SOUTH AFRICAN CIVIL AVIATION AUTHORITY

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

LIMITED INCIDENT INVESTIGATION REPORT

Reference Number	CA18/3/2/1393								
Classification	Incident	**Date**	6 April 2022	**Time**	1752Z				
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	On Moloto Road, approximately 9km east of FAWB, Gauteng Province								
GPS Co-ordinates	Latitude	25°39'23.9" S	Longitude	28°18'06.4" E	Elevation	3464.6ft			
Aircraft Information									
Registration	ZS-SBN								
Model/Make	Cessna 172M Skyhawk (Serial Number:17266104)								
Damage to Aircraft	Minor	Total Aircraft Hours	8 898.7						
Pilot-in-command									
Licence Valid	Yes	Gender	Male	Age	23				
Licence Type	Commercial Pilot Licence (CPL) Aeroplane								
Total Hours on Type	391.5	Total Flying Hours	717.1						
People On-board	2+0	Injuries	0	Fatalities	0	Other (On ground)	0		
What Happened									

On 6 April 2022, a student pilot and a flight instructor on-board a Cessna 172M Skyhawk aircraft with registration ZS-SBN took off on a night-rating training flight from Wonderboom Aerodrome (FAWB) in Gauteng province to Pretoria general flying area (GFA), north of FAWB, with the intention to return to FAWB. The flight instructor stated that they had a short briefing before the flight, whereafter, a pre-flight inspection of the aircraft was conducted. All systems functioned normally and there were no outstanding defects recorded in the flight folio. The aircraft had 120 litres (l) of Avgas 100LL fuel in the tanks. The flight, which was planned to take an hour, was conducted under Part 141 of the Civil Aviation Regulations (CAR) 2011 as amended.

The aircraft took off from Runway 29 at 1734Z and climbed to 7000 feet (ft). The flight instructor reported that approximately 15 minutes into the flight and whilst overhead Rooiwal Power Station

and at approximately 6000ft, he noticed that the engine oil temperature indication was high. The flight instructor took control of the aircraft and initiated a turn back (towards the east) with the intention to join the traffic pattern to land on Runway 29 at FAWB as a precautionary measure. After flying over the N1 Highway, he heard a 'click' noise coming from the engine compartment; this was followed by engine stoppage. The instructor then switched on the landing light and glided the aircraft in the direction of Moloto Road, which was clear of traffic. He performed a successful forced landing in a southerly direction on Moloto Road. No third-party damages were reported. The aircraft's right wing tip rear section sustained minor damage which was caused by a truck that was passing through before the aircraft was moved to the left-side of the road after landing. After the instructor had switched off the master, he disembarked the aircraft and pushed it to the left-side of the road, which was covered in grass.

The aircraft sustained minor damage and both occupants were not injured.

Figure 1: The aircraft as found at the incident site.

Engine teardown inspection report:

The engine was taken for a teardown inspection on 7 April 2022 at an FAWB-based aircraft maintenance organisation (AMO) that is approved by the South African Civil Aviation Authority (SACAA). Post-incident examination of the Lycoming O-320E2D engine with Serial Number L8102-39A showed that the crankcase was not damaged. None of the engine oil system components showed evidence of an oil leak. The engine oil level was checked using a dipstick and it had adequate oil.

The investigation revealed that the engine crankshaft broke or failed at the No.4 connecting rod/cylinder journal area.

Figure 2: The crankshaft showing the area where the failure occurred.

Figure 3: A closer view of the crankshaft showing the area where the failure occurred.

Post-incident investigation findings:

- The flight instructor was initially issued a Commercial Pilot Licence (CPL) Aeroplane on 12 April 2019. His last licence renewal was made on 15 June 2021 with an expiry date of 30 June 2022. The aircraft type was endorsed on his licence. His Class 1 medical certificate was issued on 20 October 2021 with an expiry date of 31 October 2022 with no restrictions.
- The student pilot was initially issued a Private Pilot Licence (PPL) Aeroplane on 7 January 2020. His last renewal was on 20 October 2021 with an expiry date of 31 October 2023. The aircraft type was endorsed on his licence. His Class 2 medical certificate was issued on 27 May 2019 with an expiry date of 31 May 2024, with no restrictions.
- According to the engine logbook:
    - on 14 October 2021, the magneto to engine timing was checked. The oil was drained and replenished with Aeroshell W100 plus.
    - On 9 November 2021, a 50-hour inspection was carried out and certified at 8 571.4. During this inspection, oil was drained and replenished, and the oil filter was renewed.
    - On 7 December 2021, a 100/200-hours mandatory periodic inspection (MPI) was carried out and was certified at 8 620.7 airframe hours.
    - On 13 January 2022, a 50-hour inspection was conducted and was certified at 8 668.9 hours. During this inspection, oil was drained and replenished, and the oil filter was renewed.

- On 9 February 2022, a 100-hour MPI was carried out and certified at 8 720.3 airframe hours.
- On 28 February 2022 a 50-hour inspection was conducted and certified at 8 773.0 airframe hours.
- On 18 March 2022, a 100-hour annual MPI was conducted and certified at 8 817.6 airframe hours.

- The last engine overhaul was carried out on 13 July 2021, with the total time since overhaul at 447.3, and total hours since new at 7419.3. The engine was dismantled and overhauled with the same crankshaft. The time between overhaul (TBO) for this engine type is 2 000 hours. The engine failed with 78% of its TBO still remaining. There were no recorded defects since the last overhaul.
- On 3 May 2021, a non-destructive testing (NDT) was carried out on the engine and no cracks were found at the time of testing. Moreover, a magnetic particles and florescent penetrant inspection was conducted. The area of inspection included the crankshaft; no cracks were detected.
- The last inspection carried out on the aircraft prior to the accident flight was a 50-hour oil inspection on 28 March 2022, certified at 8 864.0 airframe hours. A short engine run was conducted after the inspection, and it met all the parameters. The aircraft was issued a Certificate of Release to Service (CRS) on 18 March 2022 at 8 817.6 airframe hours with an expiry date of 17 March 2023 or at 8917.6 hours of flight time, whichever occurs first unless the aircraft is involved in an accident or becomes unserviceable.
    - The aircraft was initially issued a Certificate of Airworthiness (C of A) on 31 January 2019 with an expiry date of 31 January 2023.
    - A Certificate of Registration (C of R) was issued to the current aircraft owner on 12 May 2021.
    - After the teardown inspection of the engine, the AMO reported that the crankshaft broke off at the connecting rod journal No.4; the broken crankshaft shifted to the rear of the engine and broke the idler gear between the camshaft and crankshaft. The AMO stated that they could not determine the cause of the breakage.
    - Examination of the crankshaft revealed that it had fractured at the No.4 connecting rod journal because of fatigue cracking (see Figure 4).

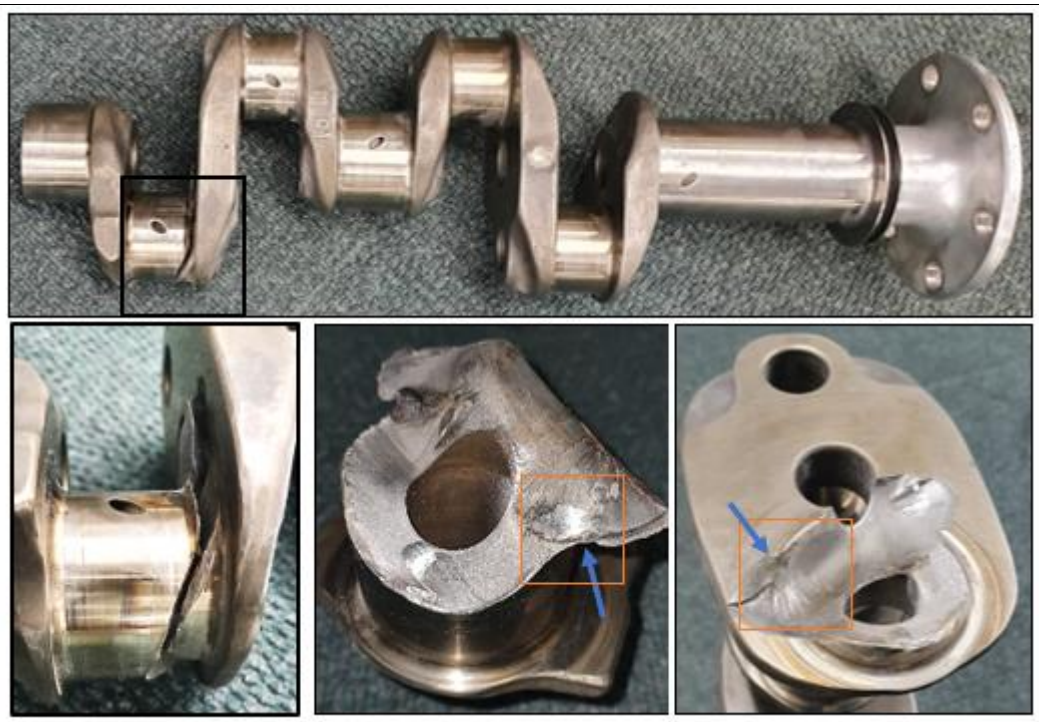

Figure 4: The initiation site and progression marks associated with fatigue crack growth indicated by the blue arrow.

- Fatigue cracking initiated at the transition between the No.6 journal surface and the fillet of the crankarm between the No.6/No.5 connecting rod journals. The region of the fatigue fracture surface had localised deformations which are distinctive fatigue progression marks that are 'step-like', extending from the site of initiation to the surface. These marks are created by major changes in the alternating loading spectrum. Typically, for engine crankshafts, they are associated with engine start/stop cycles. The magnetic particle inspection was conducted on 3 May 2021 and there were no cracks detected. According to the information in the flight folio, the aircraft had approximately 51 start/stop cycles since the last magnetic particle inspection. It was estimated that fatigue crack growth had occurred over a period of at least 51 engine start/stop cycles.

Probable cause:

The engine crankshaft failed due to fatigue, which resulted in engine stoppage and prompted the pilot to carry out a forced landing, which was successful.

Safety Recommendation
None.
Safety Message
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 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