LIMITED ACCIDENT INVESTIGATION REPORT

Reference Number	CA18/2/3/10095								
Classification	Accident	**Date**	15 December 2021	**Time**	1520Z				
Type of Operation	Training (Part 141)								
Location									
Place of Departure	Wonderboom Aerodrome (FAWB), Gauteng Province		Place of Intended Landing		Wonderboom Aerodrome (FAWB), Gauteng Province				
Place of Accident	Approximately 2.2nm Northeast of FAWB, Gauteng Province								
GPS Co-ordinates	Latitude	25°38´29" S	Longitude	028°15´43.6" E	Elevation	4110ft			
Aircraft Information									
Registration	ZU-WMM								
Model/Make	Sling 2 (Serial number: 144)								
Damage to Aircraft	Destroyed		Total Aircraft Hours		2477.9				
Pilot-in-command									
Licence Valid	Yes	Gender	Male	Age	37				
Licence Type	Airline Transportation Pilot Licence (ATPL) Aeroplane								
Total Hours on Type	±26.5		Total Flying Hours		10 209.5				
People On-board	2+0	Injuries	0	Fatalities	0	Other (on ground)	0		
What Happened									

On Saturday afternoon, 15 December 2021 at approximately 1520Z, a flight instructor and a student pilot on-board a Sling 2 aircraft with registration ZU-WMM took off on a training flight from Runway 06 at Wonderboom Aerodrome (FAWB) in Gauteng province with the intention to return to the same aerodrome when the accident occurred. After take-off, during a simulated engine failure exercise, the engine could not achieve maximum revolution per minute (RPM) and did not respond to the throttle control inputs. The flight instructor did a fault finding (including opening and closing the throttle a few times) but the engine manifold pressure (MP) and the engine RPM remained at idle and did not increase to maximum power. The flight instructor took control of the aircraft and executed an emergency landing on an open field which was approximately 2.2 nautical miles (nm) Northeast of FAWB. During the landing on a wet land, the spring-loaded main landing gear detached from the underbelly attachment point then, the nose gear was bent aircraft collided with the parameter fence and the left wing collided with a fence pole. The aircraft sustained substantial damages and the flight instructor, and a student pilot disembarked the aircraft without assistance with no injuries

Figure 1: The aircraft at the accident site and the main landing gear strut (Source: pilot)

What was found:

The aircraft was fitted with the engine control unit (ECU) which was downloaded by the Aircraft Maintenance Organisation (AMO) on 16 December 2021. (Refer to figure 2 for raw data downloads)

The ECU revealed the following:

- The engine was running as normal throughout the flight with no abnormal indication parameters being recorded except for the indications of the throttle position sensor which contradict the throttle position as described by both pilots.

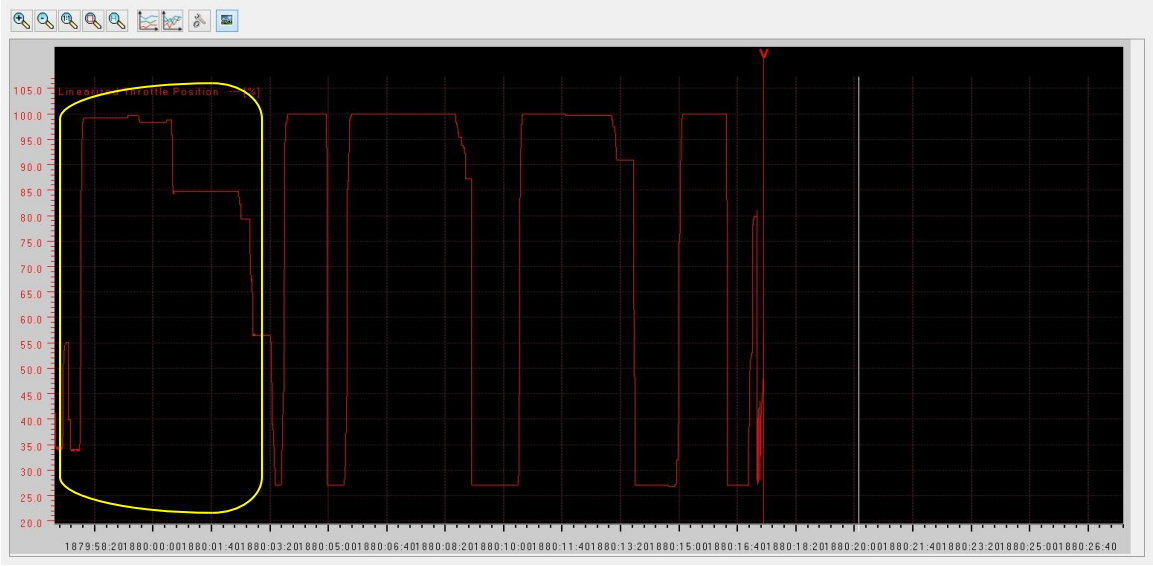

Figure 2: The throttle position sensor recordings

- The throttle sensor position varied between 28% and a max of 50% up until the time the aircraft was landed the above was a clear indication of a loss of engine power control attributed to an unresponsive throttle movement.

- The accident aircraft model had the Service Bulletin (SB)19--01102021 installed on 2 November 2021 at 48.9 hours prior to the accident it was is meant to prevent the possible loss of engine power control.

Sling Aircraft (Pty) Ltd Service Bulletin 19-01102021

1. SB19-01102021 released 1 October 2021 effective date 1 October 2021 stated that: This service bulletin provides the instruction for continued airworthiness for the throttle cables installed in the 912 and 915 iS fitted aircraft.

   Throttle cables should be replaced on all affected flying aircraft at the MPI including kit-built aircraft still under construction before first flight. However, prompt corrective action is required for aircraft experiencing throttle lag or non-responsive throttle. TABLE 1 shows the corrective action and compliance time for the 3 expected response types namely, responsive, lagging and non-responsive throttle.

- The AMO stated that: further investigation of the throttle system on the accident aircraft throughout the entire range of travel showed the following: The air filter housing had witness marks from the throttle lever cable (see figure 3). During the investigation, the throttle lever was recycled, and it revealed that during flight the air filter housing is pushed back by the high airflow and as a result, it limits the movement of the throttle lever into a full forward position. The throttle cable attachment bolt does not swivel, the lock nut is used as a result the cable tends to bend when the throttle lever is pushed forward and as a result, the flexible cable does not reach a full position when the throttle lever is pushed forward.

Figure 3: Witness marks left on the air filter housing

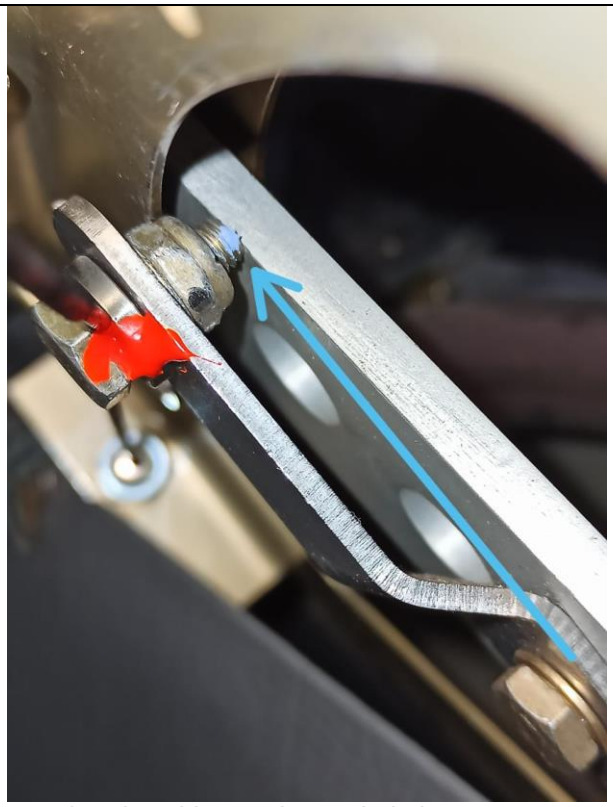

Figure 4: Throttle cable attachment bolt that was torque sealed

- The AMO inspected a further two aircraft within their air training organization (ATO) fleet and indicated the same witness marks of the air filter housing and interference with the throttle lever cable.

- The last annual maintenance inspection on the aircraft was certified on 2 November 2021 at 2429.0 airframe hours. The aircraft had accumulated an additional 48.9 airframe hours in operation since the last inspection was completed. There were no reported or recorded defects prior to the accident flight as all damages were related to the accident.

According to the original equipment manufacturer (OEM)

- After the accident on 17 and 18 December 2021 they sent their production manager to go and see the wreckage of ZU-WMM and reported back to the chief aeronautical engineer and the accountable manager.
- On 4 January 2022, the chief aeronautical engineer went to see the wreckage himself. On 19 January 2022, the chief quality inspector and the chief test pilot also went to see the wreckage.

The OEM staff findings:

- SB 19 was not done properly as the cable retaining bolt on the throttle quadrant lever side was torque sealed see figure 4 above in such a way that it prevents free rotation as required by the SB.
- The air filter housing was not tied back and limited the movement of the throttle lever into a full forward position.
- There was a section of throttle cable which was left extending beyond the throttle arm attachment bolt which was interfering with air filter housing.
- The SB was done by an unapproved person under the aircraft maintenance organization (AMO) company authorization.

- The chief quality inspector then did SB 19 on ZU-LZR and ZU-FCT to ensure that a similar accident does not happen again on the operator's aircraft.

THROTTLE SYSTEM EXPLANATION FOR SLING AIRCRAFT USING 912 IS AND 915 IS ENGINES. (Source: OEM)

a. The throttle mechanism on the engine side is a sprung throttle arm which is directly attached to a throttle position sensor ("TPS" – which is used by the engine ECU to adjust fuel injector open time) and a butterfly valve that opens to allow more air into the engine cylinders as the throttle is advanced. The throttle arm is sprung towards wide open throttle, so that if the throttle cable from throttle quadrant to throttle arm fails, the engine goes to wide open throttle, not to idle. This is standard aircraft practice and is implemented by the engine manufacturer, namely Rotax, for safety related reasons.

b. As the throttle lever is advanced on the throttle quadrant, which is positioned in the centre console inside of the cockpit, the throttle cable is accordingly released by the throttle lever, rather than pulled by it. As the cable is released by the throttle lever, the engine side throttle arm spring pulls the throttle arm forward, advancing the throttle.

c. Although the spring on the throttle arm, which is supplied by the engine manufacturer, is reasonably powerful, it is essential that when the throttle lever is advanced, the throttle cable is able to slide easily, with low friction, through the cable housing / sheath, so that the throttle arm spring can pull it through without resistance and advance, thereby increasing engine power. (The Rotax engine installation manual contemplates just such a system – see Rotax Installation Manual 73-00-00.

d. SB 19 was developed and published by Sling because it had come to Sling's attention that, with aging, exposure to dust and dirt, corrosion or poor installation technique, throttle cable friction can increase, requiring more spring force from the throttle arm side to pull the cable through the cable sheath. The consequence of that increased resistance, in its most extreme form, is that when the throttle lever in the throttle quadrant is advanced, the spring on the (engine side) throttle arm could become insufficiently powerful to pull the cable through the cable sheath, and the released cable in the throttle quadrant could, instead of being pulled through, instead kink and collect in the throttle quadrant. (See images in SB19. Under such circumstances, the throttle of course does not open, and engine power does not increase.

- A further important aspect associated with minimizing cable tension / friction between throttle quadrant and engine throttle arm, is that the cable retaining bolt positioned in the throttle lever itself must be able to swivel freely, so that the cable is able to easily and naturally align with the outer sheath. The cable retaining bolt is carefully designed to ensure such free swivelling. In the system is designed with minimization of resistance to the cable sliding from the throttle quadrant to the engine throttle arm in mind.

- In order to minimize resistance to the cable pulling through from throttle quadrant to throttle arm, SB 19 incorporated a design change to the applicable aircraft in which the cable sheath was upgraded to include a Teflon inner liner not present in the initial design, significantly decreasing cable friction in the sheath. The design change represents a design improvement. The improvement was made to a system that had already been in place for more than 5 years and had generally proven sufficiently safe and robust. The design change incorporates only an improved cable sheath, with Teflon inner.

The OEM stated that:

- It was not the throttle arm itself, but the section of throttle cable which was left extending beyond the throttle arm attachment bolt that interfered with the air filter housing box.

- The interference between the sprung engine throttle arm side of the throttle system and the air filter housing box was aggravated by the fact that the cable retaining bolt on the throttle quadrant lever side had been torque-sealed in such a manner as to prevent its free rotation, in direct contradiction of the requirements of the Service Bulletin (see Clause 3.2(c) of SB0019).

Conclusion:

- The SB was done by an unapproved person under the aircraft maintenance organization (AMO) company authorization. The SB was dual inspected by two approved people of the AMO. This is allowed as per Civil Aviation Regulations Part 44.01.4(1) (b) below. Both APs did not see that the cable retaining bold was not supposed to be torque sealed and should be free swivelling as specified in the SB
- The throttle cable is flexible and not solid it is possible for it kink, and there was a section of the throttle cable that was left extending beyond the throttle arm attachment bold that interfered with the air filter housing box, it did not advance as needed because of some interference of the system with the air filter housing box.
- The section of the throttle cable that was left extending beyond the throttle arm attachment bold should have been bend back and, if necessary, tie off the end to prevent interference.
- The air filter housing box should be effectively secured to prevent it from obstructing the throttle cable.

Persons to carry out maintenance

44.01.4 (*1) No person may carry out maintenance on an amateur built aircraft or a production-built non-type certificated aircraft, or any component thereof, unless such person—*

(a) is appropriately rated or approved on type by the Director or the organisation designated for the purpose in terms of part 149, as the case may be, to carry out maintenance; or

(b) carries out the maintenance under the prescribed supervision of a person authorised by the Director or by the organisation referred to in paragraph (a). A dual check of the maintenance carried out must be performed by a person referred to in subparagraph (a); or

(c) is the owner of the aircraft provided that an appropriately rated approved AMO, AME or Approved Person, rated in accordance with subpart 4 of part 66, performs a dual check on the maintenance which was carried out; or

(d) is an appropriately rated approved AMO, AME or approved person, rated in accordance with subpart 4 of part 66.

(2) (a) Components and parts intended to be used on non-type certificated aircraft may be fabricated by a person or organisation not licensed in terms of part 66 or part 145.

(b) The owner of the aircraft must provide the Director, or the organisation designated for the purpose in terms of part 149, as the case may be, with evidence that the components or parts meet the minimum specification for the component or part as specified by the Original Equipment Manufacturer.

(c) An appropriately rated approved AMO, AME or approved person, rated in accordance with subpart 4 of part 66 shall sign off the component or part in the appropriate logbook.

Probable cause:

During the simulated engine failure exercise, the engine could not regain power due to the air filter housing limiting the movement of the throttle lever cable into full forward position causing the engine RPM not to reach the desired power. This resulted in the pilot executing a forced landing in an open field and collided with parameter fence.

Safety Action/s

Following the accident, the OEM quality inspector did SB19 correctly on two aircraft which belong to the operator.

Safety Recommendations:

None.

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****.*

About this Report

Decisions regarding whether to investigate, and the scope of an investigation are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, no 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 brief report. The report has been compiled using information supplied in the initial notification, as well as follow-up information 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 accident.

This report provides an opportunity to share safety message/s in the absence of an investigation.

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.

Disclaimer

This report is issued by:

Accident and Incident Investigations Division
South African Civil Aviation Authority
Republic of South Africa