SOUTH AFRICAN CIVIL AVIATION AUTHORITY

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

LIMITED OCCURRENCE INVESTIGATION REPORT – FINAL

Reference Number	CA18/2/3/10441						
Classification	Accident	**Date**	15 April 2024		**Time**	0915Z	
Type of Operation	Private (Part 94)						
Location							
Place of Departure	Stellenbosch Aerodrome (FASH), Western Cape Province	Place of Intended Landing	Tedderfield Air Park (FATA), Gauteng Province				
Place of Occurrence	Open field near Touws River, Western Cape Province						
GPS Co-ordinates	Latitude	33°19'13.97"S	Longitude	19°51'33.62"E	Elevation	2659ft	
Aircraft Information							
Registration	ZU-MND						
Make; Model; S/N	Sling 4 TSI (Serial Number: 432s)						
Damage to Aircraft	Substantial	Total Aircraft Hours	84.6				
Pilot-in-command							
Licence Type	Private Pilot Licence (PPL) Aeroplane	Gender	Male	Age	23		
Licence Valid	Yes	Total Hours	101.6	Total Hours on Type	79.5		
Total Hours 30 Days	12.5	Total Flying on Type Past 90 Days	21.7				
People On-board	1+2	**Injuries**	0	**Fatalities**	0	**Other (on ground)**	0

What Happened

On Monday morning, 15 April 2024, a pilot and two passengers on-board a Sling 4 TSi aircraft with registration ZU-MND took off on a private flight from Stellenbosch Aerodrome (FASH) in the Western Cape province to Tedderfield Air Park (FATA) in Gauteng province. 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. They planned to refuel at least twice during the flight.

The pilot stated that he initially took off from Swellendam Airport (FASX) in the Western Cape province. After completing the pre-flight checks at FASX he noticed that the engine oil level was low and needed to be topped up. The pilot and the two occupants then flew to FASH where a few pints of approved engine oil were procured, but only one pint of oil was added in the oil reserve container as per the Rotax Operator's Manual. Thereafter, they took off from FASH at 0830Z to FATA. The pilot contacted the Cape Town Flight Information Service (FIS) on frequency 131.125 Megahertz (MHz) to activate the flight plan and requested to climb to flight level (FL) 115. Whilst under the Cape Town International Airport Terminal Movement Area (TMA), the pilot was advised that FIS can only approve the request once the aircraft had cleared approach airspace, which was congested at the time.

The pilot stated that before the aircraft could leave the TMA, the engine oil temperature indication increased, however, it was still within the green arc. As a precaution, he reduced the engine power. After 45 minutes of flying, the engine oil temperature indicator increased again followed by the drop in oil pressure. The pilot felt an unusual vibration as the variable propeller automatically changed from course pitch to fine pitch. The pilot lowered the engine's revolutions per minute (RPM) from 5500 to 5000 to correct the anomaly. He also changed the propeller to manual, and at that point, the oil temperature indication had moved to the yellow arc. The pilot then decided to return to FASH whilst flying at reduced power. The pilot first contacted FIS to report the engine problem and requested to return to FASH. FIS cleared the aircraft to enter the approach space at any level. Meanwhile, the oil pressure indication continued to drop; the engine over temperature warning lights flashed and the oil temperature increased rapidly. When the temperature reached the maximum 130°C, the pilot switched off the engine, checked the circuit breakers and attempted an engine re-start but was unsuccessful. The pilot declared an emergency by broadcasting a Mayday call on Cape Town FIS frequency and advised that he had identified a two-way road on which to conduct a forced landing. Initially the road had no traffic; however, during approach he realised that there was traffic in both directions of the road. Therefore, the pilot decided to land on the open area to the left of the road. A sudden strong wind from the south blew the aircraft which caused it to touch down on an uneven open area that was dotted with anthills and medium size rocks. During the ground roll, the aircraft impacted the anthills which damaged the undercarriage, ruptured the fuel tanks and broke one propeller blade. The aircraft sustained substantial damage to the lower part of the airframe. All three occupants were not injured during the accident. The occupants did not see smoke from the exhaust during the sequence of events because it is situated below the engine cowling. During the engine teardown, oil deposit was found in the exhaust.

Figure 1: The aircraft skidded easterly and came to rest facing north.

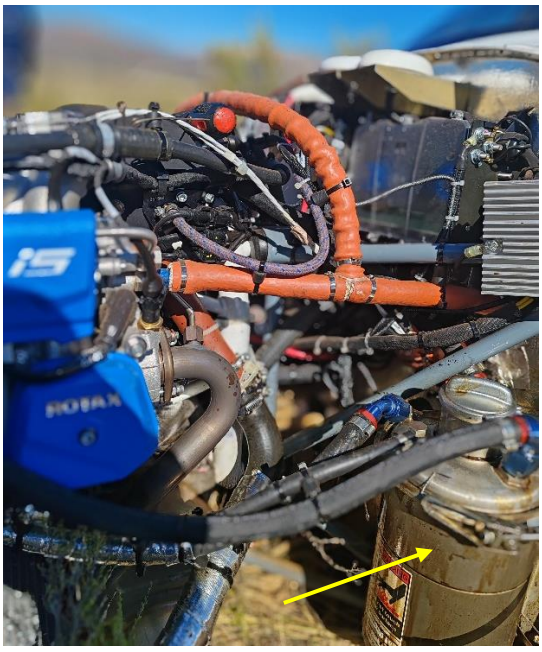


Figure 2: Traces of oil spillage mostly on the oil reservoir. **Figure 3:** The remaining oil in the reservoir was less than 100ml.

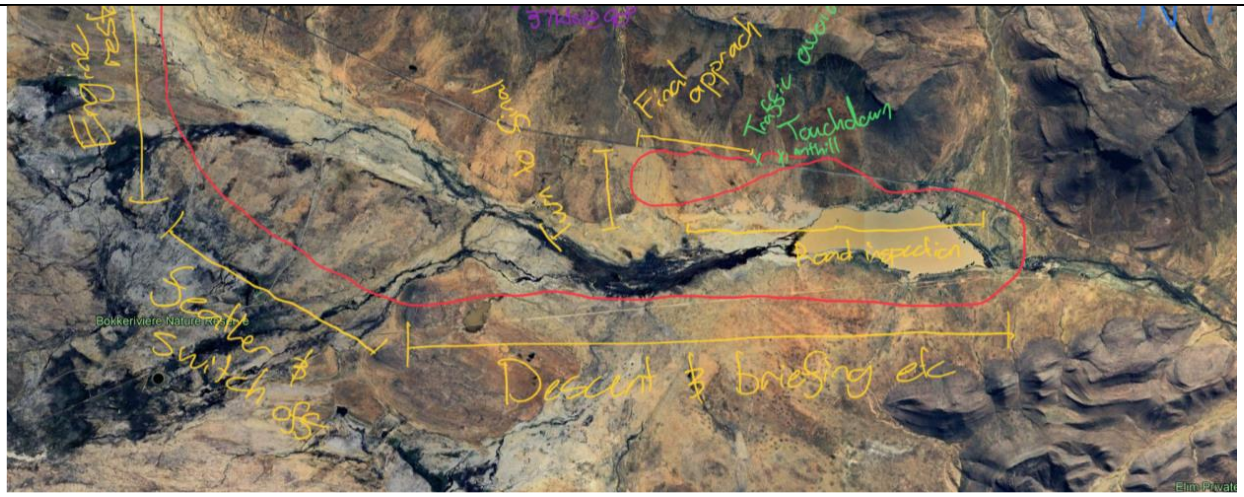


Figure 4: Illustration of the flight path before the accident. (Source: Pilot)

The aircraft owner brought the engine control unit (ECU) to Rotax's authorised engine distributor for analysis.

The following parameters were observed:

- *High oil temperatures in the cruise range.*
- *The engine was shut down approximately 1 hour and 20 minutes into the flight.*
- *The prop was adjusted into a feather position.*
- *A restart of the engine was unsuccessful.*
- *An emergency landing was carried out.*

Analysis of the ECU logs was done using the official ROTAX BUDS Log Viewer program, following instructions published by BRP-Rotax. Only the key parameters are selected for this report:

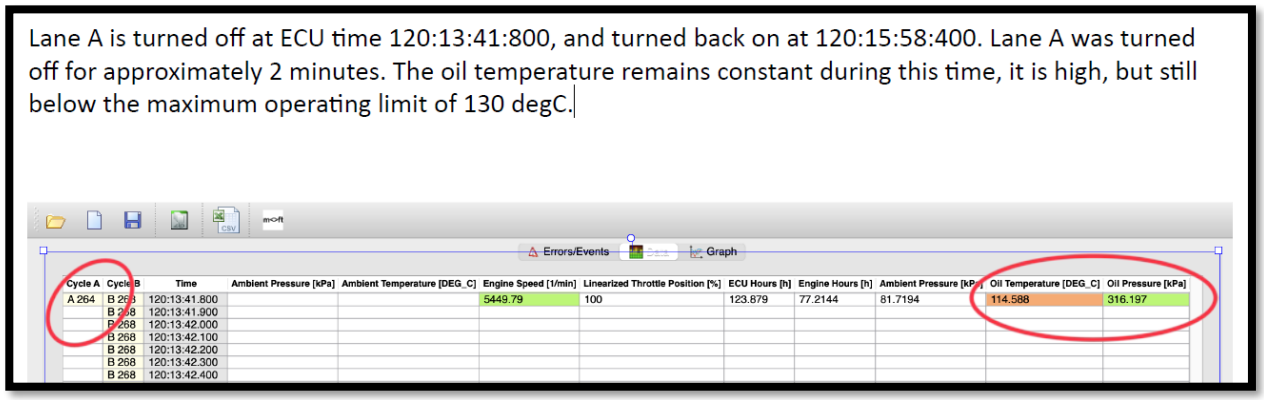
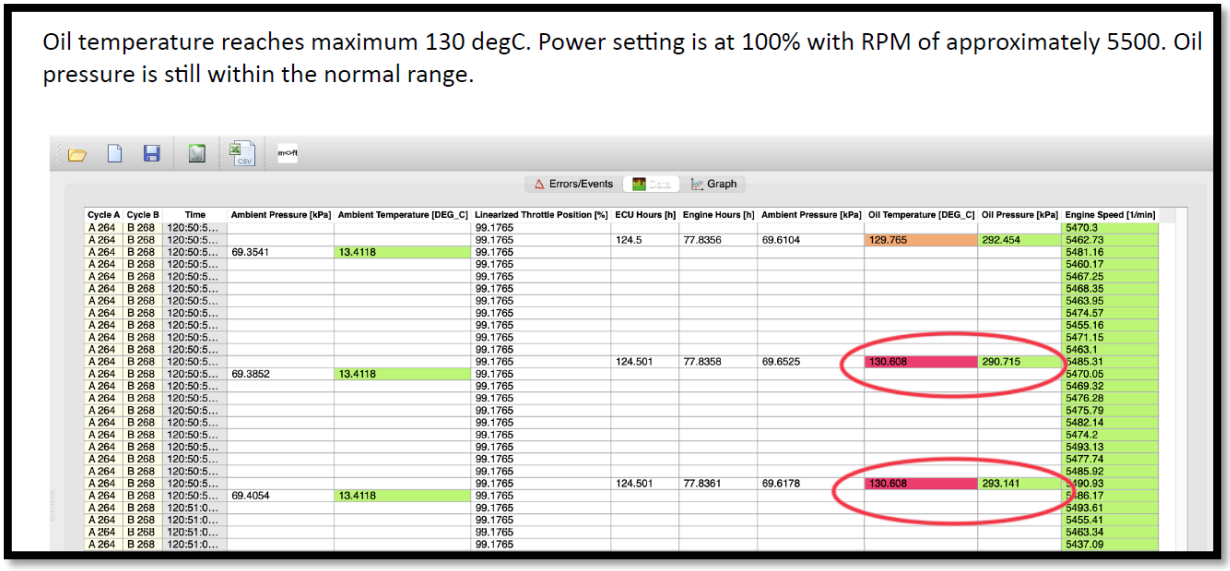


Figure 5: At 120h:13m:41s:800, oil temperature is high but has not reached the maximum 130°C. (Source: BRP Rotax)



Cycle A	Cycle B	Time	Ambient Pressure [kPa]	Ambient Temperature [DEG_C]	Linearized Throttle Position [%]	ECU Hours [h]	Engine Hours [h]	Ambient Pressure [kPa]	Oil Temperature [DEG_C]	Oil Pressure [kPa]	Engine Speed [1/min]
A 264	B 268	120:50:5…			99.1765						5470.3
A 264	B 268	120:50:5…			99.1765	124.5	77.8356	69.6104	129.765	292.454	5462.73
A 264	B 268	120:50:5…	69.3541	13.4118	99.1765						5481.16
A 264	B 268	120:50:5…			99.1765						5460.17
A 264	B 268	120:50:5…			99.1765						5467.25
A 264	B 268	120:50:5…			99.1765						5468.35
A 264	B 268	120:50:5…			99.1765						5463.95
A 264	B 268	120:50:5…			99.1765						5474.57
A 264	B 268	120:50:5…			99.1765						5455.16
A 264	B 268	120:50:5…			99.1765						5471.15
A 264	B 268	120:50:5…			99.1765						5463.1
A 264	B 268	120:50:5…			99.1765	124.501	77.8358	69.6525	130.608	290.715	5485.31
A 264	B 268	120:50:5…	69.3852	13.4118	99.1765						5470.05
A 264	B 268	120:50:5…			99.1765						5469.32
A 264	B 268	120:50:5…			99.1765						5476.28
A 264	B 268	120:50:5…			99.1765						5475.79
A 264	B 268	120:50:5…			99.1765						5482.14
A 264	B 268	120:50:5…			99.1765						5474.2
A 264	B 268	120:50:5…			99.1765						5493.13
A 264	B 268	120:50:5…			99.1765						5477.74
A 264	B 268	120:50:5…			99.1765						5485.92
A 264	B 268	120:50:5…			99.1765	124.501	77.8361	69.6178	130.608	293.141	5490.93
A 264	B 268	120:50:5…	69.4054	13.4118	99.1765						5486.17
A 264	B 268	120:51:0…			99.1765						5493.61
A 264	B 268	120:51:0…			99.1765						5455.41
A 264	B 268	120:51:0…			99.1765						5463.34
A 264	B 268	120:51:0…			99.1765						5437.09

Figure 6: At 120h:50m:11s:800, oil temperature reaches the maximum 130°C. (Source: BRP Rotax)

CONCLUSION

The decline in oil pressure an hour into the flight, suggests a loss of oil for reasons which are not currently known. Lower volumes of oil in the system, however, will naturally lead to higher oil temperatures. The spiking and the eventual loss of oil pressure confirms the near complete loss of oil from the engine and related components. Upon preliminary inspection, the oil pump was found normal and operational. Further inspection of the engine and its components may provide additional information. There is no evidence in the logs of an attempted restart after the engine was shut down.

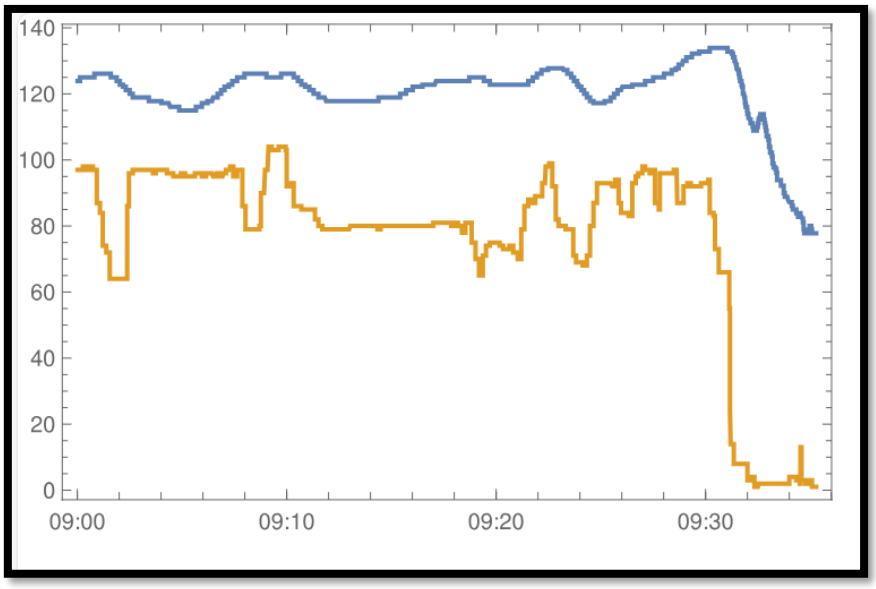


Figure 7: Oil temperature vs engine power. (Source: Pilot)

FINDINGS:

The disassembly required removing the airbox, intake manifolds and related components. The cylinder heads and cylinders were then removed.

Cylinder #2 showed a catastrophic failure of the piston ring glands leading to disintegration of the piston, caused from detonation. The extreme combustion pressures and temperatures from possible multiple detonations exerts pressure on the rings leading the eventual failure as indicated in the attached pictures. The detonations could have taken place several hours before the complete failure of the engine and the nature of detonation makes it difficult to determine the exact time.

The loss of oil was caused by the piston failure whereby oil passes to the combustion area where it is partially burnt by combustion and exits through the exhaust.

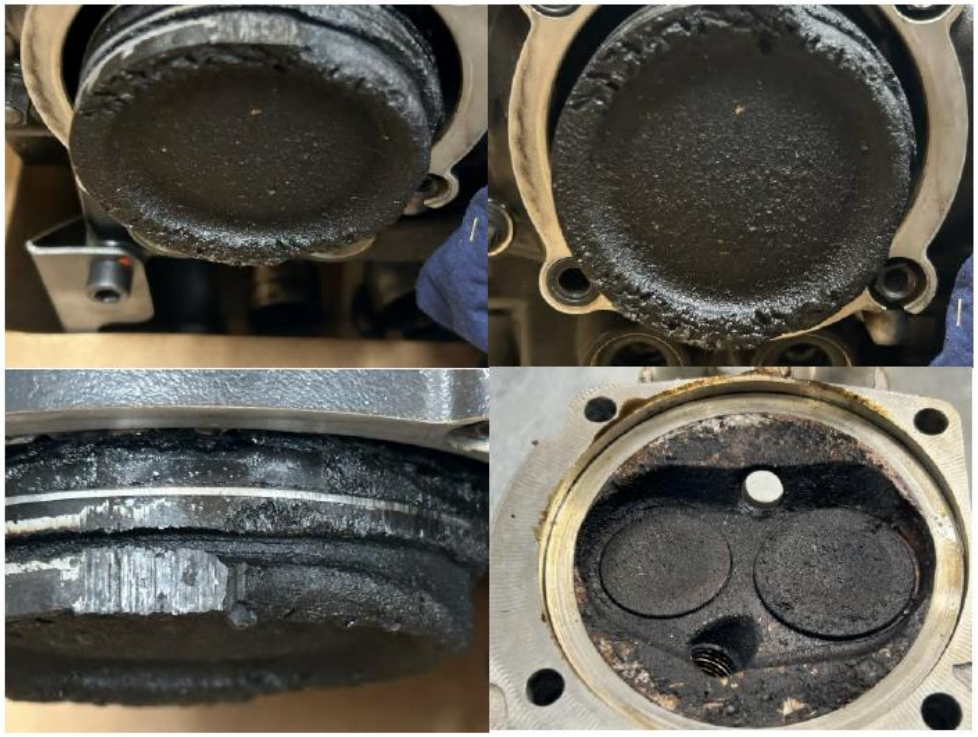


Figure 8: This report is supplementary to the report dated 19 April 2024 which relates to the same aircraft engine and accident. The engine was disassembled to inspect internal components for possible causes of the loss of oil and engine failure. (Source: Comet Aviation Supplies)

Engine history:

The aircraft was first released to service at zero hours on 7 June 2023. During the proving flight, the engine sustained a defect that required replacement. The first engine with serial number 100000502 was removed from the aircraft at 8.4 Hobbs hours after it over-revved because of slipping clutch.

On 23 August 2023, a new engine with serial number 10002365 was installed. After completing the first 25-hour required maintenance, it was issued a Certificate of Release to Service (CRS) on 23 October 2023 with an expiry date of 22 October 2024 or at 100 hours, whichever occurs first.

The accident occurred at 84.6 Hobbs hours, which meant that the aircraft accrued a further 51.2 Hobbs hours since the last inspection.

Oil top-up was only recorded in the flight folio with page serial number 241108 at 76.2 Hobbs hours, which meant that the engine must have experienced piston failure on the leg to Swellendam. It was after conducting the pre-flight checks that the pilot discovered that the engine oil level was below minimum. According to the report, the loss of oil was caused by the failed number 2 piston which resulted in the oil passing through to the combustion area where it was partially heated due to combustion and exited through the exhaust valve/pipe.

Findings

1. Personnel Information

1.1 The pilot had a Private Pilot Licence (PPL) that was initially issued on 10 May 2022. The licence was renewed on 28 May 2023 with an expiry date of 31 May 2025. The pilot flew a total of 101.6 hours of which 79.5 hours were on the aircraft type. The aircraft type was endorsed on his licence.

1.2 The pilot was issued a Class 2 aviation medical certificate on 28 May 2022 with an expiry date of 31 May 2027 with no limitations.

2. Aircraft Information

2.1 The aircraft had a valid Authority to Fly (ATF) Certificate that was initially issued by the Regulator (SACAA) on 18 July 2023 with an expiry date of 17 July 2024. The aircraft was airworthy when it was dispatched for the flight.

2.2 The aircraft's Certificate of Registration (C of R) was issued to the present owner on 5 July 2023.

2.3 The aircraft maintenance organisation (AMO) had a valid AMO Certificate that was issued on 26 March 2024 with an expiry date of 31 December 2024. The aircraft maintenance engineer (AME) had a valid AME licence that was issued on 31 August 2022 with an expiry date of 30 August 2024. The AME had an engine rating of the aircraft type endorsed on his licence.

2.4 The engine lost oil pressure which resulted in a high oil temperature due to the loss of engine oil, caused by the damaged piston.

Probable Cause(s)
The number 2 piston failed which led to the loss of oil, an increase in engine temperature and the loss of oil pressure; this resulted in the pilot executing an unsuccessful forced landing.
Contributing Factor(s)
None.
Safety Action(s)
None.
Safety Message and/or Safety Recommendation/s
None.
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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Accident and Incident Investigations Division
South African Civil Aviation Authority
Republic of South Africa