

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



ANC24LA027

ENGINE EXAM

July 17, 2024

TABLE OF CONTENTS

A. ACCIDENT.....	3
B. ENGINE EXAM.....	3
C. SUMMARY.....	3
D. DETAILS OF THE EXAMINATION.....	3
1.0 AIRFRAME EXAMINATION.....	3
1.1 Fuel/Fuel System.....	4
2.0 ENGINE EXAMINATION	4

A. ACCIDENT

Location: Marana, AZ
Date: April 19th, 2024
Time: 12:30 Local
Airplane: Piper PA 28-151, N4399X

B. ENGINE EXAM

IIC	Stacia Joyce National Transportation Safety Board Anchorage, AK
Investigator	Elliott Simpson National Transportation Safety Board Los Angeles, CA
Subject Matter Expert	Mark Platt Lycoming Williamsport, PA
Party Member	Ty Tennison Federal Aviation Administration Scottsdale, AZ

C. SUMMARY

While on a cross-country instructional flight, the engine on the Piper PA-28 began to run rough and make grinding noises, then the engine stopped producing power and the propeller would not windmill. The flight instructor attempted to restart the engine to no avail and performed a forced landing to a field. The engine examination revealed catastrophic damage to the number four cylinder. Part of the piston from the number four cylinder was retained and sent to the NTSB materials laboratory for further analysis.

D. DETAILS OF THE EXAMINATION

1.0 Airframe Examination

The nose wheel had collapsed, and an oil sheen was observed on the belly and leading edge of the step on right side of airplane.

1.1 Fuel/Fuel System

There was continuity between the throttle and fuel mixture controls within the cabin to their respective control arms on the carburetor. There was continuity between the cabin carburetor heat control controls in the cabin and the carburetor heat box on the engine. The carburetor remained firmly attached to the sump.

2.0 Engine Examination

The airplane was presented without the wings and mounted on a stand (figure 1). The airframe was intact, the nose wheel had collapsed causing damage to the underbelly. An oil sheen on the belly and leading edge of right step was observed.



Figure 1 Accident Airplane

The group removed the engine cowling; the engine remained attached to the airframe firewall. Oil was observed on the bottom of the engine cowling and the carburetor as well as the lower surface of the oil cooler and engine sump. No oil was observed on the upper cowling or upper engine surface. The engine was coated in grey paint consistent with the color applied at the Lycoming factory. Each cylinder was marked with blue paint which indicated they were steel nitrate barrels manufactured by Lycoming. The airplane was not equipped with a vacuum pump, and its accessory pad had been covered with a gasket and plate.

A continuous crack was observed above the number three intake valve tappet casting through the engine case and down through to the sump (figure 2). The right magneto was detached from its mounting flange on the accessory case, and a portion of the mounting flange remained securely clamped to the case.



Figure 2 Crack in crank case beginning near the top of cylinder #3

All oil lines were secure including the lines from the oil cooler and oil pressure sending unit. Dark colored oil flowed from the oil cooler when its lines were detached.

The tachometer drive cable was tight and its fitting on the accessory case was secure. The oil filter was safety wired and firmly attached to its mounting pad. The oil sump drain plug was in the closed position, and there were no apparent leaks. The oil cap was screwed in place, no oil was observed on the dip stick. All of the rocker box oil return lines from each cylinder were secure.

The oil cooler was checked for leaks using pressurized air, none were found. The oil suction screen was removed and appeared to be coated with black oil and metallic pieces. The oil filter was cut open and its paper medium was coated in shiny metallic particles.

The Tempest (UREM38S) fine wire spark plugs were removed (the number four top spark plug could be loosened by hand); the plugs were mechanically intact. All electrodes were covered in grey deposits and had normal wear signatures when compared to the Champion Check-A-Plug AV-27 chart. The lower number two and four spark plugs were oil wet (figure 3).

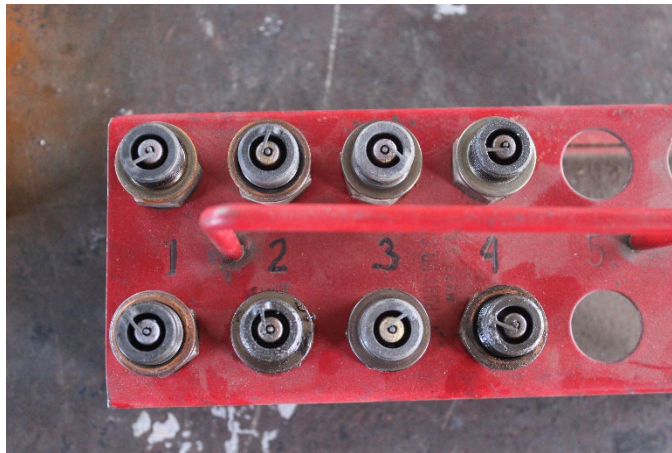


Figure 3 Spark Plugs from accident airplane

A preliminary borescope inspection through the upper crack in the case revealed catastrophic internal damage to the number four cylinder.

Cylinders one, two and three were removed. The rocker arms and springs were intact, and the push rods were straight. All of the combustion chamber and valve faces were coated in dark grey deposits. Each valve head had concentric deposit features. The piston crowns all showed similar grey and black deposits. The combustion chambers remained free of internal mechanical damage, the chamber surfaces were all shiny with no pitting or other evidence of detonation.

The aft portion of the cam shaft was bent 10-15 degrees. All intake cam shaft lobes were worn such that approximately 10-50% of the material had worn away. Metal burrs were present on the edges of the cam lobe remnants. The tappet heads were either shattered or exhibited spalling and cupping deformation to their cam lobe contact face. All four connecting rods remained connected to the crank shaft and could be moved smoothly around the crank journal.

The exhaust and intake tubes were removed. The inner exhaust tube surfaces were coated with dark grey deposits.

The oil sump was removed and contained about a quart and a half of dark colored oil. The entire lower surface of the sump was coated in metal chunks and fragments.

The accessory case was removed, the crank shaft dowl pin was intact, and the accessory gears were in place with no teeth missing. The drive gear for the right magneto was offset about 20 degrees.

The number four cylinder connecting rod was bent approximately 45 degrees at the wrist pin end (figure 4). The connecting rod was continuous. The wrist pin had detached and had become embedded in the lower section of the crankcase (figure 5). The upper portion of the number four cylinder assembly was cut from the crank case. The piston head appeared to be in its full compression stroke travel limit. The entire piston skirt was fragmented down to the piston rings and exhibited gouging damage with remnants of the piston ring boss remaining (figure 6). A section of the wrist pin boss remained, and one side exhibited dull and even granular separation

surface features. The other side of the wrist boss exhibited darker discoloration with concentric semicircular granular pattern (figure 7).

The appearance and coloration of the rod was consistent with the other rods in the engine. According to the engine manufacturer representative, the observed bearing surfaces, bushings and subject wrist pin did not exhibit any abnormal wear or heat distress.



Figure 4 Bent Connecting Rod #4 Cylinder



Figure 5 Wrist pin embedded in lower crank case



Figure 6 Cylinder #4 piston skirt and wrist pin boss damage



Figure 7 Wrist Pin Boss #4 Cylinder

Submitted by:

Stacia D. Joyce
Air Safety Investigator

ENGINE EXAM

ANC24LA027
PG 8 OF 8