

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



ERA24LA211

ENGINE EXAMINATION

November 8, 2024

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A. ACCIDENT

Location: Apopka, FL
Date: 5/8/2024
Time: 1130 EDT
1530 UTC
Airplane: N908DK; PA-32-300

B. ENGINE EXAMINATION

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C. SUMMARY

On May 8, 2024, about 1130 eastern daylight time, a Piper PA-32-300, N908DK, was substantially damaged when it was involved in an accident near Apopka, Florida. The flight instructor and student pilot were not injured and there were no reported ground injuries. The airplane was operated as a Title 14 Code of Federal Regulations Part 91 instructional flight. The flight instructor reported that they departed Orlando Executive Airport (ORL), Orlando, Florida, and flew northwest. While in the initial climb, about 1,500 ft mean sea level (msl), the flight instructor noticed the airplane performance decreased and upon checking the engine instruments noticed the exhaust gas temperature (EGT) reading for the Nos. 3 and 4 cylinders had dropped significantly. He then decided to divert to the nearest airport, Orlando Apopka Airport (X04), Apopka, Florida. About 10 miles from X04 the Nos. 2 and 5 cylinder EGTs also decreased significantly. The engine was not producing enough power to maintain altitude and upon realizing that the airplane would not be able to reach X04, the flight instructor decided to perform an emergency off field landing.

The owner reported to the NTSB that this is the third time in past couple years they have lost cylinders in flight. An FAA inspector performed a cursory examination of the engine, and reported that he found no obvious issues, he reported there was compression on all cylinders and found no obstructions in the flow divider, injector lines, and fuel injection nozzles. The FAA inspector also reported that both the left and right main fuel tanks contained fuel consistent in color with 100LL aviation fuel.

The IO-540-K1A5 is a direct drive, horizontally opposed, six-cylinder, fuel injected, air cooled engine with a rated maximum continuous power of 300 Hp at 2700 Rpm.

D. DETAILS OF THE EXAMINATION

1.0 Engine Examination

The engine was packaged in a Lycoming shipping crate. The engine was removed from the crate and installed on a Lycoming engine ring stand. The upper sparkplugs, all ignition leads, and rocker box covers were removed. The crankshaft was rotated by applying hand pressure to the crankshaft flange. Normal valve action was observed on all cylinders, compression and suction was observed on all cylinders in the correct firing order, an internal timing check IAW Lycoming SSP-475 was conducted and checked out good. Mechanical continuity was confirmed throughout the engine. The upper sparkplugs, ignition leads, and rocker box covers were reinstalled, and the engine was transferred to production test cell 2-4 for an engine test run.

The starter remained secured to the engine's crankcase. It was removed during the cursory examination and a slave unit was installed to facilitate the engine test run.

The alternator remained secured to the engine with its attaching brackets. It was removed from the engine and was not examined further.



Photo 1: The engine as first seen after the removal of the cardboard shipping box.

1.1 Induction and Exhaust System

The exhaust system exhibited minimal damage and was removed for the engine test run.



Photo 2: View of the removed exhaust system.

The induction system was undamaged and remained attached to the engine for the engine test run.

1.2 Magnetos

The left and right hand magnetos remained secured to their mounting flanges on the accessory house. Magneto to engine timing was checked, both magnetos were timed at 18 degrees BTC. Spark advance should be set at 20 degrees BTC for this engine model. 18 degrees would have a minimal effect on engine performance.



Photo 3: View of the magnetos installed in the accessory case.

1.3 Ignition System

The upper 6 spark plugs were removed and examined; the ground electrodes appeared normal. Some oil noted on the upper plugs of cylinders 1 and 5.

The ignition harness appeared undamaged from the impact sequence. Chaffing damage was observed along the lengths of each lead. The chaffing appears to have occurred during normal operation of the engine, it did not appear deep enough to cause arcing or shorting to ground of the ignition system.



Photo 4: View of the spark plugs.

1.4 Fuel System

The Bendix fuel injection servo remained secured to the engine's induction plenum. The throttle and mixture cables were removed from the servo prior to its shipment to Lycoming. The fuel injection servo was removed from the engine and fuel pressure was applied to its inlet fitting to test for leaks. None were observed and it was reinstalled on the engine prior to the engine run.

The AN style fuel pump remained secured to the accessory housing; it was not removed for further examination to facilitate the "as is" engine run.

The flow divider remained secured to the spline of the crankcase, the fuel inlet line to the flow divider was disconnected and was reassembled prior to the engine test run. The fuel injection lines remained secured to the flow divider and their respective fuel injection nozzles. The flow divider and the fuel injection nozzles were not removed for examination.



Photo 5: View of the fuel servo and fuel pump installed on the engine.

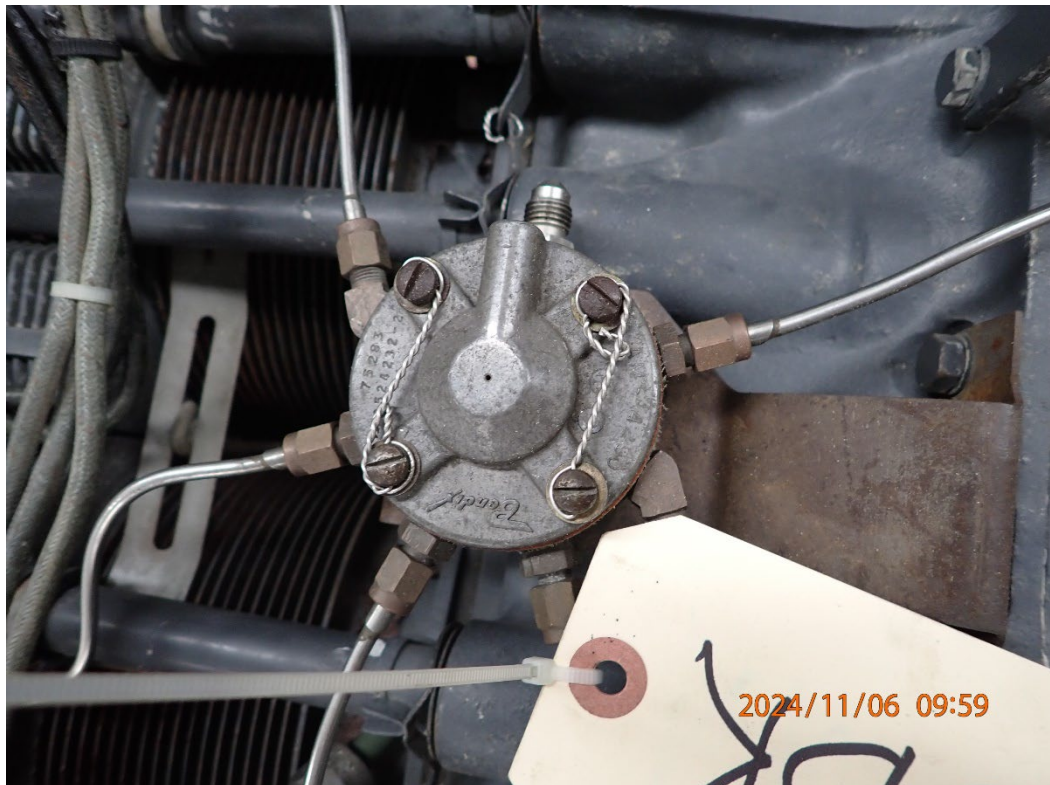


Photo 6: View of the flow divider secured to the engine.

1.5 Lubrication System

About 9 quarts of oil was read on the oil dipstick. The oil filter was secured to the oil filter adapter and was safety-wired. The oil filter was removed and cut-open. No contamination or metal particulates were observed in the pleats of the oil filters paper element. The oil suction screen was removed and examined; no contamination was observed.

The propeller governor remained attached to the engine and was removed prior to the engine test run. The governor oil screen was removed and inspected and was unobstructed. The governor gurgled oil when the drive shaft was rotated by hand.



Photo 7: Oil dipstick showing about 9 quarts of oil.



Photo 8: Oil filter removed and cut open.

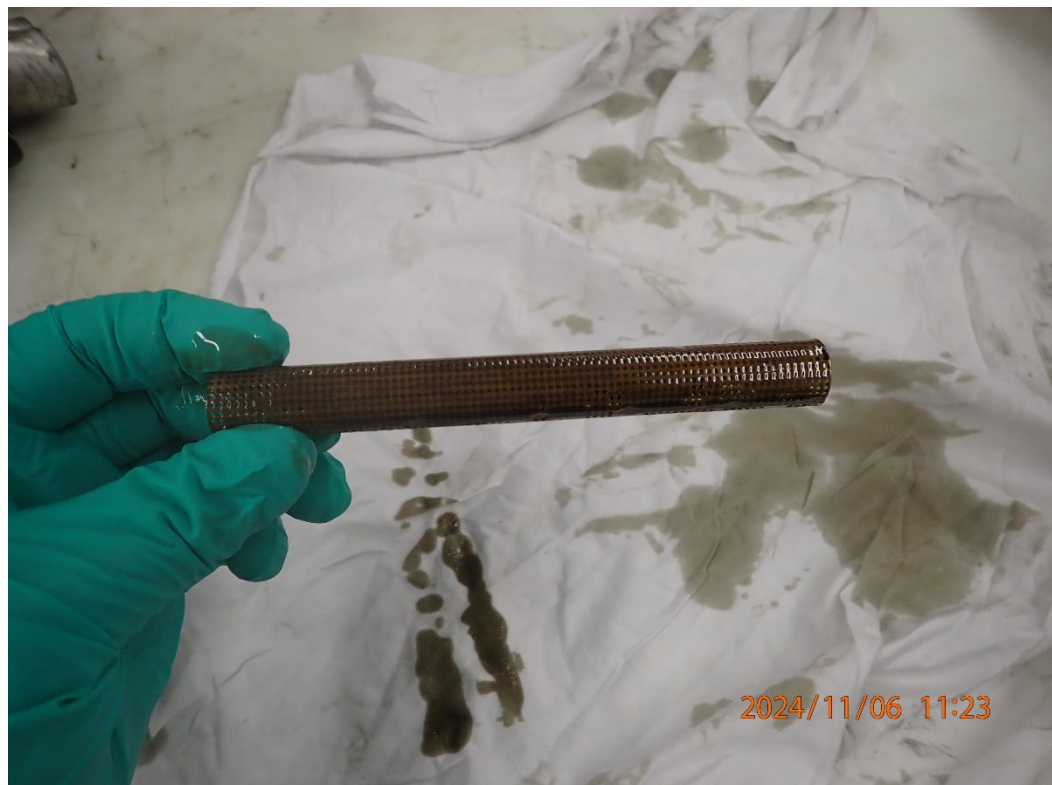


Photo 9: View of the unobstructed oil suction screen.



Photo 10: Propeller governor attached to the engine.



Photo 11: View of the unobstructed propeller governor oil screen.

2.0 Engine Test Run

Fresh oil was pumped through the engine to ensure proper lubrication, and that no contamination was present. The engine was started and warmed up. Oil temperature reach approximately 250 degrees F by the time the engine was at about 2000 rpm. The engine was shut down and the original oil filter adapter as removed, and a slave oil filter adapter was installed. The engine was then restarted the following day and oil temperature was normal and the engine was operated through its full power band following Lycoming's standard power and leak engine run test. All areas passed except for the air flow limits at rated, low limit is 1636.6 pph, test result was 1535.3 pph. There is no high limit.



Photo 12: View of the engine mounted in the test cell prior to engine test run.

Power, Filter & Leak Data Sheet

Engine # : L-8401-48	Model # : IO-540-K1A5	Order # : NTSB	Preservation: LPS 486
Operator 1: N. Welch	Accept/Date : _____	Test Mode : Final	Part 3.2 Test
Operator 2:	Accept/Date : _____	BOM : ENPL-2706	Sign: _____
Fuel Serial # : 31501/22	Ignition Left : 10090868	Ignition Right : 10080820	
Fuel Slave : NO	Ignit_L Slave : NO	Ignit_R Slave : NO	SW Rev : LSW20004(-) LYC
Fuel Curve: C-13048-D	Float Bowl Connected to Fuel Pump Inlet : YES		Barometer : 29.48
Pre-Oil Temp : 165	Pre-Oil Pres : 85	Setting # : 2524273-12	Read Time : 11/07/24 06:54
ETS # : 654_PWR & LEAK	ETS Rev : ECO-26195	Date/Time : 11/06/24 14:23	Test Status : Fail

Comments

Variations

The following minor variations to the applicable engine test specification were observed during this test and determined to be acceptable 'as is'. The acceptance of these variations will not affect air worthiness or performance.

1) _____
 2) _____
 3) _____
 4) _____
 Engr. _____ Q.C. _____ Date _____

When / Test	Low Limit	Value	High Limit	Status
Runin @ 1500 rpm for 5 min				
Allowable Speed Variation (rpm)	-75	2.7	75	Pass
Cylinder Head Temperature (°F)		244	475	Pass
Inlet Air Temperature (°F)	0	71.6	110	Pass
Runin @ 1800 rpm for 5 min				
Allowable Speed Variation (rpm)	-75	8.1	75	Pass
Cylinder Head Temperature (°F)		289.9	475	Pass
Inlet Air Temperature (°F)	0	71.9	110	Pass
Runin @ 2200 rpm for 5 min				
Allowable Speed Variation (rpm)	-75	-1	75	Pass
Cylinder Head Temperature (°F)		312.1	475	Pass
Inlet Air Temperature (°F)	0	68.9	110	Pass
MagChk @ 2200 rpm for 2 min				
Magneto Dropoff - Each Mag (rpm)		110.4	150	Pass
Magneto Dropoff - Difference (rpm)		20.9	35	Pass
Cylinder Head Temperature (°F)		309.2	475	Pass
Inlet Air Temperature (°F)	0	69	110	Pass
Rated @ Rated rpm for 10 min				
Speed (rpm)	2650	2714.2	2750	Pass
Manifold Pressure (in-Hg)	26.5	27.94	28.5	Pass
Fuel Pressure (psi)	18	23.7	28	Pass
Oil Pressure (psi)	75	80.2	85	Pass
Air Flow Limits (pph)	1636.6	1535.3	N/A	Fail
Cylinder Head Temperature (°F)		339.8	475	Pass
Oil Galley Temperature (°F)	165	185.4	215	Pass
Inlet Air Temperature (°F)	0	69	110	Pass
Idle @ Idle rpm for 5 min				
Speed (rpm)	600	648.1	700	Pass
Cylinder Head Temperature (°F)		268.2	475	Pass
Oil Galley Temperature (°F)	140	173.6	215	Pass
Oil Pressure (psi)	35	47.8	N/A	Pass
Manifold Pressure (in-Hg)	8	13.6	17	Pass
Inlet Air Temperature (°F)	0	70.2	110	Pass
WOT Time (sec)	2	4	5	Pass
Idle Cut-off Time (sec)	0	3	5	Pass

Examination of the original oil filter adapter found the thermostatic oil cooler bypass valve was not seating properly and was likely allowing hot oil to bypass the oil cooler resulting in the excess oil temperatures found when the engine was run on the test stand with the original oil filter adapter.



Photo 13: View of the thermostatic oil cooler bypass valve with inconsistent wear.

3.0 Aircraft Information

According to FAA airworthiness records, the airplane was manufactured in 1973 and was purchased by the pilot in 2007. According to airplane maintenance logbooks, the most recent annual inspection was completed on February 13, 2024, at a total time of 5473 hours. The accident flight was the 2nd flight after maintenance.

Submitted by:

Joshua Young
Air Safety Investigator