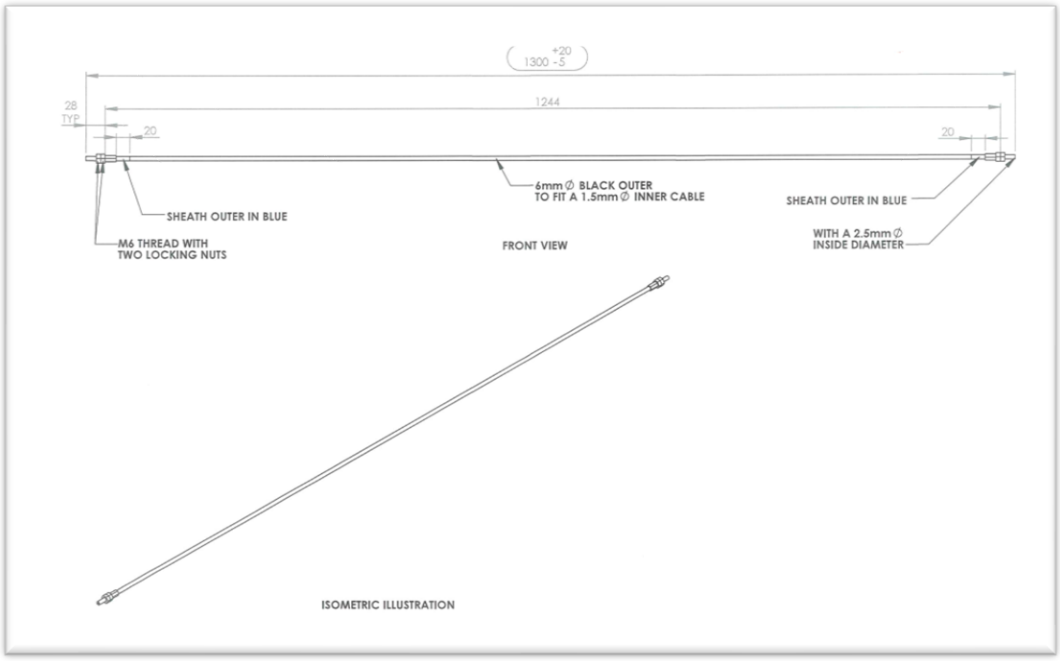

Illustration 4: Cable system architecture. (Source: Manufacturer)

Findings

1. The instructor was issued a Commercial Pilot Licence on 26 January 2023 with an expiry date of 31 January 2024. The instructor was issued a Class 1 aviation medical certificate on 22 September 2022 with an expiry date of 30 September 2023 with no medical limitations.

2. The aircraft was registered to the present owner on 31 August 2012.

3. The last 100-hour annual inspection was carried out on 21 October 2022 at 6 652.30 hours with an expiry date of 20 October 2023 or at 6 752.30 hours, whichever comes first.

4. The Authority to Fly (ATF) certificate was re-instated following the nose gear collapse incident (23 August 2022) and was issued on 17 January 2023 with an expiry date of 28 February 2024.

5. The approved person (AP) who certified the last aircraft inspection was issued an AP certificate on 8 June 2022 with an expiry date of 7 June 2024. The AP had an aircraft maintenance engineer (AME) licence that was issued on 11 May 2022 with an expiry date of 11 May 2024.

6. The aircraft maintenance organisation (AMO) that carried out the last annual inspection had an AMO certificate that was issued on 12 May 2022 with an expiry date 30 April 2023.

7. According to available information, the aircraft was approved for spiral dive exercises.

8. As part of continued airworthiness, the manufacturer issued a Service Bulletin (SB) with serial number 0019, dated 1 October 2021 to prevent potential loss of engine power malfunction during operation/flight. The AP stated that the throttle control cable was fitted to the aircraft on 19 February 2022 at 6 232.2 hours after the issuance of the mandatory SB (SB 0019, Rev.0 dated 1 October 2021), and this is recorded in the airframe logbook. Since installation, the cable had accrued a total of 445.5 hours.

9. Post-examination of the throttle cable revealed that some of the cable strands snapped from where they attach to the quadrant. The cable exhibited compression loads caused by the washer (Figure 2) and guillotined at both ends of the compression loads. The cable strand snapped on the weak points, unwound, and coiled around the cable inside the sleeve, thus, restricting movement when the throttle lever was advanced (increased) during the exercise. It is likely that during the throttle cable installation, the attaching hardware (AN3 low profile nut) was overly tightened/torqued. The torque value required to tighten the nut is 4 Newton-meters (Nm) according to the BRP Rotax Manual (connections for Bowden cable throttle actuation and permissible load). The throttle cable is an on-condition item inspected every 100-hour as per the Sling 2 Maintenance Manual, Revision 2.9 dated 10 November 2021.

10. Following the engagement with the manufacturer, they have since issued a Service Bulletin 0024, dated 1 June 2023, which supersede the Service Bulletin 0019.

11. The AIID database revealed one other report related to the engine throttle lever cable defect, with ZU-FUS being the second incident. The first incident was reported on December 2021 and was investigated by AIID (Ref: CA18/2/3/10042). The two incidents are a result of improper maintenance practices.

12. According to the Rotax Manual, in the event that the cable snaps, the engine reverts to full throttle because of the spring load fitted on the throttle body which, when in idle position, is pulled by the throttle cable against the spring.

Probable Cause(s)

In-flight failure of the throttle cable led to limited engine power because of the strand that had lodged into the cable insulation, limiting throttle movement.

Contributing Factor(s)

- Improper maintenance inspection of the throttle cable led to limited engine power due to the failed cable strand that was lodged into the protective insulation of the cable.
- Incorrect torque of the cable securing the nut and bolt, resulting in the failure of the cable strand.

Safety Action

The manufacturer issued a Service Bulletin 0024, dated 1 June 2023, which supersede the Service Bulletin 0019.

Safety Message and/or Safety Recommendation/s

Safety Recommendation: It is recommended that the manufacturer update the SB and include torque values and tools to be used during the installation of the cable to eliminate any ambiguity and misinterpretation of instructions by the end user.

Safety message: Authorised persons maintaining this type of aircraft are urged to adhere to instructions and procedures as laid out in the maintenance manuals and service instructions issued by the manufacturer for safe operation of aircraft and to prevent damage to aircraft and injury to persons.

About this Report

The decision to conduct a limited investigation is based on factors including whether the cause is known and the evidence supporting the cause is clear, the level of safety benefit likely to be obtained from an investigation and that will determine the scope of an investigation. For this occurrence, a limited investigation has been conducted, and the Accident and Incident Investigations Division (AIID) has relied on the information submitted by the affected person/s and organisation/s to compile this limited report. The report has been compiled using information supplied in the initial notification, as well as from follow-up desk top enquiries to bring awareness of potential safety issues to the industry in respect of this occurrence, as well as possible safety action/s that the industry might want to consider in preventing a recurrence of a similar occurrence.

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
In terms of Regulation 12.03.1 of the Civil Aviation Regulations (CAR) 2011 and ICAO Annex 13, 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.
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This report is issued by:
Accident and Incident Investigations Division
South African Civil Aviation Authority
Republic of South Africa