PRELIMINARY INCIDENT REPORT

Accident and Incident Investigations Division

Incident
- Preliminary Report -
AIID Ref No: CA18/3/2/1344

Figure 1: The ZS-FIY aircraft at the incident site. (Source: Pilot)

Description:

On 22 May 2021, a pilot accompanied by a passenger on-board a Cessna 182L aircraft with registration mark ZS-FIY took off from Runway 13 (RWY) at Ermelo Aerodrome (FAEO) in Mpumalanga province to participate in the 2021 President's Trophy Air Race. The pilot reported that the take-off was without incident; however, during the flight, the engine started to run rough and, thereafter, lost power. At that point, the aircraft started to lose height as well. The pilot elected to execute an emergency landing on an open field next to Arnot Power Station. The aircraft sustained damages to the number 5 cylinder and the wheel fairing; the pilot reported no injuries during the incident.

Introduction

Reference Number	**:** CA18/3/2/1344
Name of Owner/Operator	**:** J.J. Human
Manufacturer	**:** Cessna Aircraft Company
Model	**:** 182L
Nationality	**:** South African
Registration Marks	**:** ZS-FIY
Place	**:** Ermelo, Mpumalanga Province
Date	**:** 22 May 2021
Time	**:** 1145Z

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****.*

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.

Investigation Process

The AIID of the South African Civil Aviation Authority (SACAA) was informed about an aircraft incident involving a Cessna 182L which occurred at Ermelo Aerodrome on 22 May 2021. The incident was notified to the AIID investigator-on-call.

The AIID appointed an investigator-in-charge to conduct a desktop investigation. Notifications were sent to the State of Registry, State of Operator and State of Manufacture and Design.

The information contained in this Preliminary Report is derived from the factual information gathered during the on-going investigation into the occurrence. Later, an Interim Report or the Final Report may contain altered information in case new evidence is found during the on-going investigation that requires changes to the information depicted in this report.

Notes:
1. Whenever the following words are mentioned in this report, they shall mean the following:

- *Incident — this investigated incident*
- *Aircraft — the Cessna 182L involved in this incident*
- *Investigation — the investigation into the circumstances of this incident*
- *Pilot — the pilot involved in this incident*
- *Report — this incident report*

2. Photos and figures used in this report were taken from different sources and may have been adjusted from the original for the sole purpose of improving clarity of the report. Modifications to images used in this report were limited to cropping, magnification, file compression; or enhancement of colour, brightness, contrast; or addition of text boxes, arrows or lines.

Disclaimer

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ABBREVIATION	DESCRIPTION
AIID	Accident and Incident Investigations Division
AMO	Aircraft Maintenance Organisation
CAR	Civil Aviation Regulations
CVR	Cockpit Voice Recorder
C of A	Certificate of Airworthiness
C of R	Certificate of Registration
CRS	Certificate of Release to Service
FDR	Flight Data Recorder
FT	Feet
GPS	Global Positioning System
kt	Knot
m	Metre
MPI	Mandatory Periodic Inspection
NDT	Non-Destructive Testing
nm	Nautical Mile
QNH	Query Nautical Height
RWY	Runway
SACAA	South African Civil Aviation Authority
TBO	Time Between Overhaul
UTC	Co-ordinated Universal Time
VFR	Visual Flight Rules
Z	Zulu

1. FACTUAL INFORMATION

1.1. History of Flight

1.1.1 On 22 May 2021, a pilot accompanied by a passenger on-board a Cessna 182L aircraft with registration mark ZS-FIY took off from Ermelo Aerodrome (FAEO) in Mpumalanga province with the intention to participate in the 2021 President's Trophy Air Race, which started at 1130Z.

1.1.2 The pilot stated that he took off from FAEO Runway 13 at 1130Z without incident and reached cruise level at 6300 feet (ft) with 2 450 revolutions per minute (RPM) on the engine and 22 inches of manifold pressure. Temperature and pressures were in the green. After 15 minutes of flight, the engine started to run rough and subsequently lost power. At this point, the aircraft started to lose height as well. The pilot elected to execute an emergency landing on an open field next to Arnot Power Station. During the landing sequence, the aircraft sustained damages which were limited to the number 5 cylinder and the wheel fairing; the pilot reported no injuries.

1.1.3 The incident occurred during daylight on an open field next to Arnold Power Station at Global Positioning System (GPS) co-ordinates: S25° 55' 56.5" E29° 49' 17.7" at an elevation of 6300ft.

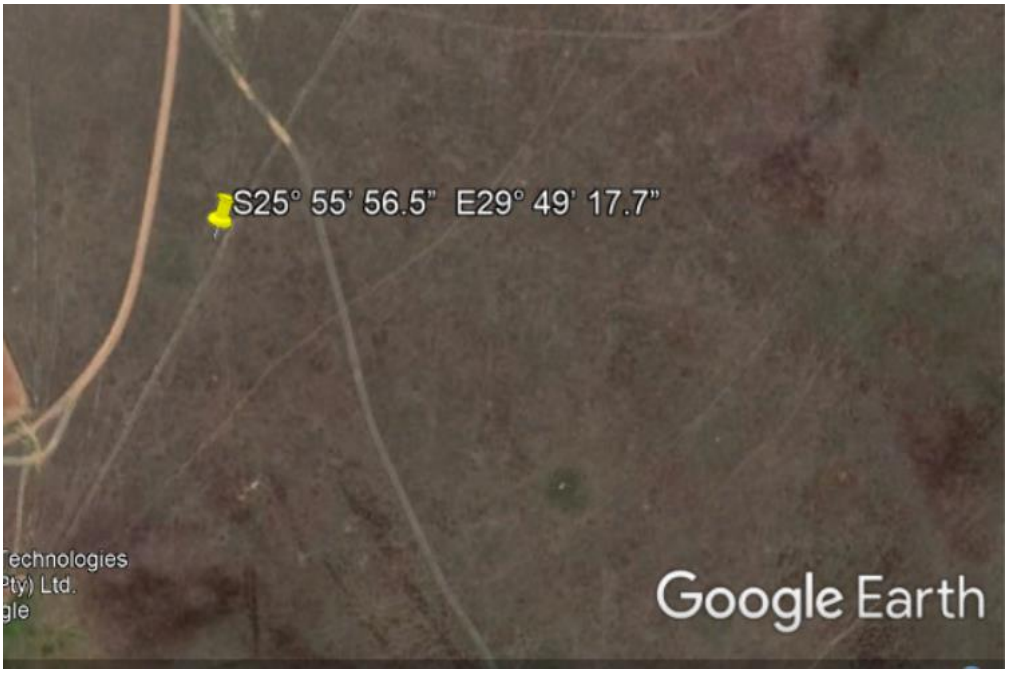


Figure 2: Google map position of incident

1.2. Injuries to Persons

Injuries	Pilot	Crew	Pass.	Total On-board	Other (On Ground)
Fatal	-	-	-	-	-
Serious	-	-	-	-	-
Minor	-	-	-	-	-
None	1	1	-	2	-
Total	1	1	-	2	-

Note: Other means people on ground.

1.3. Damage to Aircraft

1.3.1. The aircraft sustained substantial damages during the incident sequence.

Figure 3: Damaged wheel fairing post-incident.

1.4. Other Damage

1.4.1. None.

1.5. Personnel Information

Nationality	South African	Gender	Male	Age	52
Licence Number	0272486408	Licence Type	PPL		
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	None				
Medical Expiry Date	30 November 2021				
Restrictions	No night flights				
Previous Incidents	None				

Note: Previous incidents refer to past incidents the pilot was involved in, when relevant to this incident.

Flying Experience:

Total Hours	415.5
Total Past 24 Hours	0.8
Total Past 7 Days	3.6
Total Past 90 Days	13.3
Total on Type Past 90 Days	13.3
Total on Type	318.9

1.6. Aircraft Information

Airframe:

Manufacturer/Model	Cessna Aircraft Company	
Serial Number	18259062	
Year of Manufacture	1968	
Total Airframe Hours (At Time of Incident)	4034.5	
Last MPI (Date & Hours)	19 February 2021	3998.85
Hours Since Last MPI	35.65	
Certificate of Airworthiness (Issue Date)	21 November 2014	
Certificate of Airworthiness (Expiry Date)	30 November 2021	
C of R (Issue Date) (Present Owner)	7 November 2003	
Type of Fuel Used in the Aircraft	AVGAS	
Operating Categories	Part 91	
Previous Accidents	None	

Note: Previous accidents refer to past accidents the aircraft was involved in, when relevant to this accident.

1.6.1 The last maintenance inspection prior to the incident flight was carried out on 19 February 2021 at 3998.85 airframe hours. The aircraft was issued a Certificate of Release to Service (CRS) on 19 February 2021 with an expiry date of 18 February 2022 or at 4098.95 hours, whichever occurs first.

Engine:

Manufacturer/Model	Continental
Serial Number	203101-9-R
Hours Since New	4016.98
Hours Since Overhaul	1284.61

Propeller:

Type	Hartzell
Serial Number	NT123B
Hours Since New	450
Hours Since Overhaul	TBO not reached

1.6.2 Teledyne Continental issued a Service Bulletin 96-12 which stipulated visual inspections, annual inspections, compression checks and leak checks procedure for maintenance of engines, which the aircraft maintenance organisation (AMO) carried out. On 14 August 2012, the aircraft's engine with serial number 203101-9-R had cylinder 1 and 5 replaced with serviceable cylinders due to low compression. The aircraft's engine was then overhauled at 1500 engine hours on 5 April 2013. The aircraft maintenance engineer (AME) stated that non-destructive testing (NDT) was carried out on the engine, but the AMO could not locate the documents and results of that NDT. The same engine was then flown for 1280.14 hours since its last overhaul and had 220.53 hours left until its next overhaul, according to the AMO status report.

1.7. Meteorological Information

1.7.1 The weather information below was obtained from the South African Weather Service (SAWS) for Ermelo (Mpumalanga) on 22 May 2021 at 1010Z.

Wind Direction	360°	Wind Speed	5 kts	Visibility	9999m
Temperature	17°C	Cloud Cover	CAVOK	Cloud Base	CAVOK
Dew Point	6°C	QNH	1030hPa		

1.8. Aids to Navigation

1.8.1 The aircraft was equipped with standard navigational equipment as approved by the Regulator (SACAA). There were no recorded defects with the navigation system prior to the flight.

1.9. Communication

1.9.1 The aircraft was equipped with standard communication equipment as approved by the Regulator. There were no recorded defects with the communication system prior to the flight.

1.10. Aerodrome Information

Aerodrome Location	Ermelo Aerodrome FAEO (Mpumalanga)
Aerodrome Status	Licensed
Aerodrome Co-ordinates	S26°30'00" E029°59'00"
Aerodrome Altitude	5800 feet (ft)
Runway Headings	31/13
Runway Dimensions	1343 X 10 m
Runway Used	13
Runway Surface	Asphalt
Approach Facilities	None
Radio Frequency	124.800 MHz

1.11. Flight Recorders

1.11.1 The aircraft was not equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR), nor was it required by regulation to be fitted to this aircraft type.

1.12 Wreckage and Impact Information

1.12.1 The pilot reported that during the cruise phase, he felt the engine running rough then later, experienced engine power loss. He elected to execute an emergency landing on an open field next to Arnot Power Station.

1.12.2 During the emergency landing, the right main landing gear fairing as well as the number 5 cylinder boss were damaged.

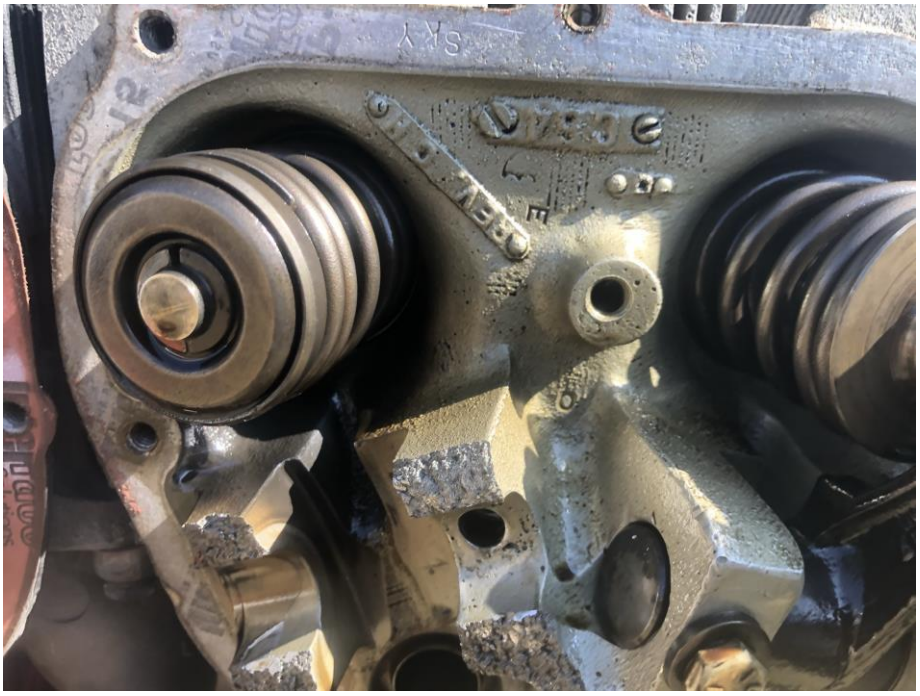


Figure 4: Damaged caused to the number 5 cylinder boss.

1.13 Medical and Pathological Information

1.13.1 None.

1.14 Fire

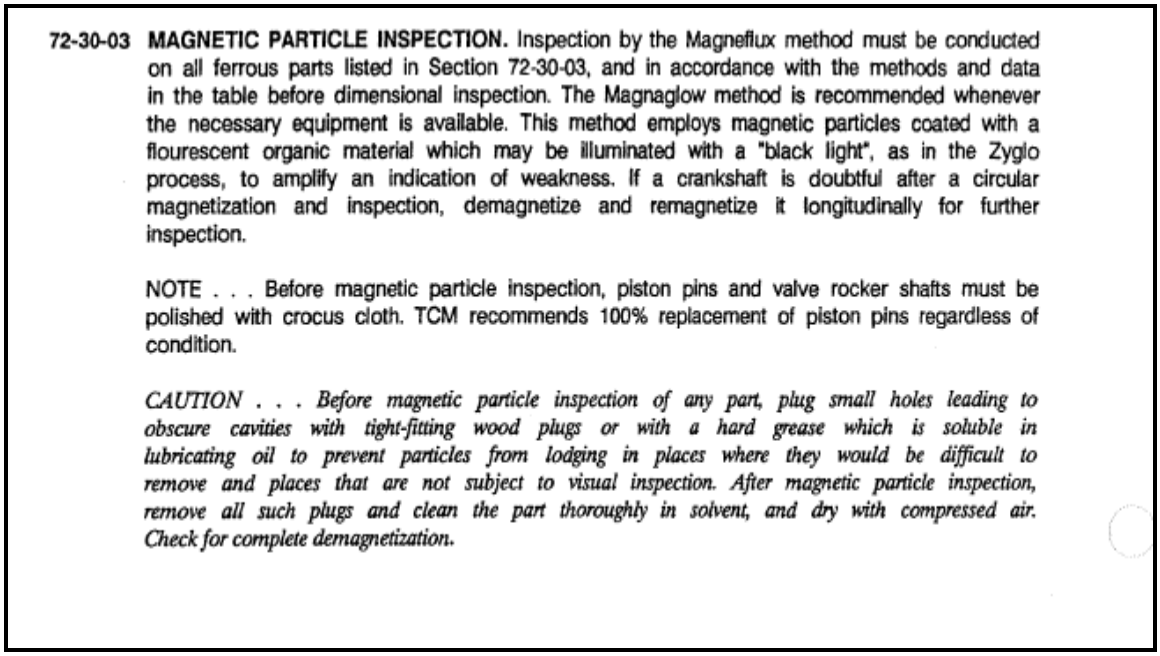
1.14.1 There was no evidence of a pre- or post-impact fire.

1.15 Survival Aspects

1.15.1 The incident was considered survivable due to the moderate speed of the aircraft before touch down and during emergency landing. The aircraft's damages were limited to the right main landing gear fairing and the number 5 cylinder.

1.16 Tests and Research

1.16.1 The method of using magnetic particle inspection is a form of non-destructive testing (NDT) which critical aircraft components are subjected to.



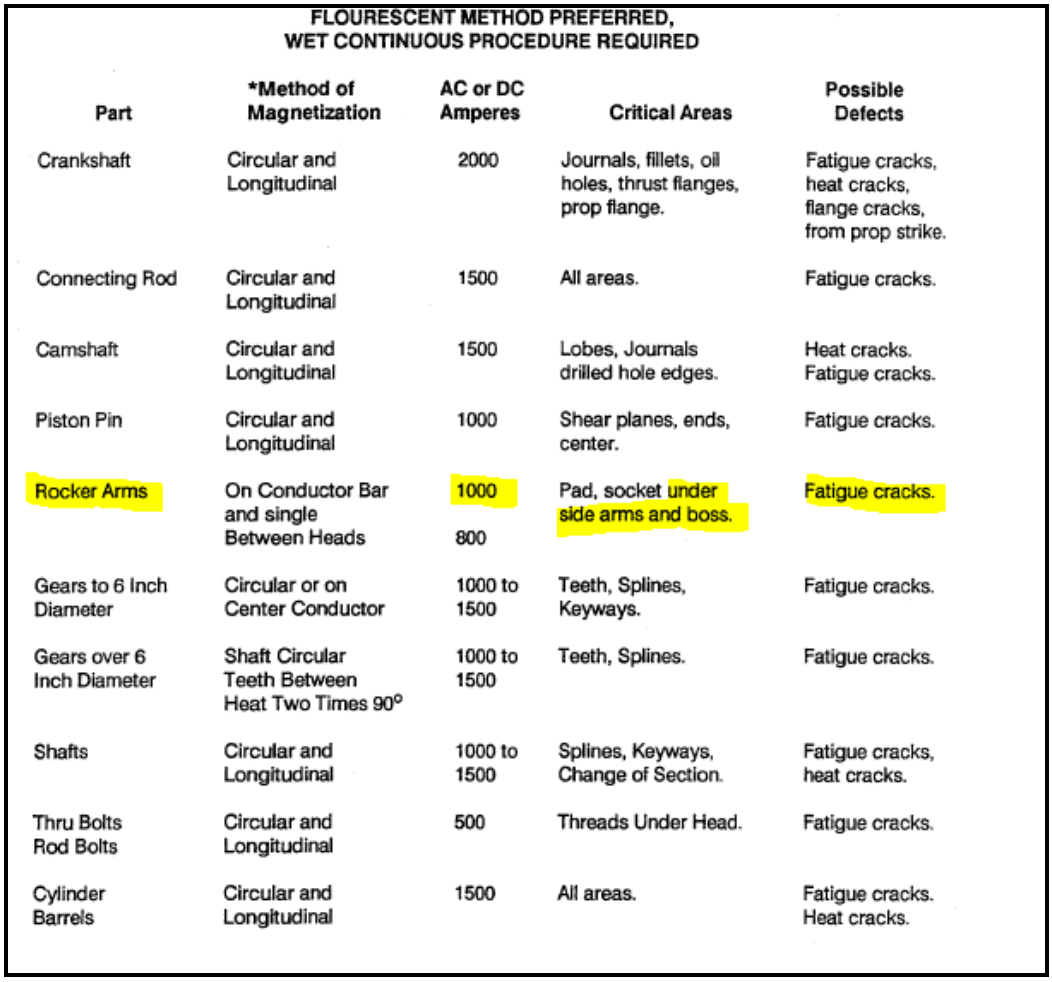
72-30-03 **MAGNETIC PARTICLE INSPECTION.** Inspection by the Magneflux method must be conducted on all ferrous parts listed in Section 72-30-03, and in accordance with the methods and data in the table before dimensional inspection. The Magnaglow method is recommended whenever the necessary equipment is available. This method employs magnetic particles coated with a flourescent organic material which may be illuminated with a "black light", as in the Zyglo process, to amplify an indication of weakness. If a crankshaft is doubtful after a circular magnetization and inspection, demagnetize and remagnetize it longitudinally for further inspection.

NOTE . . . Before magnetic particle inspection, piston pins and valve rocker shafts must be polished with crocus cloth. TCM recommends 100% replacement of piston pins regardless of condition.

CAUTION . . . Before magnetic particle inspection of any part, plug small holes leading to obscure cavities with tight-fitting wood plugs or with a hard grease which is soluble in lubricating oil to prevent particles from lodging in places where they would be difficult to remove and places that are not subject to visual inspection. After magnetic particle inspection, remove all such plugs and clean the part thoroughly in solvent, and dry with compressed air. Check for complete demagnetization.

Figure 5: Inspection extract from the Continental Maintenance Manual.

1.16.2



FLOURESCENT METHOD PREFERRED,
WET CONTINUOUS PROCEDURE REQUIRED

Part	*Method of Magnetization	AC or DC Amperes	Critical Areas	Possible Defects
Crankshaft	Circular and Longitudinal	2000	Journals, fillets, oil holes, thrust flanges, prop flange.	Fatigue cracks, heat cracks, flange cracks, from prop strike.
Connecting Rod	Circular and Longitudinal	1500	All areas.	Fatigue cracks.
Camshaft	Circular and Longitudinal	1500	Lobes, Journals drilled hole edges.	Heat cracks. Fatigue cracks.
Piston Pin	Circular and Longitudinal	1000	Shear planes, ends, center.	Fatigue cracks.
Rocker Arms	On Conductor Bar and single Between Heads	1000 800	Pad, socket under side arms and boss.	Fatigue cracks.
Gears to 6 Inch Diameter	Circular or on Center Conductor	1000 to 1500	Teeth, Splines, Keyways.	Fatigue cracks.
Gears over 6 Inch Diameter	Shaft Circular Teeth Between Heat Two Times 90°	1000 to 1500	Teeth, Splines.	Fatigue cracks.
Shafts	Circular and Longitudinal	1000 to 1500	Splines, Keyways, Change of Section.	Fatigue cracks, heat cracks.
Thru Bolts Rod Bolts	Circular and Longitudinal	500	Threads Under Head.	Fatigue cracks.
Cylinder Barrels	Circular and Longitudinal	1500	All areas.	Fatigue cracks. Heat cracks.

Figure 6: Extract from the Maintenance Manual showing specific engine parts to be tested.

1.17 Organisational and Management Information

1.17.1 The aircraft was maintained by Sky Sprayers (Pty) Ltd in accordance with Part 145 of the Civil Aviation Regulations (CAR) 2011 as amended, as well as aircraft maintenance manuals.

1.17.2 The AME who performed the last Mandatory Periodic Inspection (MPI) on the aircraft prior to the incident flight was in possession of a valid AME licence which was issued on 16 August 1995 with an expiry date of 26 October 2022. According to the reviewed records, the aircraft type was endorsed on his licence, and he was rated on this aircraft type.

1.18 Additional Information

1.18.1 **Piston Engine Rocker Shaft Boss Failures** (Australian Airworthiness Bulletin (AWB)):

Overhaul

Some lug or boss failures have been attributed to improper NDT processes during overhaul which has failed to detect fatigue cracks developed during the previous time in service. In some cases, cylinders have simply fallen over during handing for cleaning, etc., and the outside bosses have received a severe impact which has initiated undetected cracking, particularly post NDT / inspection. Improper repair by oversize reaming rocker boss bores has caused boss lugs to become too thin and unable to withstand operational normal stresses.

Operation

Sticking valves result in the valve train delivering shock loading to the rocker shaft bosses via push rods and valve rockers. Corrective maintenance following operation with sticking valves should include an inspection of the cylinder rocker shaft lugs for cracking.

When removing or installing a valve rocker shaft without removing the cylinder from the engine, ensure that any valve spring pressure transmitted to the rocker shaft and boss through the rocker arm is relieved.

Driving a rocker shaft out of the shaft bosses (with a soft drift pin and hammer) without first relieving all valve spring pressure may result in overload shocks being delivered to the cast rocker bosses, possibly causing cracks which could remain undetected during initial routine maintenance. In addition, if the metal drift should contact the internal diameter of the boss during rocker shaft removal, it can nick or gouge it, causing a stress riser and introduce a potential failure point. When inserting a rocker shaft into the bosses and the rockers, first remove varnish build-up on the pin or in the boss internal diameter. Test-fit the rocker shaft into the bosses and rocker by hand before final assembly with the rockers and thrust washers and push rods. Lubricate generously to assure smooth final assembly, which should be carried out without any valve spring pressure. Never tap a shaft into a boss to start it, as having to do so is an indication that it is not properly lined up with the boss bore, or may have excess varnish, etc.

1.19 Useful or Effective Investigation Techniques

1.19.1 No new techniques were used in this investigation.

2. FINDINGS

2.1 General

From the available evidence, the following preliminary findings were made with respect to this incident. These shall not be read as apportioning blame or liability to any particular organisation or individual.

To serve the objective of this investigation, the following sections are included in the conclusions heading:

- **Findings —** are statements of all significant conditions, events or circumstances in this incident. The findings are significant steps in this incident sequence, but they are not always causal or indicate deficiencies.

2.1.1 The pilot was issued a Private Pilot Licence (PPL) on 27 August 2014 with an expiry date of 31 October 2021. The pilot's Class 2 aviation medical certificate was issued on 26 November 2020 with an expiry date of 30 November 2021, with a restriction not to engage in night flights.

2.1.2 The aircraft was issued a Certificate of Airworthiness on 21 November 2014 with an expiry date of 30 November 2021.

2.1.3 The aircraft was issued a Certificate of Registration (C of R) on 7 November 2003.

2.1.4 On 14 August 2012, the aircraft's engine with serial number 203101-9-R had cylinder 1 and 5 replaced with serviceable cylinders due to low compression (note: serviceable cylinders are not new cylinders). The aircraft's engine was overhauled at 1500 engine hours on 5 April 2013. The AMO could not locate the documents and results of the NDT that was carried out. The same engine was then flown for 1280.14 hours since its last overhaul and had 220.53 hours left until its next inspection, according to the AMO status report.

2.1.5 The last MPI was conducted on 19 February 2021 at 3998.85 airframe hours and the aircraft had flown a total of 35.65 hours since its last MPI, according to the owner/operator. On 19 February 2021, the inspections carried out were: MPI, 50-hour inspection, 100-hour inspection, 200-hour inspection, blow-by-leak check on six cylinders and a twelve-year inspection which does not include a NDT. The aircraft was issued a Certificate of Release to Service (CRS) on 19 February 2021 with an expiry date of 18 February 2022 or at 4098.95 hours, whichever occurs first.

2.1.6 The pilot flew the aircraft at the correct RPM values (2450 rpm) during the cruise phase at the time of the incident as prescribed in the Pilot's Operating Handbook (see Figure 4).

2.1.7 The pilot reported that the engine ran rough, followed by power loss; he then elected to execute an emergency landing on an open field next to Arnot Power Station.

CRUISE.

(1) Power -- 15-23 INCHES Hg., 2200-2450 RPM (no more than 75%).
(2) Mixture -- LEAN.
(3) Cowl Flaps -- CLOSED.

Figure 7: Extract from Cessna 182L Pilots Operating Handbook.

3. ON-GOING INVESTIGATION

3.1 The AIID investigation is on-going and the investigator/s will be looking into other aspects of this occurrence which may or may not have safety implications.

This report is issued by:

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