SOUTH AFRICAN CIVIL AVIATION AUTHORITY

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

LIMITED OCCURRENCE INVESTIGATION REPORT – FINAL

Reference Number	CA18/2/3/10567										
Classification	Accident		**Date**	24 March 2025			**Time**	0800Z			
Type of Operation	Private (Part 91)										
Location											
Place of Departure	Howick Airfield (FAHC), KwaZulu-Natal Province		Place of Intended Landing			Ladysmith Aerodrome (FALY), KwaZulu-Natal Province					
Place of Occurrence	North of Runway 11/29 at Ladysmith Aerodrome (FALY)										
GPS Co-ordinates	Latitude	28° 34′ 54″ S	Longitude	29° 44′ 59″ E		Elevation	3548 ft				
Aircraft Information											
Registration	ZT-RTF										
Make; Model; S/N	Robinson; R44 Raven II (Serial Number: 13863)										
Damage to Aircraft	Substantial			Total Aircraft Hours	886						
Pilot-in-command											
Licence Type	Private Pilot Licence		Gender	Male		Age	44				
Licence Valid	Yes	Total Hours	204.5	Total Hours on Type	198.85						
Total Hours 30 Days	3.56		Total Flying on Type Past 90 Days	9.86							
People On-board	1+0	**Injuries**	0	**Fatalities**	0	**Other (on ground)**	0				

What Happened

On Monday morning, 24 March 2025, a pilot on-board a Robinson R44 Raven II helicopter with registration ZT-RTF took off on a private flight from Howick Airfield (FAHC) to Ladysmith Aerodrome (FALY), both located in KwaZulu-Natal province. The pilot intended to refuel at FALY and, thereafter, continue to Grand Central Aerodrome (FAGC) in Gauteng province. The flight was conducted under visual metrological conditions (VMC) by day and under the provisions of Part 91 of the Civil Aviation Regulations (CAR) 2011 as amended.

The pilot stated that he conducted a pre-flight inspection of the helicopter with no anomalies noted. The take-off was uneventful, and the pilot proceeded with the first leg of the flight. The helicopter approached FALY from the south-east direction; after flying over the mountains at approximately 400 feet (ft) above ground level (AGL) and about 0.6 nautical miles (nm) to FALY, he noticed that the engine oil light on the cockpit annunciator panel was flashing (on and off); this was immediately followed by an abnormal sound that emanated from the engine. Subsequently, the low rotor revolutions per minute (rpm) warning horn sounded.

The pilot engaged autorotation to perform a forced landing in the vicinity of the aerodrome. During descent whilst transitioning, the pilot observed smoke on the right side of the engine cowls. The helicopter landed hard on the grass-covered terrain, north of Runway 11/29.

The landing gear skids were level during the hard landing. One of the main rotor blades severed part of the tail boom aft section (which consisted of the tail rotor, part of the tail rotor drive shaft and the tail rotor drive gearbox).

The pilot was not injured during the accident sequence. The helicopter's tail boom and the landing gear skid were damaged.

Clear weather conditions prevailed at the time of the flight; the weather did not contribute to this accident.

Figure 1: The helicopter at the accident scene. (Source: Pilot)

The helicopter was recovered to the owner's hangar at FAGC in Gauteng province after the accident.

The investigation team examined the helicopter at the owner's hangar. The examination revealed that the aircraft had fuel in both the main and auxiliary fuel tanks. The engine dipstick (oil gauge

stick) was used to check the oil level in the engine; it showed that the engine had approximately 5 quarts of oil in the sump, with 6 quarts being the maximum capacity. Further examination determined that the engine could not turn freely by hand. To determine the cause of the engine stoppage, the engine was removed from the helicopter and transported to a SACAA-approved engine workshop maintenance facility for engine teardown inspection.

The engine teardown inspection was conducted on 7 April 2025. It was found that the Number 3 piston was damaged, one of the piston pin plugs on the Number 3 piston head was missing, the engine oil was contaminated with magnetic and non-magnetic metallic particles, and the oil pump suction filter screen was blocked with magnetic and non-magnetic metallic debris.

The non-magnetic metallic debris found in the oil sump was silvery-white in colour, which is indicative of aluminium presence. *Aluminium is the same material used for the manufacture of the piston pin plug*. It was then concluded that the contamination material found in the oil was residue and particles of the failed piston plug, damaged piston, and failed engine journal bearings which led to the engine failure during the flight.

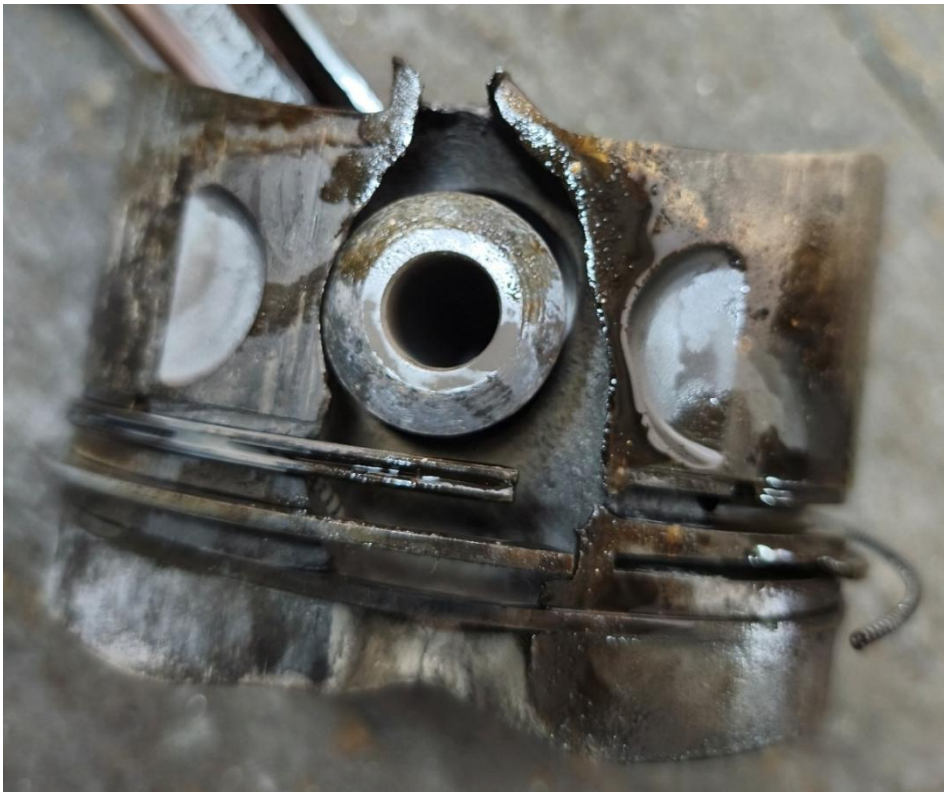

Figure 2: The failed engine piston pin plug from the damaged Number 3 piston.

Figures 3 and 4: Metal particles on the oil pump suction screen and tubing. (Source: Investigator)

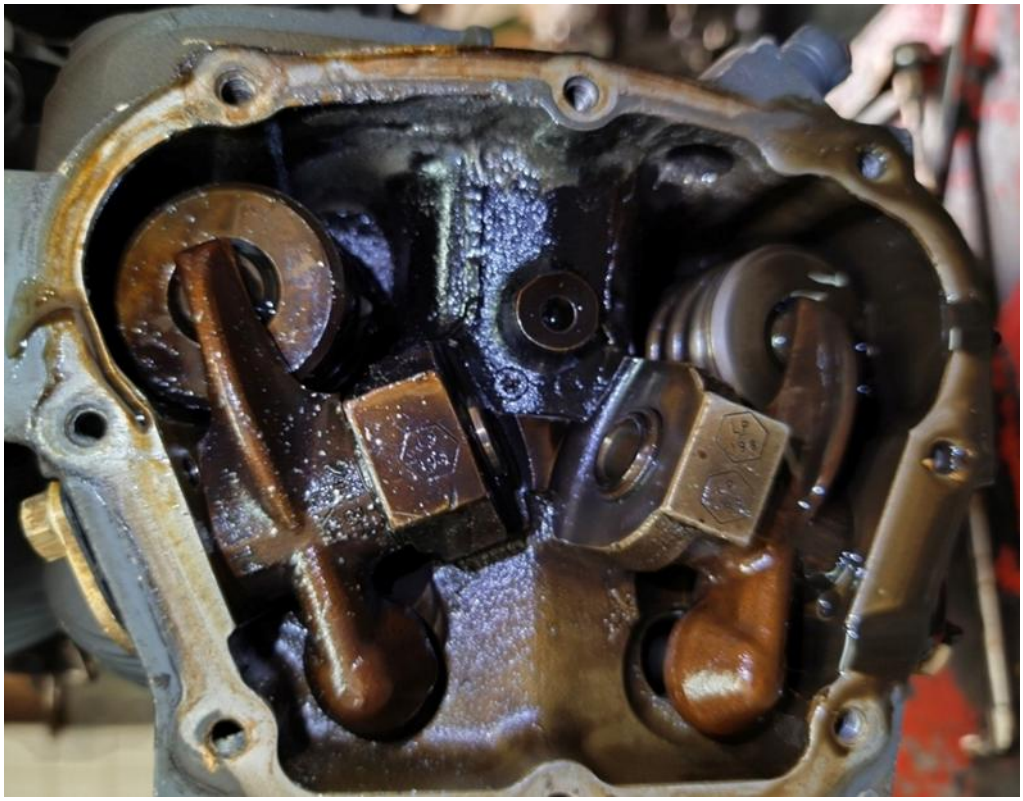

Figure 5: Metal particles found on engine cylinder valves and rocker assemblies due to the circulated contaminated oil.

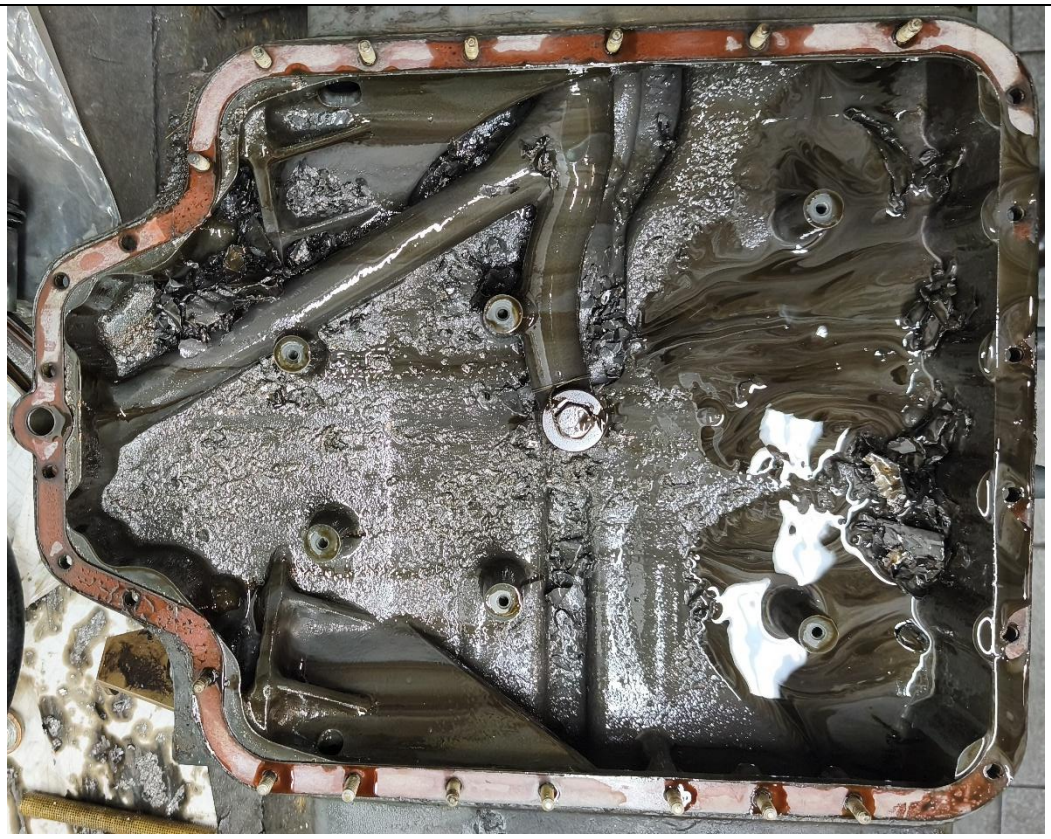

Figure 6: The severely contaminated oil in the engine oil sump.

An extract from the Federal Aviation Administration Special Airworthiness Information Bulletin Number ANE-99-18, dated 9 April 1999:

Piston Pin Plug failure is caused by unusually high wear of the piston pin plug ultimately leading to failure of the piston pin plug. This condition, in turn, may lead to complete engine failure.

The Lycoming Mandatory Service Bulletin (MSB) Number 480F, dated 25 May 2017, mandated the inspection of oil and oil filter for metallic and non-metallic residue or particles during routine oil changes as a means detect piston pin failure at an early stage. This is a known issue on the Lycoming IO series aircraft engines. The original equipment manufacturer addressed the problem in the above-mentioned service bulletin. The service bulletin further recommended that operators take oil samples during oil changes for spectrometric oil analysis for the detection of trace metal elements in the oil.

Findings

1. Man

1.1. The pilot had a Private Pilot Licence (PPL) that was initially issued by the Regulator (SACAA) on 7 May 2013. His licence renewal was issued on 1 August 2025 with an expiry

date of 31 July 2026. The pilot's Class 2 aviation medical certificate was issued on 28 August 2024 with an expiry date of 31 August 2026.

1.2. The pilot was appropriately rated for the flight, and the helicopter type was endorsed on his licence. The pilot had a total of 204.5 hours which were accumulated on the helicopter type.

2. Machine

2.1. The helicopter was issued a Certificate of Airworthiness (C of A) on 21 February 2019 with an expiry date of 28 February 2026. The Certificate of Registration (C of R) was issued to the current owner on 21 February 2019.

2.2. The last mandatory periodic inspection (MPI) of the helicopter was conducted and certified on 6 February 2025 at 857.89 airframe hours after which a Certificate of Release to Service (CRS) was issued with an expiry date of 5 February 2026 or at 957.89 airframe hours, whichever comes first. The helicopter had a total of 886.58 airframe hours at the time of the accident.

2.3. Maintenance records indicated that the requirements of Lycoming MSB 480F, dated 25 May 2017, which required a routine oil change and visual inspection of the oil, oil filter paper element and oil pressure screen for metallic contamination at every 50 hours of engine operation, were complied with.

2.4. The helicopter had sufficient fuel in both the main and auxiliary fuel tanks after the accident.

2.5. The last engine oil and oil filter changes were conducted during the 300-hour MPI on 6 February 2025. There was sufficient oil in the engine for the safe operation of the helicopter at the time of flight.

2.6. The piston of the Number 3 engine cylinder was missing a pin plug, and the piston head was damaged on both ends (above and below) where the piston pin plug was missing.

2.7. Engine cylinder Number 5 exhibited a failed connecting rod bearing. This was consistent with damage caused by overheating due to inadequate oil lubrication. The loss of lubrication was the result of the blockage caused by debris that was originating from the Number 3 piston and piston pin plug.

2.8. Damage to the Number 3 piston and pin plug was extensive, which resulted in severe contamination of the engine oil, as well as the clogged engine oil pump suction screen and tubing. This, therefore, led to loss of lubrication and rapid deterioration and failure of other internal engine components which ultimately caused a complete engine stoppage. This failure is a known issue that was addressed by the engine manufacturer through the mandatory Service Bulletin 480F. The bulletin required the inspection of the engine oil and oil filter for metallic and non-metallic particles during routine oil changes, which would serve as an early detection method of potential failure of the piston pin plugs.

3. Environment

3.1. Clear weather conditions prevailed at the time of the flight; the weather did not contribute to this accident.

Probable Cause(s)

Unsuccessful forced landing after an in-flight engine stoppage due to the failed piston pin plug which disintegrated and severely contaminated the engine oil. The metal contaminants in the oil blocked the oil pump suction screen and tubing; this led to loss of lubrication and rapid deterioration, and failure of other internal engine components.

Contributing Factor(s)

None.

Safety Action(s)

None.

Safety Message and/or Safety Recommendation/s

Safety message: Operators of all Lycoming direct drive and TIGO-541 piston engines are strongly advised to implement a spectrometric oil analysis programme for oil samples taken during engine oil changes to detect possible piston pin plug failure at an early stage as per the recommendation in the Lycoming mandatory Service Bulletin Number 480F, dated 25 May 2017.

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 desktop 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