SOUTH AFRICAN CIVIL AVIATION AUTHORITY

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

LIMITED OCCURRENCE INVESTIGATION REPORT – FINAL

Reference Number	CA18/3/2/1450						
Classification	Serious Incident	**Date**	10 May 2024		**Time**	0735Z	
Type of Operation	Private (Part 94)						
Location							
Place of Departure	Kroonstad Aerodrome (FAKS), Free State Province	Place of Intended Landing	Bram Fisher Airport (FABL), Free State Province				
Place of Occurrence	On the N1 Highway, approximately 12 nautical miles (nm) south-west of Kroonstad Aerodrome FAKS						
GPS Co-ordinates	Latitude	27º 41'16.39" S	Longitude	027º 14'26.97" E	Elevation	4534 feet	
Aircraft Information							
Registration	ZS-BGL						
Make; Model; S/N	De Haviland; DH-82A Tiger Moth II (Serial Number: T7852)						
Damage to Aircraft	None	Total Aircraft Hours	4 957.9				
Pilot-in-command							
Licence Type	Airline Transport Pilot Licence (ATPL)	Gender	Male	Age	67		
Licence Valid	Yes	Total Hours	1 199.3	Total Hours on Type	176.4		
Total Hours 30 Days	12.3	Total Flying on Type Past 90 Days	12.3				
People On-board	1 + 1	**Injuries**	0	**Fatalities**	0	**Other (on ground)**	0

What Happened

On Friday morning, 10 May 2024, a pilot and a passenger on-board a Tiger Moth II DH-82A aircraft with registration ZS-BGL were on a private flight from Kroonstad Aerodrome (FAKS) in the Free State province to Bram Fisher Airport (FABL) in the same province. Visual meteorological conditions (VMC) by day prevailed at the time of the flight which was conducted under the provisions of Part 94 of the Civil Aviation Regulations (CAR) 2011 as amended.

The pilot reported that he conducted a pre-flight inspection of the aircraft, and no anomalies were found. He later started the engine and allowed it to warm-up. Once satisfied, he taxied the aircraft to the holding point of Runway 25 and performed the pre-take-off checks. The pilot later taxied the aircraft to the threshold of Runway 25 where he opened the throttle to 2100 revolutions per minute (RPM). The aircraft commenced with the take-off run and rotated. During cruise, the engine started to run rough, and the pilot decided to return to FAKS. After about 1.8 hours of flight time, the aircraft lost engine power. The pilot initiated the fault-finding procedure by applying carburettor heat and adjusting the fuel mixture, but these actions did not resolve the issue.

The pilot then elected to execute a forced landing on the N1 Highway. The aircraft landed safely with no damage. The pilot and the passenger were not injured during the forced landing sequence.

The incident occurred during daylight at Global Positioning System (GPS) co-ordinates determined to be 27º 41'16.39" South 027º14'26.97" East, at an elevation of 4 534 feet (ft).

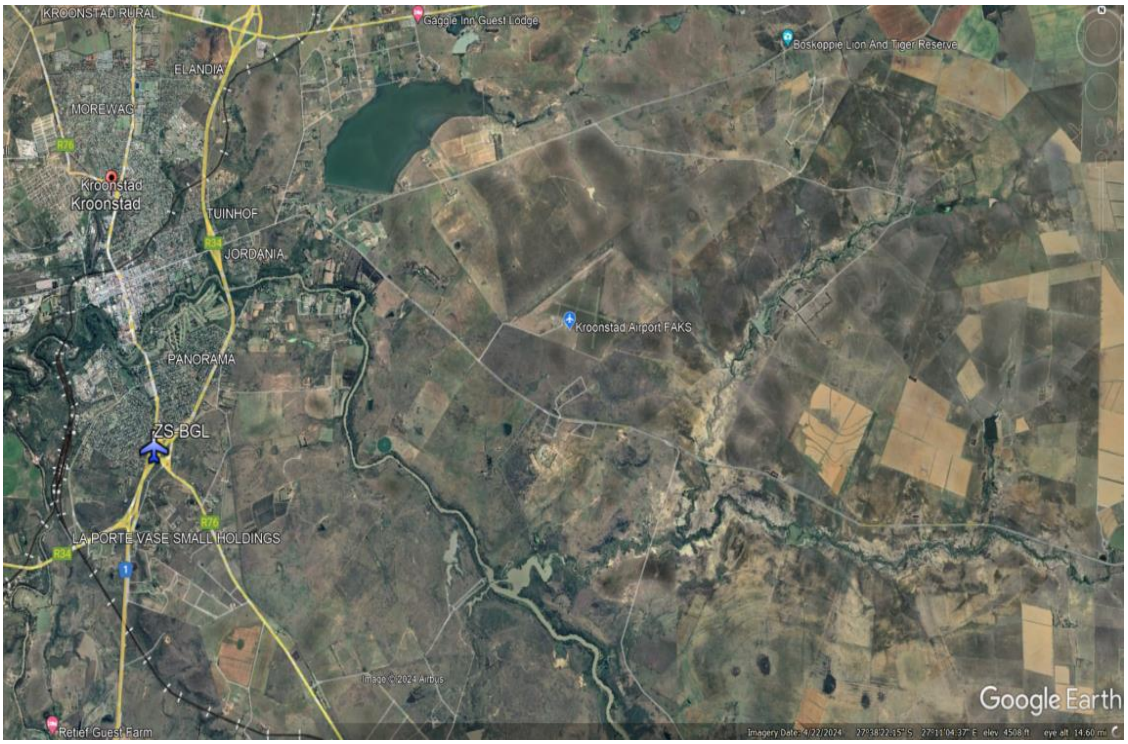

Figure 1: The approximate area where the aircraft landed. (Source: Google Earth)

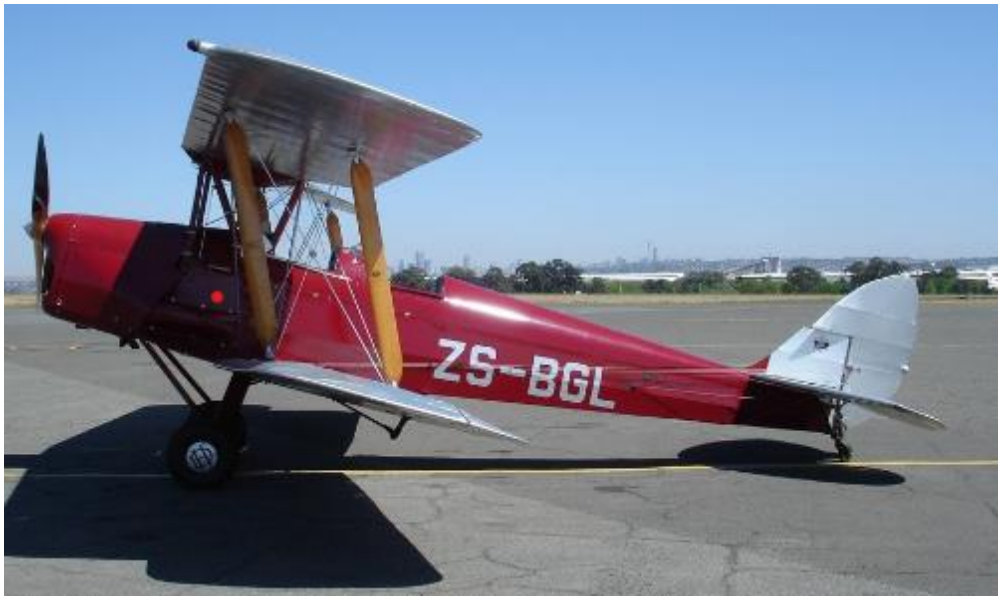

Figure 2: The file picture of the aircraft
(Source: De Havilland DH.82A Tiger Moth, ZS-BGL / 84221, Private: ABPic)

Aircraft Description (Source: Pilot's Operating Handbook [POH])

The De Havilland DH.82A Tiger Moth aircraft is fitted with a Gipsy Major 1H engine driving a fixed-pitch, two-bladed, wooden propeller. The Gipsy Major is a four-cylinder, air-cooled, inline inverted engine. The engine is equipped with two independent ignition systems comprising two magnetos, one on each side of the engine, each feeding four spark plugs. The right magneto is fitted with an impulse coupling, which retards the ignition to aid engine starting. Two pairs of ignitions (magneto) switches are fitted outside each cockpit on the left-side of the fuselage. The front switch of each pair controls the right magneto, and the rear switch of each pair controls the left magneto. A control in each cockpit operates the throttle by means of metal control rods. Throttle and magneto controls are interconnected so that when the throttle is closed the ignition is fully retarded. The throttle is moved forward to increase engine power and an engine rpm gauge is fitted in both cockpits.

Post-incident Investigation

The aircraft was recovered to the approved person's (AP) facility at Rand Airport (FAGM) in Gauteng province where the engine was subjected to a teardown examination. The upper spark plugs and rocker box covers were removed, and the propeller was rotated by hand. Rotational continuity was established throughout the engine. Thumb compression was obtained on cylinder No. 1, 2 and 4. No compression was obtained on cylinder No. 3, which was removed for further examination. The No. 3 cylinder was intact and undamaged. The exhaust and intake valve springs were intact and oil-coated, as were the intake and exhaust valve rocker arms. The valve springs and keepers were removed. The intake valve slid out of the valve guide freely. The exhaust valve seat area exhibited carbon build-up. This is the area that maintains the airtightness of the combustion chamber and it could not seal properly, thus, had resulted in poor compression in the No. 3 cylinder during the compression stroke which led to the engine power loss.

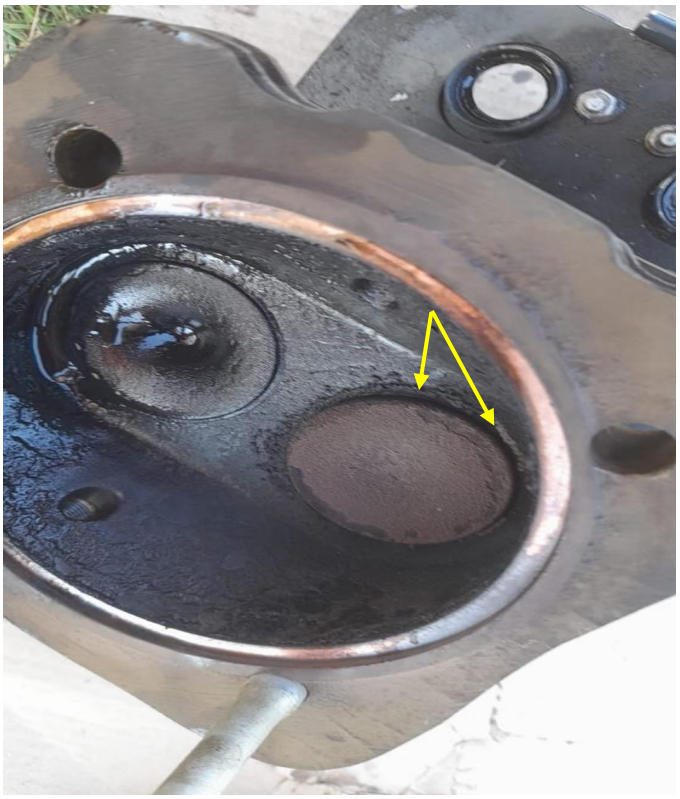

Figure 3: The partially opened No. 3-cylinder exhaust valve. (Source: Operator)

Findings

The Pilot

1. The pilot was initially issued a Private Pilot Licence (PPL) on 1 February 1982. His Airline Transport Pilot Licence (ATPL) was reissued on 29 January 2024 with an expiry date of 31 March 2025. The pilot had the aircraft type endorsed on his licence.

2. The pilot had a Class 1 aviation medical certificate that was issued on 5 March 2024 with an expiry date of 30 September 2024. The pilot had a restriction to wear suitable corrective lenses. The pilot was adequately licensed and experienced to conduct the flight.

Aircraft information

3. The aircraft had an Authority to Fly (ATF) Certificate that was initially issued on 30 October 2017. The ATF was renewed on 5 December 2023 with an expiry date of 13 December 2024.

4. The aircraft's Certificate of Registration (C of R) was issued to the owner on 3 March 2016.

5. The last annual inspection of the aircraft was conducted and certified on 10 November 2023 at 332.90 engine hours after the major overhaul. The total hours since new were unknown as they were not recorded in the engine logbook.

6. The Certificate of Release to Service (CRS) was issued on 10 November 2023 at 4950.4 airframe hours with an expiry date of 9 November 2024 or at 5050.4 airframe hours, whichever comes first. The aircraft accrued 7.54 hours after the annual inspection.

7. The aircraft was maintained by an approved person (AP) and had an Approved Person Certificate that was issued by the Regulator (SACAA) on 27 June 2020 with an expiry date of 26 June 2024.

8. The engine power loss was due to the No. 3 cylinder exhaust valve which did not seal properly because of carbon build up in the valve seat, resulting in poor compression.

Probable Cause

Engine power loss due to poor compression in the No.3 cylinder which was caused by the exhaust valve that did not seal properly due to carbon build up in the valve seat; this consequently led to poor compression and a successful forced landing on the N1 Highway.

Contributing Factors

Probable gradual build-up of lead Oxy Bromide which is from tetra-ethyl lead added to Avgas 100LL fuel, as well as operating the engine at low power settings (to cool off).

Safety Action(s)

None.

Safety Recommendation or Message

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.

Disclaimer

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

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