

LIMITED OCCURRENCE INVESTIGATION REPORT – FINAL

Reference Number	CA18/3/2/1482						
Classification	Serious Incident	Date	21 May 2025			Time	0515Z
Type of Operation	Private (Part 91)						
Location							
Place of Departure	Newcastle Airfield (FANC), KwaZulu-Natal Province			Place of Intended Landing	New Tempe Airfield (FATP), Free State Province		
Place of Occurrence	Approximately 6 nautical miles south-west of Chelmsford Nature Reserve						
GPS Co-ordinates	Latitude	28° 04' 57.3" S	Longitude	029° 45' 37.6" E	Elevation	4 219 ft	
Aircraft Information							
Registration	ZS-FXT						
Make; Model; S/N	Cessna; Cardinal C177B (Serial Number: 177-01400)						
Damage to Aircraft	None			Total Aircraft Hours	3 553.99		
Pilot-in-command							
Licence Type	Private Pilot Licence (PPL)			Gender	Male		Age 38
Licence Valid	Yes	Total Hours	126.32		Total Hours on Type	123.62	
Total Hours 30 Days	5.43			Total Flying on Type Past 90 Days	7.97		
People On-board	1+1	Injuries	0	Fatalities	0	Other (on ground)	0
What Happened							
<p>On Wednesday morning, 21 May 2025, a pilot and a passenger on-board a Cessna Cardinal C177B aircraft with registration ZS-FXT took off on a private flight from Newcastle Airfield (FANC) in KwaZulu-Natal province to New Tempe Airfield (FATP) in Free State province. Visual meteorological conditions (VMC) prevailed at the time of the flight which was conducted under the provisions of Part 91 of the Civil Aviation Regulations (CAR) 2011 as amended.</p> <p>According to the pilot, he conducted a pre-flight inspection of the aircraft with no anomalies noted. Clear weather conditions prevailed at the time of take-off; the aircraft routed south-west towards FATP. Ten minutes into the flight and at a height of 1500 feet (ft) above ground level (AGL), the engine ran rough and lost power; as a result, the aircraft rapidly lost height. The pilot surveyed the surrounding area and identified a field on which to force-land the aircraft. Whilst the aircraft was still descending and at approximately 800ft AGL, the engine stopped. The pilot successfully executed a forced landing on the identified field about 6 nautical miles (nm) south-west of Vryheid in Chelmsford Nature Reserve.</p> <p>The aircraft was not damaged during the forced landing, and both occupants disembarked from the aircraft unassisted; they were not injured. The aircraft engine was recovered to an approved aircraft maintenance organisation (AMO) in Springs, Gauteng province, for further investigation.</p>							

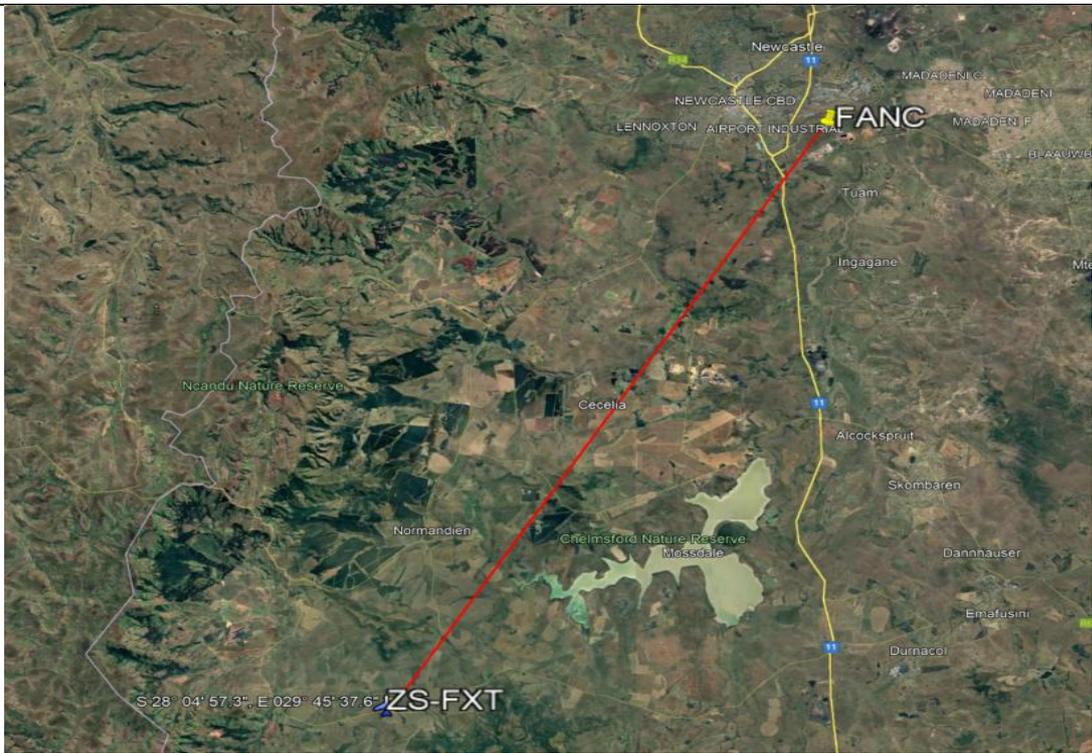


Figure 1: The approximate aircraft flight path (red line). (Source: Google Earth Map)



Figure 2: The aircraft post-serious incident. (Source: Operator)

Aircraft and Engine Maintenance Inspection

Previous Incident Investigation:

During an interview with the pilot, he reported a previous incident that occurred on 22 February 2024 during which the engine ran rough; however, he managed to safely land the aircraft at Vryheid Airfield (home base) in KwaZulu-Natal province. Upon consulting a qualified AMO, the pilot was advised that the engine had experienced a 3-cylinder exhaust valve failure and required an overhaul. This was due to the engine nearing its life limit of 2000 hours after having accrued 3 545 hours since the previous 1500-hour overhaul. Therefore, the engine was due for maintenance at that time.

According to the reviewed maintenance records, the engine maintenance history revealed that it was overhauled on 7 May 2024 at 3 545.41 hours. During this maintenance, new components that included cylinders with pre-installed valves, new pistons and a new connecting rod were fitted. A valve leak inspection test of the cylinder valves was conducted and found satisfactory. After the overhaul maintenance, the engine-run test was conducted, and all parameters were satisfactory.

Post-serious Incident Engine Teardown Inspection

A Lycoming O-360 A1F6 engine with serial number L-14516-36 and with 3 571.41 hours was recovered to an approved AMO for further investigation. A teardown inspection was conducted on 28 May 2025. Figure 3 shows the cylinders and pistons after the engine was dismantled.



Figure 3: The damaged engine pistons. (Source: AMO)

The following was revealed:

- All four cylinders were removed from the engine casing. The Number 3 cylinder and the associated piston showed signs of damage caused by the failed exhaust valve. The exhaust valve was damaged on the stem behind the valve head which caused damage to both the cylinder and piston. The exhaust valve spring (upper rotator) key with part number MS13997-3 failed and caused the valve to get stuck and, subsequently, the malfunctioning of the valve operation. This, therefore, led to it being damaged by the piston movement, further exacerbating damage.
- The number 1, 2 and 4 cylinders also displayed damage caused by debris (fragments) from the Number 3 (No.3) cylinder and piston.
- Debris from the engine component was found in the oil sump which caused blockage in the oil strainer.

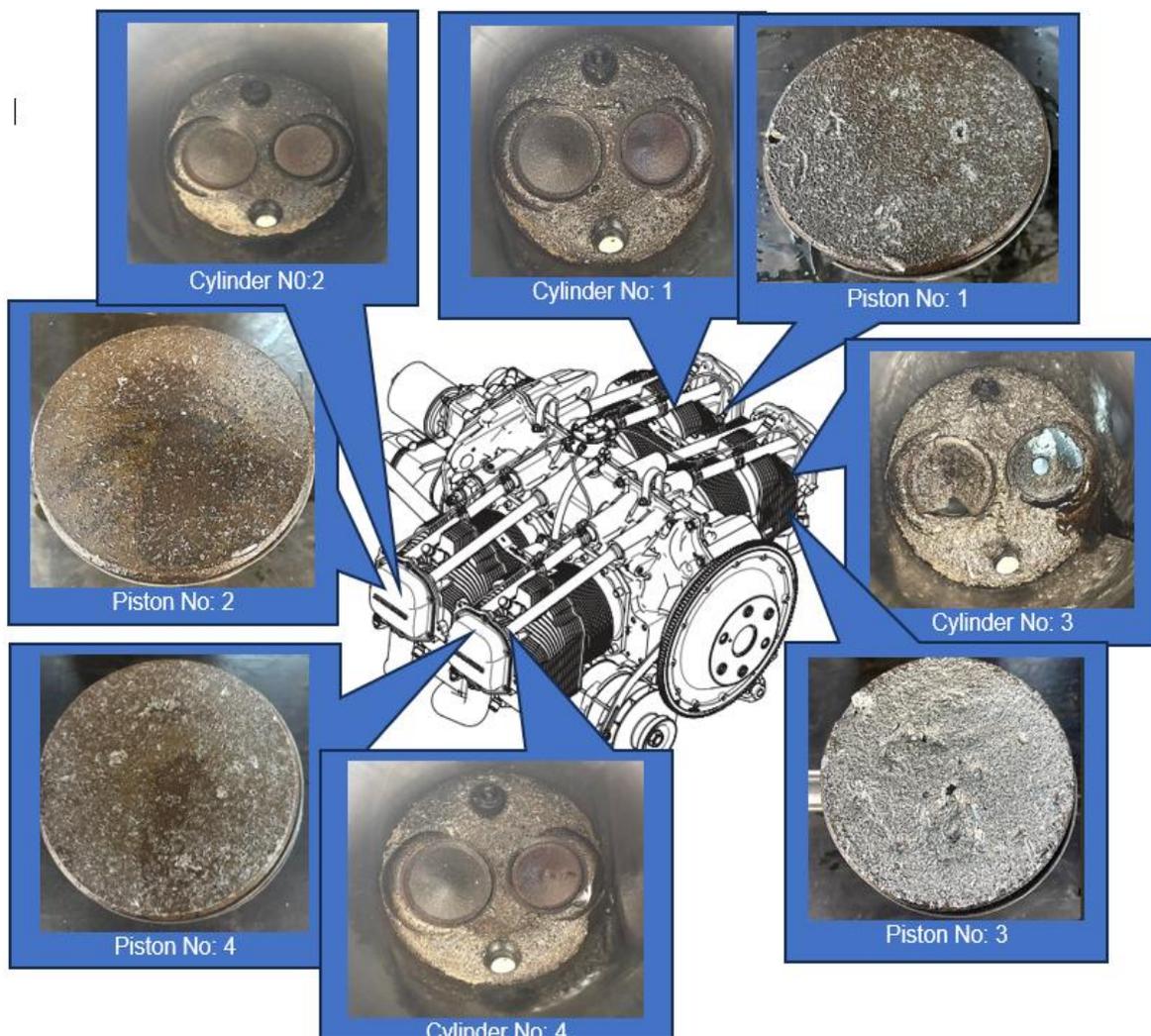


Figure 4: The damaged engine cylinders and their associated pistons.



Figure 5: The damaged No.3 piston, exhaust valve area and piston crown.

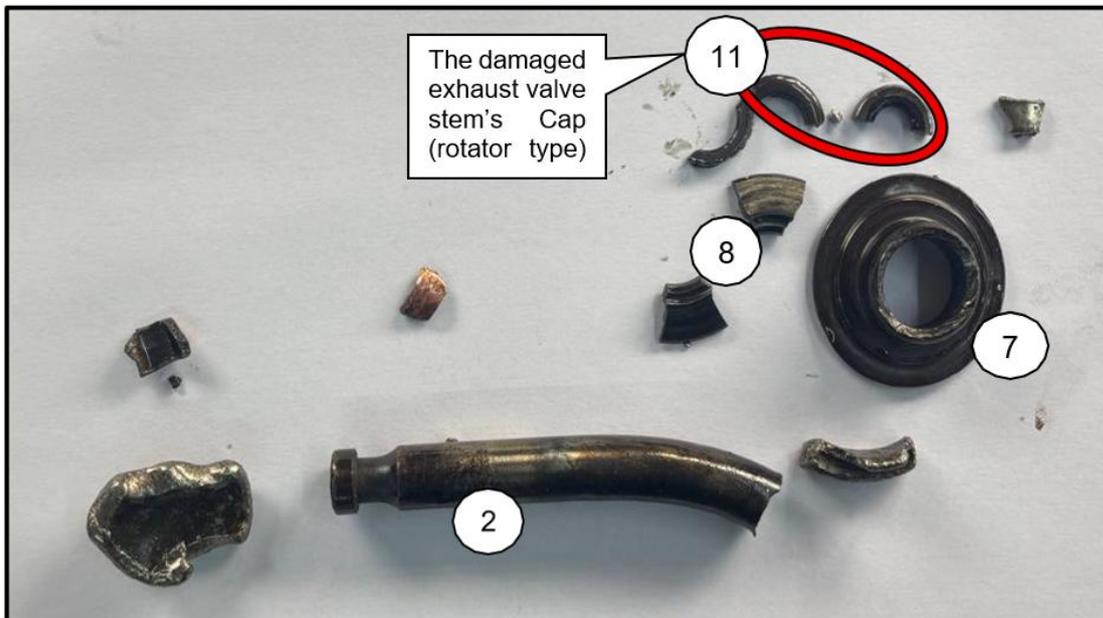


Figure 6: The failed No.3 cylinder exhaust valve.

Figure 6 shows the failed components: the damaged exhaust valve rotatory type cap (11), the damaged exhaust valve stem (rotator type) (2), and the failed upper valve spring seat (8).

Maintenance Procedure (Source: Lycoming Series Operator's Manual)

Assembly of Valves in a Cylinder

(1) *Pre-lubricate the valve stems and interior of valve guides with Molytex "O" grease or equivalent and insert each valve stem in its respective guide. Hold the valve stem tips to prevent them from falling from the cylinder.*

(2) Place the cylinder with valves over a wood block so that the valves are held against the seats. Assemble the lower valve spring seats, auxiliary valve spring, and outer valve spring over the valve stems and valve guides. Place the upper valve spring seat on top of the springs.

NOTE: When installing valve springs, place the dampener end of the spring (the close-wound coils is marked with dye or lacquer) toward the cylinder head.

1	73938	VALVE, Intake	4
2	74541	VALVE, Exhaust (rotator type)	4
3	LW-11796	SPRING, Valve, inner	8
4	LW-11800	SPRING, Valve, outer	8
5	65441	SEAT, Valve spring, lower, intake	4
6	LW-13323	SEAT, Valve spring, lower, exhaust	4
7	LW-10077	SEAT, Valve spring, upper, intake	4
8	LW-10076	SEAT, Valve spring, upper, exhaust (rotator type)	4
9	60009	KEY, Valve, intake	8
10	MS13997-3	KEY, Valve, exhaust (rotator type)	8
11	MS13998-3	CAP, Valve stem, exhaust (rotator type)	4
12	78290	PLUNGER ASSY., Hydraulic tappet	8
13	78624	SOCKET, Push rod, hydraulic tappet	8
14	LW-11486	TUBE, Push rod shroud	8
15	LW-14906	SPRING, Shroud tube	4
16	LW-12272	LOCKPLATE, Shroud tube	4
17	STD-1411	NUT, 1/4-20 plain	4
18	62922	SEAL, Shroud tube	8
19	70310	SEAL, Shroud tube	8

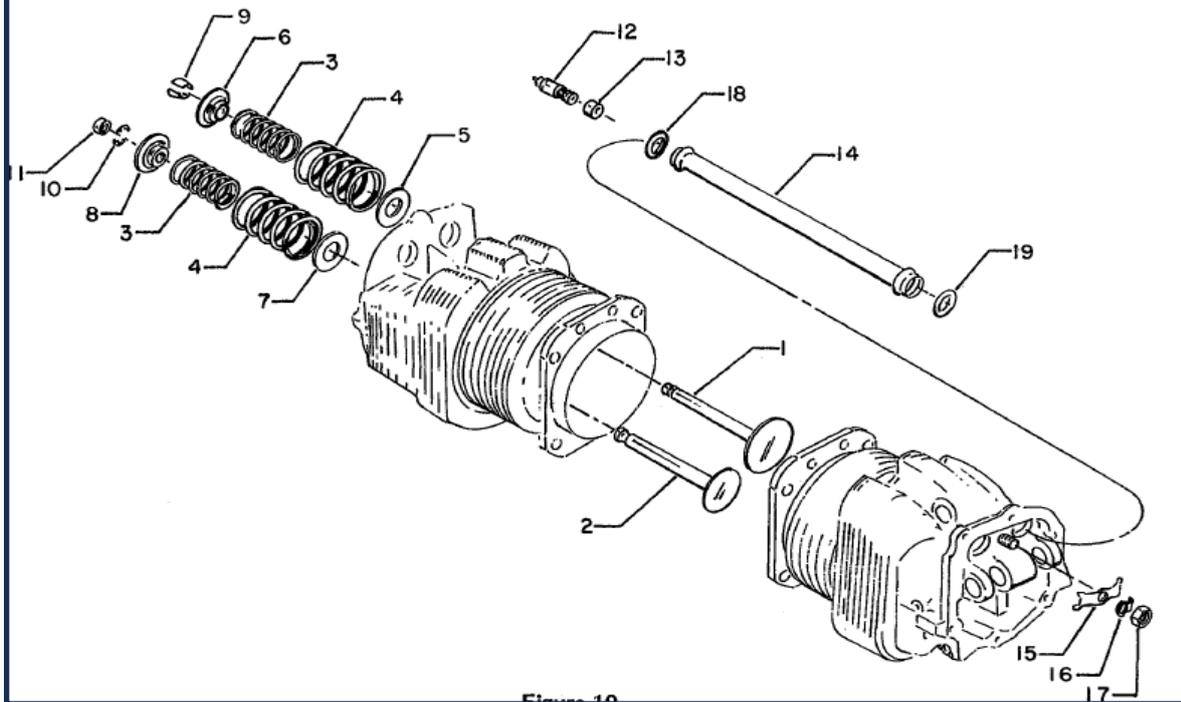


Figure 7: Exhaust and intake valve schematics.

(3) Using a valve spring compressor (Service Tool No: ST-419), compress the valve spring and place the split keys in the groove around the upper end of the valve stems. Slowly release the pressure on the valve spring compressor and allow the upper spring seat to lock itself in place around the valve keys.

According to the AMO, they received the new engine cylinders pre-installed with all the components. Upon receipt and before installation, only the valve leak checks were conducted, and they were found

satisfactory. The installation of the cylinders was performed after the piston and cylinder measurements were checked. No valve clearance checks or adjustments were made on any of the cylinders.

After reporting the failure to the supplier, the AMO received communication that they will receive a new set of components as they (supplier) believed there was a manufacturing defect that had led to the No.3 cylinder exhaust valve stem failure.

The Service Bulletin 388C

The manufacturer released a Service Bulletin (SB) 388C (388C) dated 22 November 2004, which was supplementary to No.1 SB 388B. The SB outlined a procedure for determining the condition of the exhaust valve guide. The SB further emphasised the compliance time of all engines operating on fixed wings to be at 400 hours intervals or earlier if valve sticking is suspected, until exhaust valve guides are replaced with guides made of improved material.

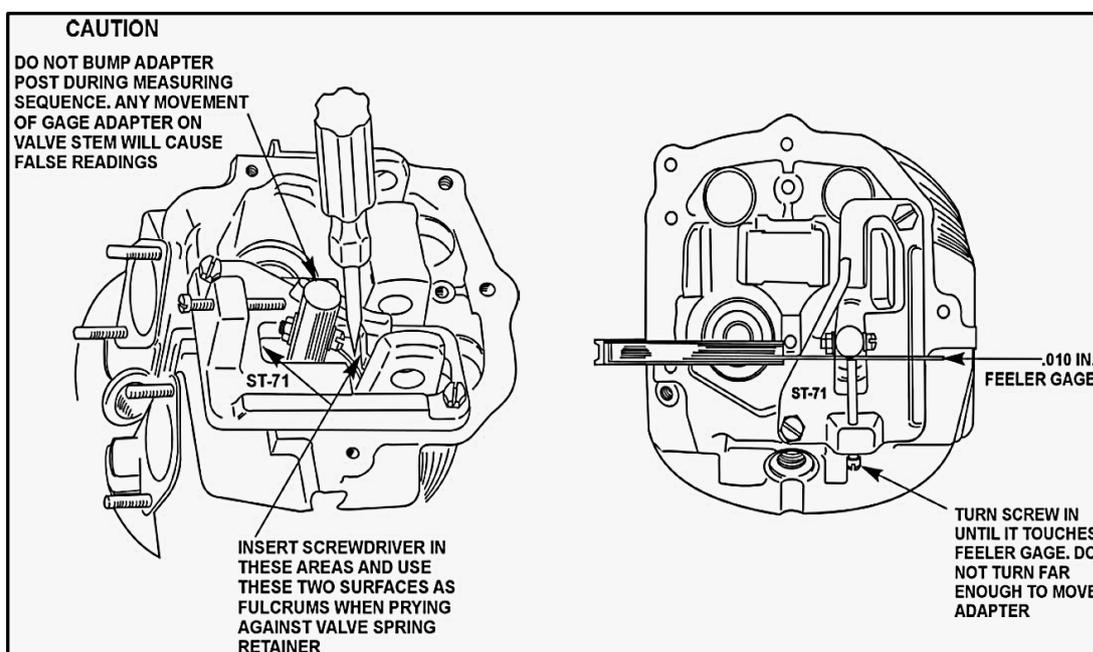


Figure 8: Exhaust valve guide adjustment.

Primary Inspection Method (PART 1) (Source: www.lycoming.com)

All other engines (e.g., O-360-A1F6): Inspect every 400 hours, or sooner if valve sticking is suspected, until newer, improved valve guides are installed via Service Instruction 1485A.

Tools required: P/N ST-71 (parallel) or ST-310 (angle-valve) fixture, valve-stem adapter, feeler gauges, and screwdriver.

Steps:

1. *Remove the rocker cover, pushrods, rocker arm, tappets, etc.*
2. *Install the fixture and adapter post on the valve stem.*
3. *Compress spring, push adapter against retainer.*
4. *Push valve stem laterally via a screwdriver; use feeler gauges to measure movement.*
5. *Acceptable lateral movement depends on guide ID—typically 0.010–0.035". Greater movement guide wear; lesser movement = carbon build-up. Clean or replace the guide accordingly.*

Follow-up:

- *Reinstall hardware.*
- *Log inspection results and corrective actions.*
- *Reassemble components per the overhaul manual.*

NOTE: There were no instructions that required the new pre-installed cylinders to be reset.

Findings

Pilot

1. The pilot had a Private Pilot Licence (PPL) that was initially issued by the Regulator (SACAA) on 15 May 2023. The PPL was reissued on 10 June 2024 with an expiry date of 31 May 2026. The pilot's Class 2 aviation medical certificate was issued on 9 May 2025 with an expiry date of 21 July 2025.
2. The pilot had a total of 126 flying hours. The aircraft type was listed in the pilot's logbook.

Aircraft

3. The aircraft had a valid Certificate of Airworthiness (C of A) that was issued by the Regulator on 4 February 2025 with an expiry date of 31 March 2026. The Certificate of Registration (C of R) was issued to the current owner on 5 June 2019.
4. The last mandatory periodic inspection (MPI) of the aircraft was conducted and certified on 4 February 2025 at 3 545 hours after which a Certificate of Release to Service (CRS) was issued with an expiry date of 3 February 2026 or at 3 645.91 hours, whichever comes first. The aircraft had a total of 3 553.99 hours at the time of the serious incident. It had accumulated a total of 8.99 hours since the last inspection.
5. The aircraft maintenance organisation (AMO) which conducted the last MPI had an AMO Certificate that was issued on 13 December 2024 with an expiry date of 31 December 2025. The aircraft type was endorsed on the AMO's operational specifications.

Environment

- 6. Clear weather conditions prevailed on the day of the flight; the weather was not an attribute to the cause of the engine failure.

Mission

- 7. The valve key on the No.3 cylinder failed during flight, 29 hours after the engine overhaul was conducted. This caused the exhaust valve to drop into the cylinder and was struck by the piston. The impact broke the valve and this led to serious internal engine damage which resulted in complete engine failure. The pilot conducted a successful forced landing.
- 8. The AMO confirmed that the new cylinders were installed without performing the required exhaust valve guide inspection as the cylinders were delivered with pre-installed components from the manufacturer; only a valve leak test was conducted. Furthermore, the manufacturer had not provided any instructions or guidance regarding valve guide adjustments prior to installation.
- 9. After the AMO's enquiry into the matter, the supplier responded by offering to replace the cylinder components, indicating their belief that the issue was due to a manufacturing defect in the supplied parts.

Probable Cause(s)

A successful forced landing following an in-flight engine failure due to the failure of the No.3 cylinder exhaust valve.

Contributing Factor(s)

The valve key failed which caused the exhaust valve to drop into the cylinder where it was repeatedly struck by the piston. This caused the valve to break and, subsequently, caused extensive internal engine damage.

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 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
<i>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.</i>
Disclaimer
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This report is issued by:

**Accident and Incident Investigations Division
South African Civil Aviation Authority
Republic of South Africa**