SOUTH AFRICAN CIVIL AVIATION AUTHORITY

Section/division **Accident and Incident Investigations Division** Form Number: CA 12-55

LIMITED SERIOUS INCIDENT INVESTIGATION REPORT

Reference Number	CA18/3/2/1350						
Classification	Serious Incident	**Date**	27 June 2021	**Time**	0647Z		
Type of Operation	Training (Part 141)						
Location							
Place of Departure	Port Alfred Aerodrome (FAPA), Eastern Cape Province	Place of Intended Landing	Port Alfred Aerodrome (FAPA), Eastern Cape Province				
Place of Occurrence	On a field close to R72 road, about 2 nautical miles (nm) north-east of Kenton on Sea, Eastern Cape Province						
GPS Co-ordinates	Latitude	S33° 66' 07.09"	Longitude	E26°54'.15.31"	Elevation	300 feet	
Aircraft Information							
Registration	ZS-ISU						
Model/Make	Piper PA-28-180 Cherokee						
Damage to Aircraft	Minor	Total Aircraft Hours	2422.2				
Pilot-in-command							
Licence Valid	Yes	Gender	Male	Age	22		
Licence Type	Commercial Pilot Licence (CPL)						
Total Hours on Type	520.3	Total Flying Hours	635.2				
People On-board	1 + 1	Injuries:	0	Fatalities:	0	Other (On Ground)	0
What Happened							

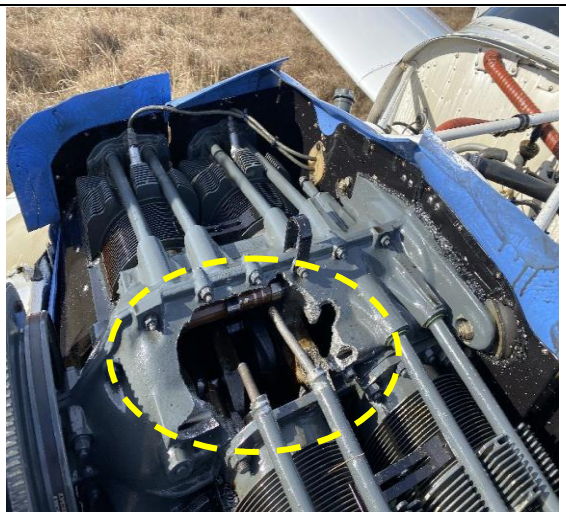
On Sunday morning 27 June 2021, a Grade III flight instructor and a student pilot on-board a Piper PA-28-180 Cherokee aircraft with registration ZS-ISU were on a navigation training flight from Port Alfred Aerodrome (FAPA) in the Eastern Cape province when the in-flight engine failure occurred. The flight was conducted under Visual Meteorological Conditions (VMC) by day; the flight plan was filed with Cape Town (FACT) briefing. The route chosen for the navigation flight was southerly through Kenton on Sea, Alicedale, Fort Beaufort (FAFO), Bathurst and back to FAPA. The flight was planned to last about 1 hour and 30 minutes (90 minutes). Before the flight, the duo had a short briefing in the office and, later, carried out a thorough preflight inspection on the aircraft. The aircraft had a total of 48 gallons of Avgas LL100 fuel in the tanks and the engine oil level in the sump was above 6 quarts. The aircraft was airworthy, and the flight folio indicated no defects. The duo boarded the aircraft and strapped on their safety harnesses.

The instructor reported that he assumed the pilot flying (PF) duties for the first leg to Kenton on Sea in a southerly direction so he could demonstrate the navigation flight to the student pilot. He started the engine and allowed it to run for a few minutes. After the engine instruments had stabilised, he taxied the aircraft to Runway 28L and took off. Whilst cruising at 4500 feet, he took note of the oil pressure indication which was a little lower than usual at 60 pounds per square inch (60 psi); however, still within the green arch at the low end. The oil temperature indication remained within the normal operating range at 60°C. The crew continued to fly, and after about 3 minutes, the instructor noted that the oil pressure had dropped to 20psi and that the oil temperature indication was too high, above 245°C. At this point, the aircraft was about 3 nautical miles (nm) north-east of Alexandria and about 20nm west of FAPA.

The instructor decided to return to FAPA. However, before he could make a turn, he heard a loud bang coming from the engine. This was followed by oil splattering on the windscreen. The student pilot broadcasted a PAN-PAN radio call to Cape Town International Airport (FACT) information on 127–575-Megahertz (MHz) frequency informing them that they will be performing a forced landing at their current location. The instructor spotted an open field on which to perform a forced landing and followed the emergency procedures as stipulated in the Pilot Operating Handbook (POH). The instructor glided the aircraft into wind and performed a successful forced landing on an open grassy field close to R72 road, about 2nm north-east of Kenton on Sea in the Eastern Cape province.

Figure 1: The aircraft at the accident site with oil streaking down the side of the engine cowling. (Source: Operator)

After the aircraft landed, oil was observed dripping from the engine cowlings. The flight lasted about 30 minutes. The aircraft sustained minor damages and no persons were injured. Examination of the engine at the incident site indicated that the No.3 connecting rod had detached from the crankshaft journal, the connecting rod had suffered severe impact damage, and the upper left part of the crankcase had a hole of an approximate 6 x 8 inches on it.

Figures 2 and 3: Damage on the engine top cowling (left picture). Damage on the upper left part of the crankcase (right picture). (Source: Operator)

The aircraft was powered by a Lycoming O-360-A4A four-cylinder, direct drive, horizontally opposed reciprocating engine with serial number L-18644-36A and with a rated maximum power output of 180 brake horsepower (BHP) at 2700 revolutions per minute (RPM). The engine crankcase consists of three plain type main bearings. Each connecting rod is attached to the crankshaft journal by a split, plain bearing retained by a bearing cap. The assembly is secured by two bolts, each passing through integral bosses formed on the connecting rod and the cap, and retained by nuts. Rotation of the journal within the main bearings, together with the viscosity of the oil, create a dynamic wedge of high-pressure oil that keeps the parts separated.

Examination of the engine logbooks indicated that it had accumulated a total of 12 962 hours since new (HSN) and 754 hours since it was overhauled on 28 August 2019. The manufacturer's service instruction No:1009BE dated 24 April 2020 indicated that the engine type fitted on the aircraft time between overhaul (TBO) is 2 200 hours. The crankcase used during the engine overhaul was reconditioned by Divco Engineering situated in the United States of America (USA) and certified by the Federal Aviation Administration (FAA) and European Aviation Safety Agency (EASA). New main and big end bearings, including all components as mandated by the engine manufacturer service instruction, were used during the engine overhaul. The engine-through bolts were each torqued to 50-foot pounds; all the crankcase main bearings were firmly locked into their respective saddles. The engine logbook showed no entry indicating any of the cylinders being replaced since the engine was last overhauled.

The aircraft was recovered to FAPA where the engine was removed. On 28 June 2021, the engine teardown examination was carried out by the Aircraft Maintenance Organisation (AMO) under the auspices of the South African Civil Aviation Authority (SACAA) inspector. Findings of the engine teardown examination were as follows:

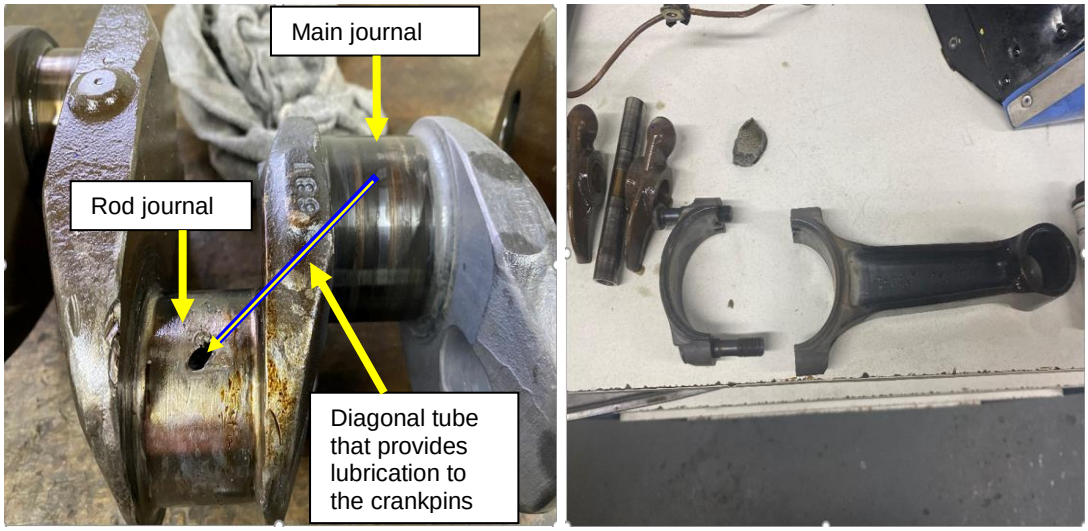
I. The engine sump and the oil filter were removed and found to contain a large number of metallic debris.

II. A substantial amount of engine oil had escaped through the hole on the upper left part of the crankcase. The oil pump was inspected and its components were found to be in good condition, with minor damage on the gear teeth. The pump did not show any signs of having been operated without oil.

Figures 4 and 5: The oil sump indicating the presecence of metal debris (left picture). The oil pump gear teeth indicating minor damage (right picture). (Source: Operator)

III. Examination of the engine crankcase halves indicated that the bearing shells were firmly locked into their respective saddles and that all three main bearings were firmly in their seats and did not shift, meaning that each main bearing shell oil supply hole had lined up with its respective oil passage in the saddle.

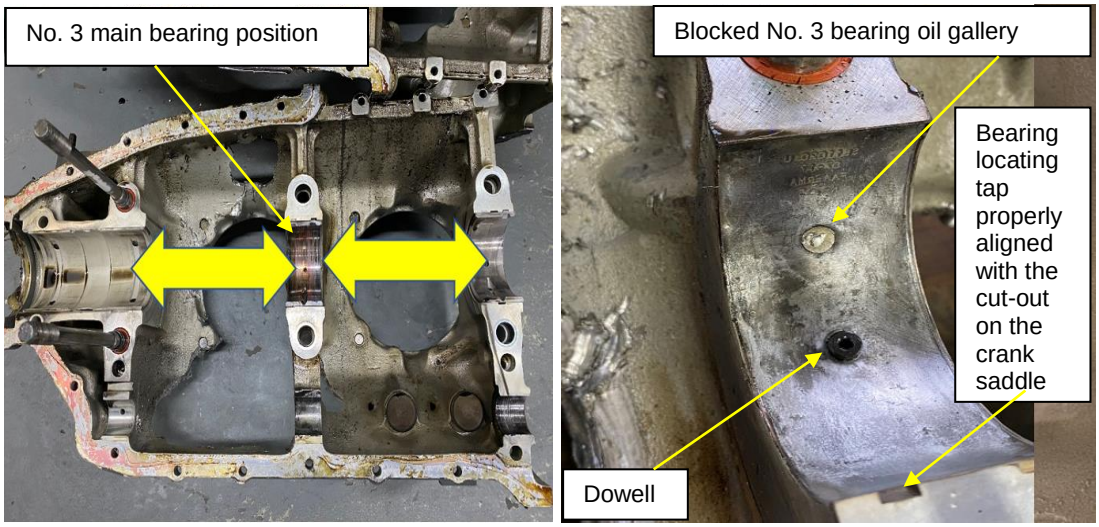
IV. Numbers 1, 2 and 4 main crankcase bearings and journals indicated no signs of wear or damage.



Figures 6 and 7: Damage (rubbing) on No. 3 main bearing and the connecting rod journal (left picture). The No. 3 connecting rod that separated (right picture).

V. The accessory drive of the engine indicated no signs of damage.

VI. No. 3 main bearing (main journal) overheated due to lack of lubrication caused by a blocked main bearing oil gallery.



Figures 8 and 9: The crankcase half showing excessive heat damage on the No. 3 (centre) main bearing (left picture). The No 3 main bearing showing a blocked oil gallery, a bearing locating tap and a dowell (right picture).

Examination of the aircraft maintenance records indicated no defects with the engine prior to the occurrence.

The Lycoming mandatory Service Bulletin (SB) No:480F dated 25 May 2017 mandates engine oil and oil filter change at 50-hour interval, as well as cleaning of oil suction screen.

Job card No: 45059 dated 22 June 2021 indicated that a 50-hour oil change was carried out by the operator at FAPA at 24 221 recorded engine hours. The engine fitted to the aircraft had the oil sump capacity of 8 quarts and the minimum safe quantity of 2.5 quarts. A quart of oil is equal to 946 millilitres. The engine oil was drained during the 50-hour inspection and the oil filter was removed and cut open. The oil filter element was inspected for metal particles and no signs of metal particles were observed. The flight folio entry on page serial number 3168 indicated that the operator uplifted 7 quarts of engine oil during the 50-hour oil inspection. A new oil filter was also fitted to the engine before the oil was uplifted. The type of oil uplifted to the engine was the correct grade (Aero Shell W100/SAE 50) and conformed to the specifications.

The engine ground run was carried out on 22 June 2021 and had met all the parameters. Following the engine parameter register held at the operator's facility, the parameters under monitoring during each flight are static engine revolutions per minute (RPM), oil pressure, oil temperature, cylinder compression, condition of spark plugs, condition of oil filter and fuel consumption. According to the records, all the engine parameters were within limits and the engine had no history of excessive oil consumption.

The engine oil consumption, in accordance with (IAW) Lycoming Service Instruction No -1427C dated 29 December 2010, was calculated to be 0.58 quarts per hour (0,006 x 180 BHP x 4 ÷ 7.4 = 0.58 quarts “about 300 millilitres” per hour), meaning that an uplift of 1 quart of oil was required for every 3 hours of operation. The flight folio entries on page serial number 3168 indicated that 2 quarts of oil were added to the engine at FAPA on 25 June 2021 after 7 hours of flight time. The aircraft was flown an additional 3 hours before the occurrence flight. The occurrence flight on 27 June 2021 lasted 30 minutes (0.5). The above calculation and the last oil uplift at FAPA on 25 June 2021 indicated that the engine was operated with more than 2.5 quarts of oil on the day of the occurrence flight.

The investigation concluded that a blocked main bearing oil gallery which was supposed to supply the No. 3 connecting rod connecting journal (main and big end bearings) with oil caused the No.3 connecting rod to overheat from excessive heat emanating from lack of hydrodynamic lubrication. The blockage of the oil gallery on the No.3 main bearing was caused by unexplained foreign particles or contaminants which found their way into the lubrication gap between the main bearing and crankshaft. This subsequently created metal-to-metal contact, thus, causing the metal to expand, either compressing the aluminium of the No.3 connecting rod bearing cap or stretching the steel bolts and causing them to lose their pre-load, at which point they started backing out.

Safety Action/s

None.

Safety Message and/or Safety Recommendation/s

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.

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This report is issued by:

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