AIRCRAFT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/9483		
Aircraft Registration	ZU-FZF	**Date of Accident**	25 September 2015		**Time of Accident**	0945Z	
Type of Aircraft	Sling 2		**Type of Operation**		Private Part 61		
Pilot-in-command Licence Type	PPL		**Age**	43	**Licence Valid**	Yes	
Pilot-in-command Flying Experience	Total Flying Hours		171.9		Hours on Type	4	
Last point of departure	Grand Central Airport (FAGC), Gauteng Province						
Next point of intended landing	Grand Central Airport (FAGC), Gauteng Province						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
Near Eagles Creek Airfield at an open field near the N14 highway (GPS coordinates: S25°54'23.59" E028°02'19.88")							
Meteorological Information	Wind direction: 120º; wind speed: 6 kt; air temperature: 32ºC; visibility: CAVOK; cloud base: 4 500 ft; cloud cover: SCT045						
Number of people on board	1 + 1	**No. of people injured**	0	**No. of people killed**	0		
Synopsis							

The pilot accompanied by a passenger (his son) was engaged on a scenic flight at the time the accident occured. The pilot was operating in the area towards north-westerly side of Grand Central Airport (FAGC), within a distance of 30 nm. During return flight, at approximately 7 nm while inbound to FAGC, the pilot noticed two red light indications for engine oil pressure, followed by the engine running rough. At this time the pilot contacted FAGC air traffic control (ATC) and broadcasted a MAYDAY call, and advised of the situation of the engine failure. Thereafter, the pilot surveyed the surrounding area and noticed Eagle Creek Airfield, where he opted to land; however, he was unsuccessful. The aircraft force-landed on the N14 highway which was not busy at the time of the accident. During landing, the aircraft impacted hard with the surface and both nose gear and the right main gear collapsed during the accident sequence. The aircraft sustained substantial damage to the landing gears, propeller, engine and the left wing leading edge.

The post-accident investigation revealed that the cause of the forced landing was due to engine failure during flight as a result of insufficient lubrication To include injuries on synopsis.

Probable Cause

The aircraft accident was due to hard landing following a unsuccessful forced landing following an engine failure.

Contributing Factors:

1. Engine failure was due to insufficient lubrication following an rotary oil seal failure, allowing oil venting
2. The seal failed following damage resulting from wrong technique used during maintenance

SRP Date	28 March 2017	Release Date	05 May 2017

AIRCRAFT ACCIDENT REPORT

Name of Owner	**:** Slingstar Aviation (Pty) Ltd
Name of Operator	**:** Aviation Towards Success (ATS)
Manufacturer	**:** The Airplane Factory (Pty) Ltd
Model	**:** Sling 2
Nationality	**:** South African
Registration Marks	**:** ZU-FZF
Place	**:** N14 highway at Centurion, Gauteng Province
Date	**:** 25 September 2015
Time	**:** 0945Z

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 (1997) this report was compiled in the interests of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and ***not to establish legal liability****.*

Disclaimer:

This report is produced without prejudice to the rights of the CAA, which are reserved.

1. FACTUAL INFORMATION

1.1 History of Flight

1.1.1 The pilot, accompanied by a passenger (his son), was engaged on a private scenic flight in the north-westerly area from Grand Central Airport (FAGC), within a range of approximately 30 nm. The pilot was operating under private capacity as a hire-and-fly from the training school. During the return flight, while executing a 180º right turn inbound for FAGC, the pilot noticed two red warning indications for engine oil low pressure. The lights indication was followed by the engine running rough and then failing. The pilot then attempted a restart and noticed dark smoke coming from the engine compartment. At this time the pilot contacted the FAGC tower, and broadcasted a MAYDAY call and reported his situation.

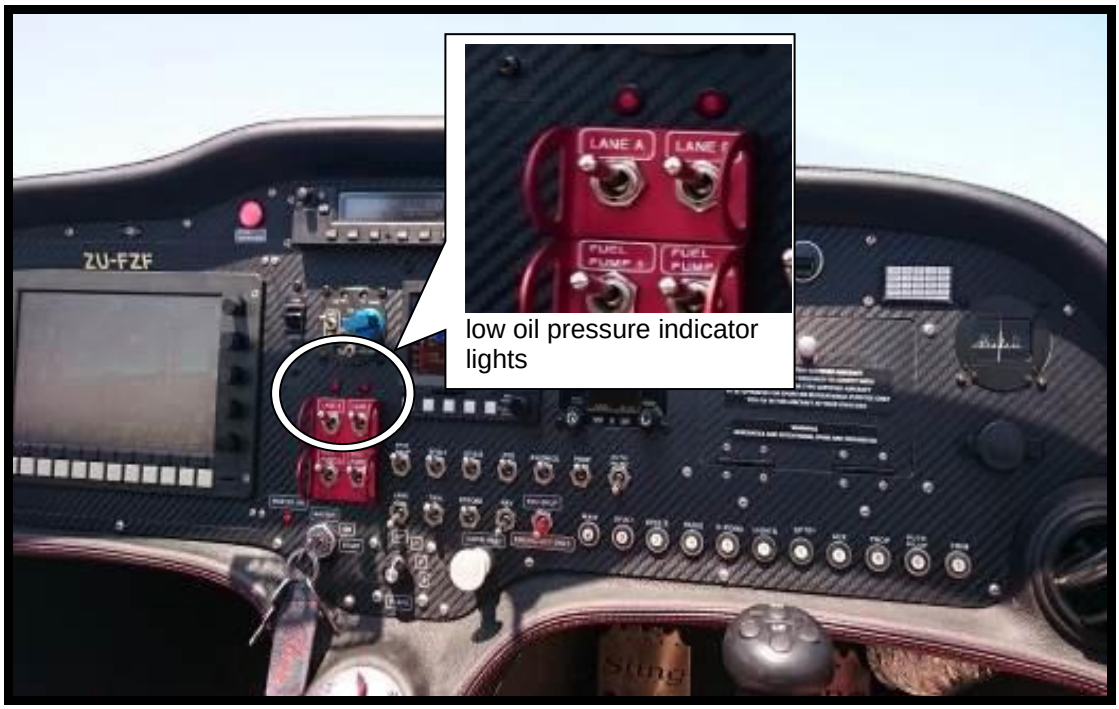

Figure 1: The low oil pressure indicator lights

Note: According to the pilot, the picture was taken during flight by the passenger at the time of engine failure.

1.1.2 The pilot then surveyed the surrounding area and noticed Eagle's Creek Airfield on his right hand side. The FAGC tower asked the pilot if he could make it to FAGC, but the pilot answered negative and advised that he was going to attempt landing at Eagle's Creek Airfield as it was nearer. The tower lost contact with the aircraft and noticed on their radar that there was another aircraft (ZS-PTK) inbound to FAGC from the westerly direction, and asked them to assist in locating the accident aircraft. The pilot of ZU-FZF executed another right turn to head towards Eagle's Creek.

1.1.3 When ZS-PTK was approximately 1 nm from the accident aircraft, the pilot of ZU-FZF contacted FAGC tower via a cellular phone and informed them that they were on the ground on the left side of the N14 highway to Pretoria near Eagle's Creek airfield. The pilot further informed the tower that they had not sustained any injuries but the aircraft was damaged. The aircraft sustained substantial damage to the nose landing gear, right landing gear, engine, propeller and the left wing outer leading edge.

1.1.4 The accident occurred in a daylight visual meteorological conditions across the N14 highway near Eagle's Creek Airfield (GPS coordinates: S25°54'23.59" E028°02'19.88") at a field elevation of 4 855 ft.

1.2 Injuries to Persons

1.2.1 The pilot and his passenger did not sustain any injuries

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

1.3 Damage to Aircraft

1.3.1 The aircraft sustained substantial damage to the nose landing gear, right landing gear, engine, propeller and the left wing outer leading edge and structure.

Figure 2: The aircraft as it came to a full stop

1.4 Other Damage

1.4.1 Damage was limited to minor highway road scraping after the landing gear collapsed.

1.5 Personnel Information

1.5.1 Pilot-in-command:

Nationality	South African	Gender	Male	Age	43
Licence Number	0272308321	Licence Type	Private pilot		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	None				
Medical Expiry Date	30 August 2016				
Restrictions	Corrective lenses				
Previous Accidents	None				

1.5.2 Pilot-in-command Flying Experience:

Total Hours	171.9
Total Past 90 Days	4
Total on Type Past 90 Days	4
Total on Type	4

1.5.3 The pilot was a newly qualified pilot with relevant qualification for the flight. The last time the pilot flew an aircraft was 10 December 2014 prior to returning to do convention flight training on a Sling aircraft type. The pilot accumulated four flying hours on a Sling 2 aircraft type over a period of 27 days, during which he flew only four times.

1.6 Aircraft Information

1.6.1 Airframe:

The Sling 2 airplane is a South African two-seater light aircraft designed and produced by The Airplane Factory in Johannesburg, South Africa. In 2009 the specially modified second prototype was flown around the world in a westerly circumnavigation that took 40 days. This was the first time any aircraft of this class had achieved a circumnavigation. The design complies with the requirements of four different regulatory aircraft classes. The Sling 2 is supplied as a kit and as a ready-to-fly aircraft, and can be operated as a light-sport aircraft or home-built aircraft. The aircraft is powered by a 100 hp (75 kW) Rotax 912 IS engine, which drives a three-bladed Airmaster AP332 72” propeller. The airplane features a sliding

canopy and large fuel tanks, and standard equipment includes a "glass cockpit" style display.

Type	Sling 2	
Serial Number	132	
Manufacturer	The Airplane Factory (Pty) Ltd	
Date of Manufacture	2013	
Total Airframe Hours (At time of Accident)	1 159.0	
Last MPI (Date & Hours)	11 September 2015	1 147.7
Hours since Last MPI	11.3	
C of A.T.F (Issue Date)	8 July 2015	
C of A.T.F (Expiry Date)	14 June 2016	
C of R (Issue Date) (Present owner)	3 July 2015	
Operating Categories	Training Part 61	

1.6.2 Engine:

Type	Rotax 912 IS
Serial Number	4417397
Hours since New	1 191.5
Hours since Overhaul	TBO not yet reached

1.6.3 Propeller:

Type	Airmaster AP332 72”
Serial Number	T13298
Hours since New	677.9
Hours since Overhaul	TBO not yet reached

1.6.4 The aircraft documentation (such as maintenance logbooks, service bulletins and latest mandatory periodic inspections) was studied and reviewed. All service bulletins published by the engine and aircraft manufacturers were adhered to and complied with by the aircraft maintenance organisation (AMO)/approved personnel. The information provided indicated that the aircraft engine was maintained by the Rotax engine type model accredited personnel.

1.6.5 On the day of the accident the aircraft had enough fuel on board for the flight and, with two occupants on-board, the weight was within limits.

1.7 Meteorological Information

1.7.1 Meteorological report as obtained from the official SAWS website.

Wind direction	120º	Wind speed	6 kt	Visibility	CAVOK
Temperature	32ºC	Cloud cover	SCT 045	Cloud base	4 500 ft
Dew point	None				

1.8 Aids to Navigation

1.8.1 The aircraft was equipped with the standard factory-fitted navigational equipment approved by the Regulator. There were no recorded defects to navigational equipment prior to the flight.

1.9 Communications

1.9.1 The aircraft was equipped with one very high frequency (VHF) radio approved by the Regulator. There were no recorded defects regarding the communication equipment prior to the flight. The frequency used between the pilot and the FAGC tower was 125.80 MHz. Later, after landing, the pilot contacted the FAGC tower using a cellular telephone and advised them about his forced landing.

1.10 Aerodrome Information

1.10.1 The aircraft accident occurred on the left side of N14 highway to Pretoria near Eagle's Creek during an attempt to make a forced landing.

Aerodrome Location	Eagle's Creek Airfield	
Aerodrome Co-ordinates	S25°54'23.59", E028°02'19.88"	
Aerodrome Elevation	4 855 ft	
Runway Designations	08/26	
Runway Dimensions	1 250 m x 20 m	
Runway Used	Intended	
Runway Surface	Tar	
Approach Facilities	None	

1.11 Flight Recorders

1.11.1 There were no flight data recorder or cockpit voice recorder) installed, neither were they required by regulations.

1.12 Wreckage and Impact Information

Figure 3: The aircraft path and the contact points

1.12.1 The aircraft forced landing occurred on the N14 highway near the intended diversion airfield. During a turn towards the intended identified landing airfield, the aircraft began to lose height at a high rate of descent. During approach, the aircraft was heading at an angle of approximately 45° toward the intended runway. The pilot attempted to control the aircraft during glide, however the aircraft contacted the ground hard between the two opposite road traffic space and bounced onto highway to Pretoria. The aircraft came to a full stop at approximately 55 m from the runway centreline, which was at approximately 33 m from the threshold of Runway 26.

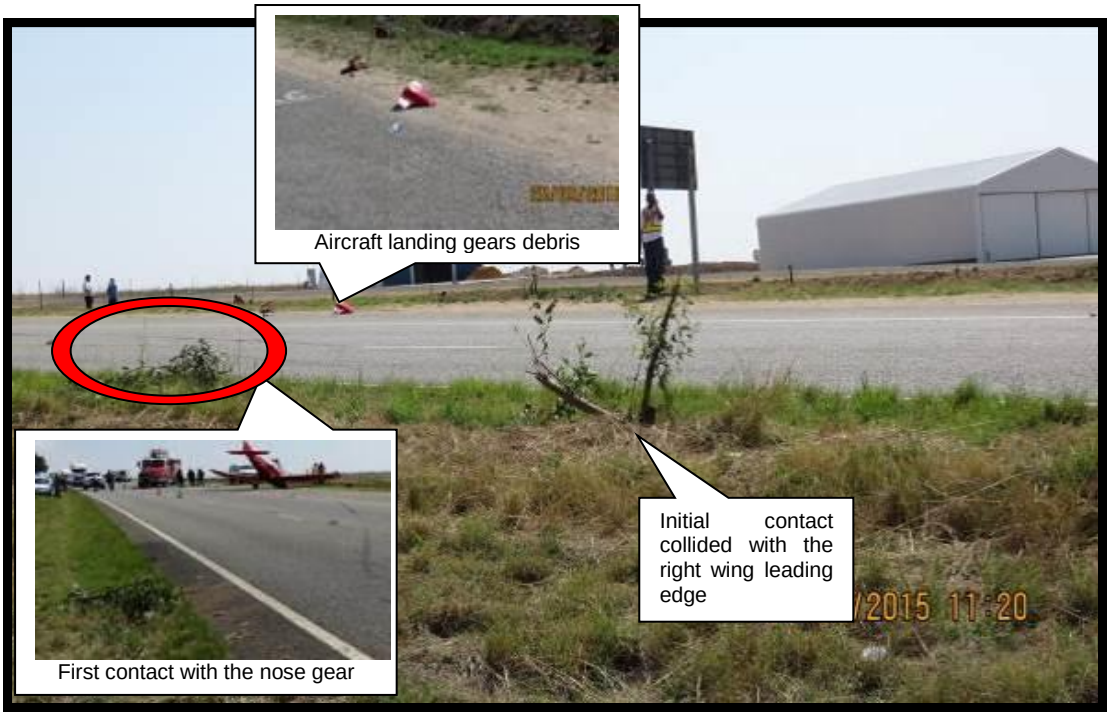

Figure 4: Shows the aircraft path and the contacts points

1.12.2 The aircraft impacted at a low angle and in a slight left roll attitide. During impact, the aircraft contacted the ground hard with the main landing gears and the left wing outer part first, approximately 70 m away from the wreckage resting point, and bounced. Upon contact the left wing sustained structural damage, with visible bending on the leading edge caused by collision with a small tree. The left main landing gear was pushed into the wing bottom, causing damage under the left wing.

Figure 5: The aircraft as it came to stop

During the second contact, at approximately 15 m from the initial contact point, the nose wheel impacted and collapsed and then detached from the wheel assembly. The nose wheel caused more damage to the aircraft bottom surface as it detached. Two blades of the three-bladed propeller contacted the ground and sustained damage. This was followed by the nose section scraping along the tar road surface as the aircraft crossed the road until the aircraft came to a full stop. The nose wheel was found on the right side of the plane, across the road, approximately 4 m away from the main aircraft wreckage.

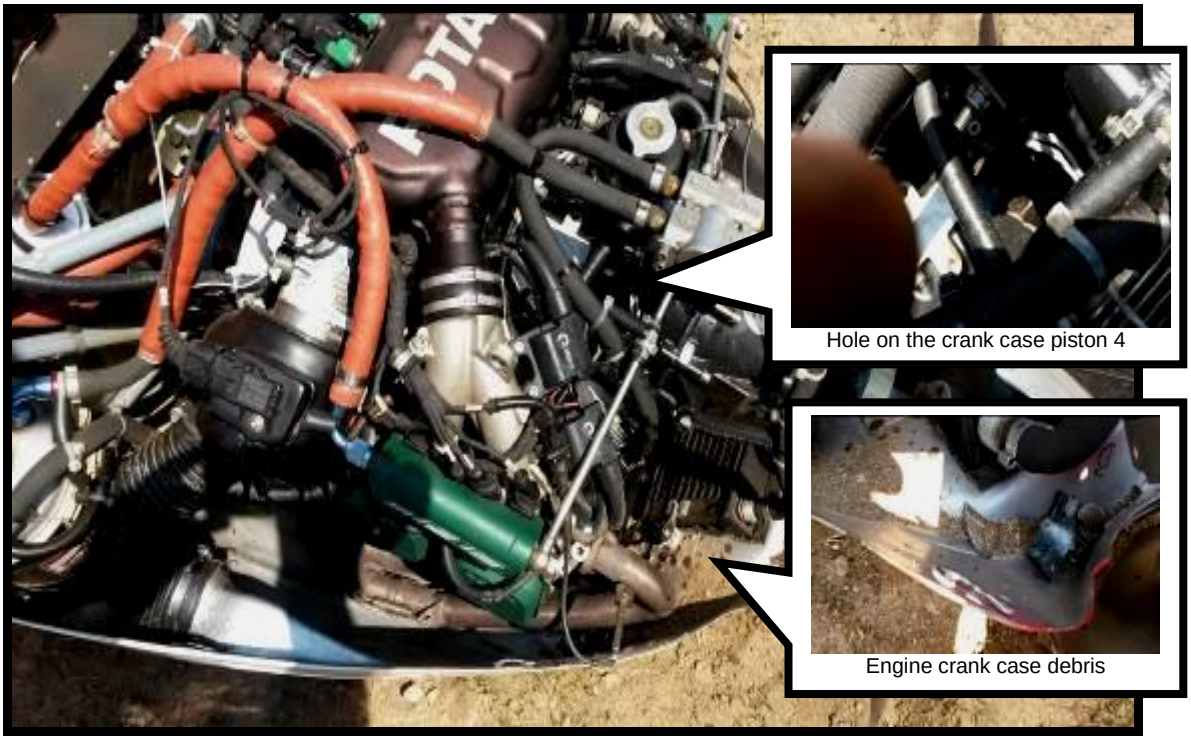

Figure 6: Damage on the engine

1.12.3 Beside airframe damage, there was more visible damage observed on the engine crank case next to piston number 4's cylinder. The aircraft wreckage was fairly localised within a radius of 10 m. The aircraft came to a full stop across the road, with the aft part of its tail protruding onto the road, causing traffic obstruction on one road traffic lane.

1.13 Medical and Pathological Information

1.13.1 The pilot held a valid class 1 aviation medical certificate with waivers (corrective lenses). The pilot had no medical condition that may have prevented him from flying the aircraft, and he was making use of his corrective lenses at the time of flight. The pilot and passenger did not sustain any injury during the accident sequence.

1.14 Fire

1.14.1 There was no pre or post-impact fire during the accident sequence.

1.15 Survival Aspects

1.15.1 The accident was considered survivable due to the attitude angle at which the aircraft impacted the ground. The aircraft was equipped with shoulder harness and the pilot and his passenger were making use of them.

1.16 Tests and Research

1.16.1 The following tests were conducted on the engine following evidence of crank casing damage, by a Rotax engine type model accredited personnel.

1. Engine control unit data analysis
2. Engine tear down inspection

1.16.1.1 Engine control unit:

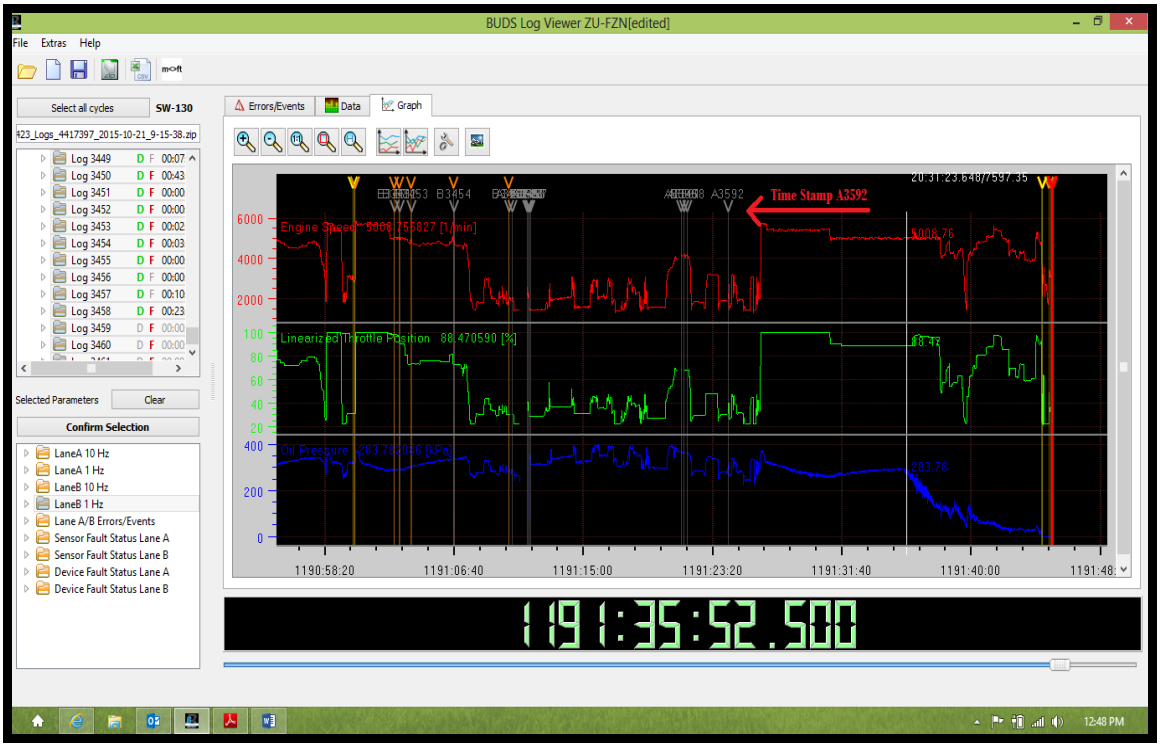

Figure 7: ECU data log of last few flights

Figure 7 above represents the ECU log for the last few flights of the aircraft prior to

the engine failure. The arrow drawn in the image above represents a time stamp. A time stamp demonstrates to the technician the point in time at which the lanes were cycled, showing also the time when the aircraft was turned on.
1191:24:20.000 – Start of engine.
(Engine Hours: Minutes: Seconds. Split Seconds)
1191:45:11.000 – Engine failure, complete stop.
(Engine Hours: Minutes: Seconds Split Seconds)

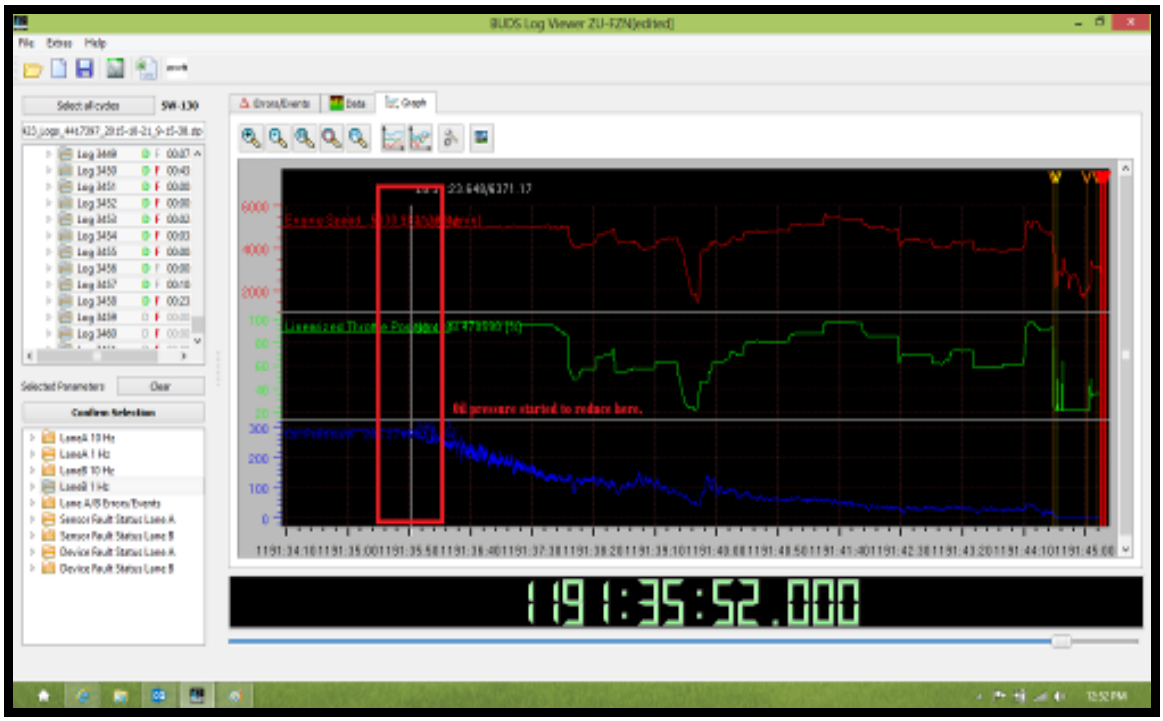

Figure 8: The ECU log for the accident flight

Figure 8 above shows that at 1191:35:52.000 the oil pressure started reducing, highlighted in the red block. The oil pressure, prior to the failure of the water pump impeller oil seal, was between 2.8 bar and 3.0 bar. As represented in figure 8, the throttle position was set between 88% and 100% with a revolutions per minute (RPM) of 5 000 before oil pressure started reducing in the engine.

Figure 9 below would appear to illustrate the time that the pilot noticed that the oil pressure was low, resulting in his reduction of the throttle setting. The time stamp is 1191:37:46.500. From the time the oil pressure dropped from the normal 2.8 bar to low (CAUTION) 1.2 bar, it took the pilot from 1191:35:52.000 to 1191:37:46.500, which is 2 minutes and 32 seconds, to react. In the image above you can see that once the pilot noticed the oil pressure at 1.2 bar, he reduced the throttle setting from 95% to 48% bringing the RPM to 4 000. After 40 seconds the pilot further reduced power to 22%, reducing RPM to 1 700; the oil pressure then reduced further to 0.47 bar.

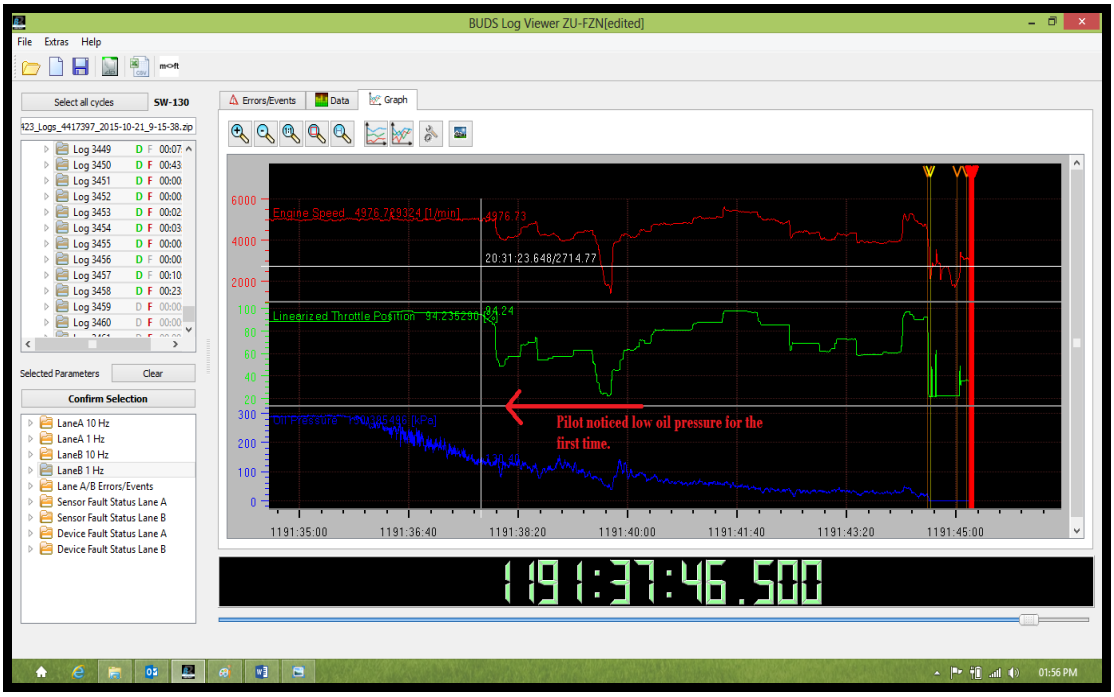

Figure 9: The pressure warning initiating stage

The Rotax operator's manual stipulates that 0.8 bar is minimal oil pressure below 3 500 RPM. The RPM was well above 3 500 for 4 minutes.

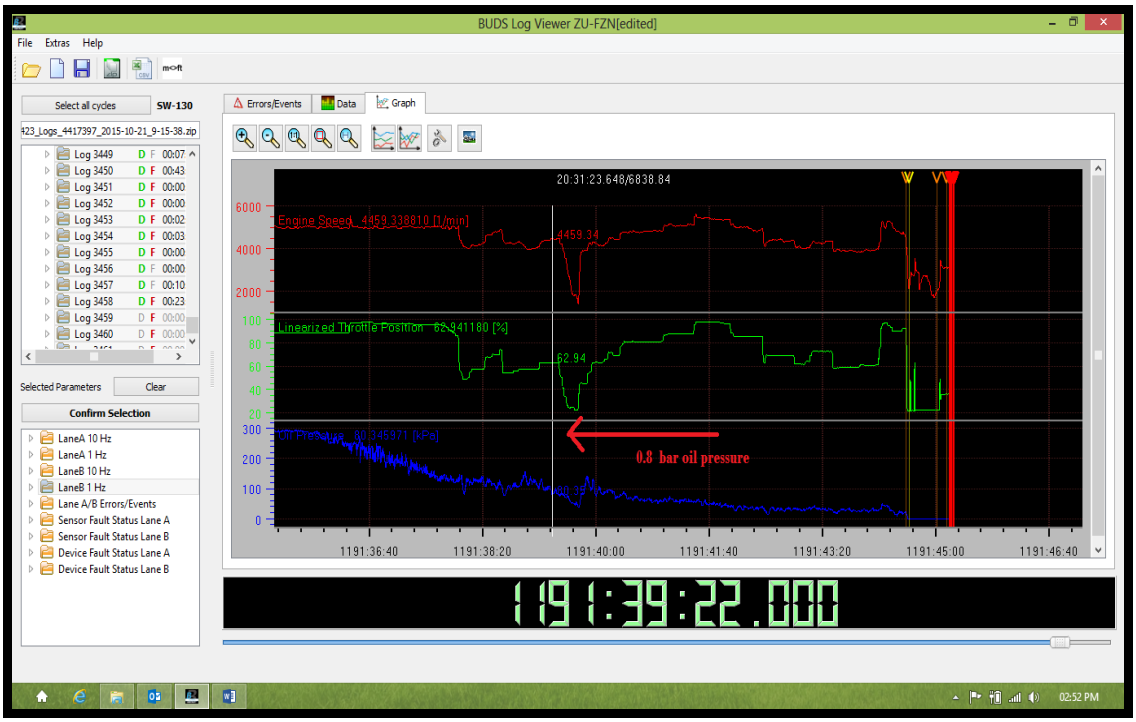

Figure 10: When oil pressure reached 0.8 bar

Figure 10 illustrates when the oil pressure reached a minimum 0.8 bar at time stamp 1191:39:22.000. The oil pressure reached 0.8 bar and continued reducing over a period of 5 minutes, until it reached 0.2 bar. Once the oil pressure reached 0.0 bar the engine ran for a further 1 minute and 17 seconds before the engine

completely shut down as a consequence of the connecting rod failure on cylinder number 1.

1.16.1.2 Engine teardown:

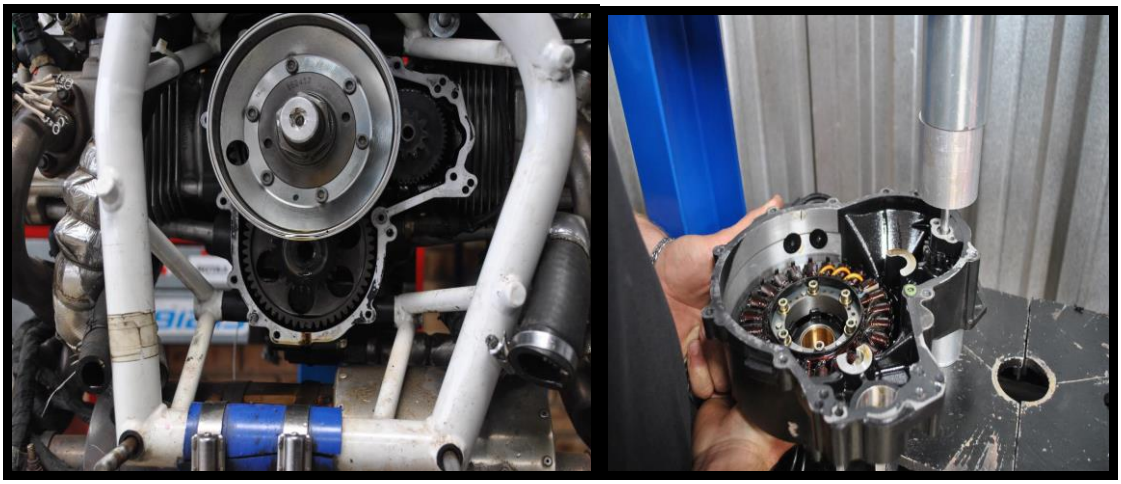

Figure 11: Removal of the ignition housing

The ignition housing and associated components and the impeller shaft were removed to inspect the rotary seal and associated oil seal. On inspection, the oil seal was clearly damaged, the shaft sealing lip appearing to have separated from the seal.

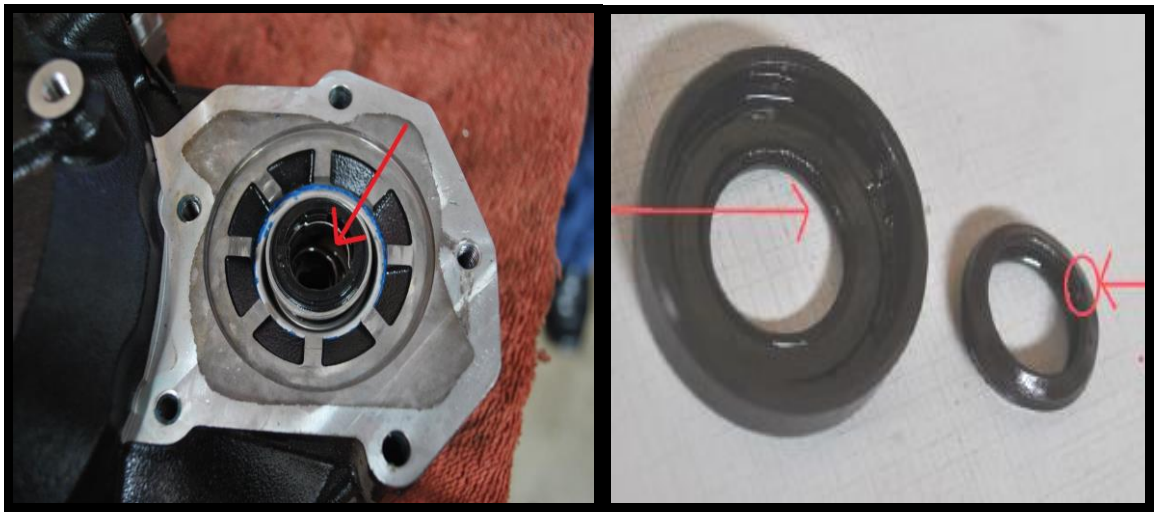

Figure 12: The oil seal damage during installation

Since the ignition housing, impeller, rotary and oil seal had been removed (to access the engine stator) some 10 hours prior to the failure, it was speculated that in re-assembly the oil seal may have been damaged, leading to its failure. The precise events leading to the engine failure itself could be substantially gleaned by reference to the record contained in the flight log on the ECU for the engine. The logs were downloaded onto an AMO computer using the Rotax-developed BUDS

system applicable to the engine, and which the AMO uses regularly to diagnose engine operational issues. The files are also regularly downloaded by the AMO and transmitted to Rotax by email.

Figure 13: Wrong installation pattern

Figure 14: Correct installation pattern

During seal installation mistakes can be made, as demonstrated by Rotax during the maintenance induction course on how to install the seal. When inserting the shaft with a wrong pattern, the oil seal gets damaged easily as it stretches. The shaft is installed inside out to allow compression on the seal during fitting, as opposed to stretching the seal.

1.17 Organizational and Management Information

1.17.1 The engine was maintained by personnel who were accredited for several series of Rotax engines, including the specific engine type model that was the latest design.

1.17.2 The aircraft was operated by an organisation that holds a valid air-service certificate (AOC), which was due to expire on 30 November 2015.

1.17.3 This was a private flight, which was a hire-fly operated under guidance of a valid ATO, Part 135.

1.18 Additional Information

1.18.1 The aircraft engine was also taken to the airframe manufacturer following the finding of the engine teardown by accredited Rotax personnel. There was no feedback received from the manufacturer.. Should the manufacturer's report reveal

any other factors contributing to the engine failure, the report will then be re-opened and amended accordingly.

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

2.1 The pilot was qualified and licensed for the flight in accordance with the existing regulatory procedures requirements. He was medically fit and held a valid medical certificate, expiring on 30 August 2016. At the time of the accident flight, the pilot had just converted to the aircraft type and had accumulated a total of 4 flying hours.

2.2 On the day of the flight, the pilot was engaged in a scenic flight with his son. While turning to fly back to FAGC, the accident occurred. When he noticed the engine oil low pressure lights, the pilot contacted FAGC ATC and alerted them to his situation. As the situation worsened, the pilot diverted to a possible nearest landing location, which was a good decision to make at the time. Without full knowledge of what was happening with the engine, the pilot attempted to restart the engine, causing further damage and the engine to fail completely.

2.3 At the time of the initial low oil pressure lights going on, the oil was escaping the engine after the seal failed. After sufficient oil had run out, lubrication was insufficient, which led to number 4 connecting rod failure due to metal-to-metal friction, and damaging the engine top casing prior to total failure.

2.4 Post engine investigation revealed that the engine oil/water seal was damaged. The damage on the oil/water seal was consistent with damage caused during maintenance.

The investigator, considering advice from the accredited maintenance personnel, is of the opinion that during maintenance a wrong technique was used to insert the shaft through the seal (Figure 13). When using this technique to insert the shaft, damage is caused to the seal. When the shaft is forced through the seal's tapered hole, it stretches the seal neck and causes it to weaken. When more excessive force is applied, seal material damage results, without the technician noticing. During operation, the seal will fail over time as pressure builds up.

2.5 On the day of the flight, the pilot was accompanied by his son as a passenger. This might have increased the pilot's stress, particularly during the forced landing as the pilot noticed that the aircraft was aiming for a national highway road with active traffic. The aircraft contacted the ground hard at a slight roll angle to the left and then bounced. On second contact with the ground, the aircraft landing gears were damaged and the nose landing gear detached, causing more damage to the left wing bottom, and the aircraft came to a full stop with the nose pointing down.

2.6 Neither the weather nor the fuel was considered contributing factors to the accident.

3. CONCLUSION

3.1 Findings

3.1.1 The pilot was qualified for the flight in accordance with the existing regulations. He held a valid medical certificate which was valid until 30 August 2016.

3.1.2 According to the pilot flying records, he was a recent convert on the aircraft model type with a maximum of four aircraft flying hours.

3.1.3 The aircraft has a valid certificate of authority to fly expiring on 30 November 2015.

3.1.4 The engine was maintained by personnel who were accredited for several series of Rotax engines, including the specific engine type model that was the latest design.

3.1.5 Incorrect installation caused damaged and let to oil starvation.

3.1.6 There were no other reported defects relating to airframe and aircraft operational systems.

3.1.7 The aircraft engine failed due to insufficient lubrication following oil seal failure, which allowed oil venting.

3.1.8 The aircraft approach was at a high rate of descent and was off course from the left hand side towards the intended landing runway, following diversion due to engine failure.

3.2 Probable Cause/s as per synopsis

3.2.1 The aircraft accident was due to hard landing following a unsuccessful forced landing following an engine failure.

3.3 Contributing Factors

3.3.1 . Engine failure was due to insufficient lubrication following a rotary oil seal failure, allowing oil venting

3.3.2 The seal failed following damage resulting from wrong technique used during maintenance

4. SAFETY RECOMMENDATIONS

4.1 This incident serves to underline the importance of ensuring that all maintenance is completed entirely and correct. The incorrect installation of oil seal caused damaged and let to oil starvation, this starved the engine of oil and led to the engine power loss in flight. It therefore recommended that the Director of Civil Aviation during the safety oversight activities bring to the attention of aviation maintenance organisation the human factor errors made in the maintenance environment.

5. APPENDICES

5.1 None.