

# National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



ERA24FA078

## **AIRFRAME AND ENGINE EXAMINATION**

N539MA, PA46R-350T

## **A. ACCIDENT DETAILS**

Location: Mooresville, NC  
Date: December 31, 2023  
Time: 1213 EST  
1713 UTC  
Airplane: N539MA, Piper PA-46R-350T

## **B. EXAMINATION PARTICIPANTS**

|                        |                                                                     |
|------------------------|---------------------------------------------------------------------|
| Investigator In Charge | Lynn Spencer<br>NTSB/AS-ERA<br>Washington, DC                       |
| Investigator           | Eric Alleyne<br>NTSB/AS-ERA<br>Washington, DC                       |
| FAA                    | Chad Spoon<br>Federal Aviation Administration/FSDO<br>Charlotte, NC |
| Party Coordinator      | Russel Gait<br>Lycoming Engines<br>Williamsport, PA                 |
| Party Coordinator      | Kris Wetherell<br>Piper Aircraft<br>Vero Beach, FL                  |

## **C. SUMMARY**

On December 31, 2023, at 1213 eastern standard time (EST), a Piper PA-46R-350T airplane, N539MA, was substantially damaged when it was involved in an accident near Mooresville, North Carolina. The pilot was fatally injured. The airplane was operated as a Title 14 Code of Federal Regulations Part 91 personal flight.

## D. MAINTENANCE LOG REVIEW

### *Annual Inspection:*

The last annual inspection took place on August 15, 2023. The airframe logbook included the following entry:

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                 |           |       |
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| DATE 8-15-2023                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | TACH 1208.0                                                                                                                                                                                                     | TT 1208.0 | N539M |
| Date                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | REMOVE ENGINE FROM AIRCRAFT N539MA AND INSTALL LYCOMING FACTORY OVERHAULED ENGINE MODEL T10-540-AE2A, S/N L-10566-61A, W.O. NFR10566, SEE 8130-3 W.O. MS-5895 DATED 7-14-23 AND LOG ENTRY FOR MORE INFORMATION. |           |       |
| I CERTIFY THAT THIS AIRFRAME HAS BEEN INSPECTED IN ACCORDANCE WITH AN ANNUAL INSPECTION AND WAS DETERMINED TO BE IN AN AIRWORTHY CONDITION. INSPECTED IAW FAR 43 APPENDIX D. AND INSPECTION REQUIREMENTS IN MM MAINTENANCE MANUAL 761-876 DATED 3-25-21 CHAPTERS 4 AND 5. MAINTENANCE AND REPAIRS ARE AS FOLLOWS:<br>COMPLY WITH SB 1103F BY INSTALLATION OF NEW ENGINE MOUNT P/N 89137-043 S/N M01362576 SEE PIPER AIRCRAFT 8130-3 W.O. STD972958 DATED 4-20-23.<br>REMOVE AND REPLACE RIGHT MAIN TIRE P/N 070-317-0.<br>REMOVE AND REPLACE VACUUM REGULATOR FILTER P/N (2)B3-5-1.<br>REMOVE AND REPLACE LEFT AND RIGHT MAIN GEAR PIVOT BEARINGS AND PINS P/N'S (2) 83645-802, (4) 5944092, (4) 83698-002, (4) 452-838.<br>WEIGH FIRE EXTINGUISHER, FOUND TO BE WITHIN SERVICEABLE LIMITS.<br>SERVICE A/C SYSTEM WITH 1.5 LBS OF R134 FREON.<br>REMOVE AND REPLACE STATIC WICK ON STAB TRIM TAB P/N C592001-0203.<br>REMOVE AND REPLACE UPPER RUDDER FAIR WITH NEW P/N 83450-804.<br>R/R AIRCRAFT BATTERY P/N WITH NEW P/N 7025-20.<br>SERVICE HYDRAULIC RESERVOIR.<br>REMOVE AND REPLACE TIT PROBE P/N 686-216.<br>REMOVE AND REPLACE ELT BATTERY P/N 452-6499 NEXT DUE 7/29.<br>C/W FAR 91.207d, ELT INSP. BY INSP. NEXT DUE 08-2024.<br>ALL ADS CURRENT SEE AD COMPLIANCE RECORDS. ALL APPLICABLE ICA'S INSPECTED AND COMPLIED WITH. OPERATIONAL AND LEAK CHECK PERFORMED SATISFACTORY. LANDING GEAR RETRACTION, EXTENSION AND EMERGENCY EXTENSION TEST PERFORMED SATISFACTORY END. |                                                                                                                                                                                                                 |           |       |

**Photo 1 - Last annual inspection entry in airframe logbook.**

### *Engine Logbook Entries:*

The engine logbook included the following entries since engine overhaul at the manufacturer's facility:

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |             |           |           |        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------|-----------|--------|
| DATE 8-15-2023                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | TACH 1208.6 | TT 1795.2 | TSMOH 0.0 | N539MA |
| INSTALL LYCOMING FACTORY OVERHAULED ENGINE MODEL T10-540-AE2A, S/N L-10566-61A, W.O. NFR10566, SEE 8130-3 W.O. MS-589579 DATED 7-14-23 AND LOG ENTRY FOR MORE INFORMATION. INSTALLATION PERFORMED IAW MANUFACTURERS MAINTENANCE MANUAL 761-876 DATED 3-25-21 AND LYCOMING SI 1427C.<br>INSTALL THE FOLLOWING NEW PARTS. INSTALL ALL NEW ENGINE LORD MOUNTS P/N'S (4) 475-116, (4) 475-117, (4) 587-307, (4) AN7-40A, (4) 477-664. INSTALL NEW STARTER P/N 149NL/EC S/N H-X042707. INSTALL ORIGINAL HARTZELL PROP GOV AFTER OVERHAUL P/N S-1-30 S/N G356NJ, PROP LOG BOOK FOR MORE INFORMATION. INSTALL NEW ALT BELTS AND ADJUST TO SPEC., P/N 37B19774-460, 37A19773-382, 37A 19773-464. INSTALL ALL NEW VAC HOSES WITH NEW. INSTALL NEW AIRFILTER P/N P15-1936. REMOVE AND REPLACE ALL FLEXIBLE BAFFLE SEAL WITH NEW TA8071. RE-INSTALL ORIGINAL SERVICEABLE VACUUM PUMPS. INSTALL NEW P5000 OIL QUICK DRAIN. INSTALL 5 NEW HIGH PRESSURE FUEL AND OIL HOSES MANUFACTURED BY PHT INV 624319 P/N 124F003-8CR0210, 124F001-8CR0214, -8CR0320, -4CR0420, 124F012E0193C270.<br>INSTALL NEW TIT PROBE 686-216. REMOVE LEFT AND RIGHT TURBOCHARGERS AND INSTALL ORIGINAL SERVICEABLE TURBOCHARGERS AT LYCOMINGS REQUEST, SEE LYCOMING SERVICE REQUEST NO 27245, 27246. SERVICE ENGINE WITH PHILLIPS VICTORY 20W-50 OIL AND PRE-OIL ENGINE IAW SI1427C.<br>I CERTIFY THAT THIS ENGINE HAS BEEN INSPECTED IN ACCORDANCE WITH AN ANNUAL INSPECTION AND WAS DETERMINED TO BE IN AN AIRWORTHY CONDITION. INSPECTED IAW FAR 43 APPENDIX D. AND INSPECTION REQUIREMENTS IN MM MAINTENANCE MANUAL 761-876 DATED 3-25-21 CHAPTERS 4 AND 5. ALL ADS CURRENT SEE AD COMPLIANCE RECORDS. GROUND RUN IAW SI1427C. OIL AND FILTER CHANGED, SUCTION SCREEN AND OIL FILTER INSPECTED IAW SI1427C. NO METAL FOUND, INSTALL NEW CH48103-1 AND SERVICE ENGINE WITH 11 QTS OF AEROSHELL VICTORY 20W-50 OIL. GROUND RUN, OPERATIONAL AND LEAK CHECK PERFORMED SATISFACTORY END. |             |           |           |        |

**Photo 2- Reinstallation of engine after factory overhaul.**

|                                                                                                                                                                                                                     |             |        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------|
| DATE 8-17-2023                                                                                                                                                                                                      | TACH 1211.3 | N539MA |
| OIL AND FILTER CHANGE AFTER TEST FLIGHT IAW SI1427C. INSPECT OIL FILTER, INSTALL NEW CH48103-1 OIL FILTER. INSPECT OIL SUCTION SCREEN, NO METAL FOUND. SERVICED ENGINE WITH 11 QTS. OF PHILLIPS VICTORY 20W-50 OIL. |             |        |

**Photo 3 - 8/17/2023 oil change.**

|                                                                                                                                                                                                                                                                                                                                                              |              |        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------|
| DATE 9-18-2023                                                                                                                                                                                                                                                                                                                                               | HOBBS 1211.3 | N539MA |
| RE-INSTALLED ORIGINAL LEFT AND RIGHT TURBOCHARGERS P/N 466642-005 S/N H-ZLL00010, S/N H-AAL00081 AFTER REPAIR BY HARTZELL ENGINE TECHNOLOGIES FOR COMPLIANCE OF LYCOMING SPECIAL ADVISORY SA-203, AND HET SB-203. SEE HET FORM 8130-3 W/O MW65610, W/O MWV65600 DATED 9-15-2023 FOR MORE INFORMATION. OPERATIONAL AND LEAK CHECK PERFORMED SATISFACTORY END. |              |        |

**Photo 4 - Turbocharger reinstallation.**

|                                                                                                                                                                                         |              |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------|
| DATE 10-24-2023                                                                                                                                                                         | HOBBS 1242.1 | N539MA |
| OIL AND FILTER CHANGE. INSPECT OIL FILTER. INSTALL NEW AA48103-1 OIL FILTER AND SERVICE ENGINE WITH 10 QTS. OF PHILLIPS VICTORY 20W50 OIL. GROUND RUN AND LEAK CHECK SATISFACTORY. END. |              |        |

**Photo 5 - Last engine logbook entry for oil change.**

#### *Airframe Airworthiness Directive Status:*

2022-03-15 N/A

2013-13-01 c/w 9/25/2013 Hobbs 397

2011-06-10 c/w 8/15/2023 TT 1208.6

2009-07-08, 2009-05-05, 2008-26-11, 98-25-02, and 96-12-12 c/w at manufacturing

## **E. AIRFRAME EXAMINATION AND PHOTOS**

The airplane, a PA-46R-350T (Malibu Matrix), S/N: 4692139, was manufactured in 2010. It was a low-wing, high performance, single engine piston airplane with retractable landing gear. It seated up to 5 passengers plus 1 pilot. A limited airframe examination took place at the accident site on January 1-2, 2024, and in more detail at the Atlanta Air Salvage, Griffin, Georgia, on January 4, 2024.

### **Wreckage Description**

The airplane as first observed was upright in the vacant lot about 58 ft from the base of the impacted trees. The fuselage, right wing, and most of the empennage were intact. A portion of the upper fuselage and windscreen of the cockpit was cut to facilitate recovery of the pilot. The left wing was fractured and resting inverted on top of the

right wing. The left horizontal stabilizer (minus the elevator) was located in front of the cockpit, and the left elevator remained in a tree. The right wing remained attached by the aft wing attachment, and the main spar was fractured at the wing root. The left wing spar was fractured at the wing root. The engine remained attached to the fuselage at the engine mount. One propeller blade came to rest at the base of the impacted trees and a second propeller blade came to rest about 25 ft to the right of the fuselage. The third blade remained attached to propeller hub.



**Photo 6 - Wreckage as viewed from left side.**



**Photo 7 - Wreckage as viewed from rear.**



**Photo 8 - Wreckage as viewed from right side.**



**Photo 9 - Wreckage as viewed from front.**



**Photo 10 - Close-up view of crushing to lower front left cockpit area.**

### **On Scene Airframe Examination**

This portion of the airframe examination was conducted at the accident site under the authority of NTSB Investigator-In-Charge Lynn Spencer on January 1-2, 2024.

#### *Fuselage:*

The fuselage was resting upright and was canted slightly to the left side. The left front side of the airplane had been cut by emergency personnel to facilitate removal of the pilot. The firewall displayed downward bending. The engine was canted down and to the left. The nose baggage area displayed compression damage and was crushed aft. The left side of the fuselage was torn open at the wing root and displayed compression damage. The right side of the fuselage displayed compression damage. The cabin roof displayed a localized area of compression damage near aft portion of the cabin.



**Photo 11 - Close-up of upper fuselage damage.**

*Empennage:*

The left side of the horizontal stabilizer separated from the airframe at the inboard end. It displayed compression damage about 12 inches inboard from the tip that was about 18 inches wide. The left side of the elevator separated from the horizontal stabilizer. The left side of the elevator was bent aft 22 inches from the tip. The left side of the elevator trim surface remained attached to the elevator at the hinges. The right side of the horizontal stabilizer remained attached to the empennage. The right side of the elevator remained attached to the stabilizer at the hinges. The right side of the elevator trim surface remained attached to the elevator. The elevator control cables remained attached to the elevator sector in the empennage. The elevator trim control cables remained attached to the elevator trim actuator. The elevator actuator rod was observed with 1 inch of threaded rod showing on the forward end, equating to a near neutral position. Movement of the elevator and elevator trim cables from the empennage by hand revealed that the cables were bound in the forward cabin floor area due to deformation in that location. Some sound could be heard in the forward cabin floor during this effort. No movement of the control column was noted during this manipulation.

The vertical stabilizer remained attached to the empennage and revealed leading edge damage. The rudder remained attached to the vertical stabilizer at all hinges. The rudder displayed minor damage. The rudder control cables remained attached to the rudder horn on both sides in the empennage. The rudder cables were moved by hand and sound could be heard in the forward cabin floor location. Damage to the forward cabin floor precluded movement to the rudder pedals. No movement of the rudder pedals was noted during the hand manipulation.



**Photo 12 - Empennage with fractured left horizontal stabilizer.**



**Photo 13 - Left horizontal stabilizer with elevator after elevator recovery from tree.**



**Photo 14 - View of right horizontal stabilizer from fracture area.**

#### *Wings:*

The left wing was fractured from the fuselage at the wing root at the main wing spar and aft wing attachment. Damage consistent with tree impact was observed on the wing's leading edge about 60 inches outboard of the wing root, and the leading edge from the wing root displayed aft compression and deformation. The flap displayed impact damage and remained attached to the wing by the outboard hinge only. The flap was torn mid-span from the wing root. The aileron remained attached to the wing at all hinges. The aileron cables both remained attached to the aileron sector. The aileron control rod from the sector to the aileron remained attached. Both aileron cables were separated at the wing root. The separated ends displayed fraying and unraveling consistent with overload separation. The left main landing gear was found retracted, with the gear door slightly open. The pitot tube remained attached to the wing. The lift detector remained attached to the wing and was not damaged. The fuel cap was found secured at the fuel filler port. Blue fuel was observed to be leaking from the fuel vent during the investigation. The wing spoiler was found in the retracted position.



**Photo 15 - Inverted left wing as found on right wing.**



**Photo 16 - View of inverted left wing once partially removed from right wing.**

The right wing main spar was completely fractured and the wing remained attached to the airframe at the aft wing attachment. The wing displayed compression damage consistent with tree impact about 30 inches outboard of the wing root that was about 24 inches wide. The main landing gear was found in the retracted position. The pitot tube remained attached to the wing and was undamaged. The fuel cap was intact and secured at the filler port. Some fuel was present in the fuel tank. The spoiler was in the retracted position.



**Photo 17 - View of right wing with left wing removed.**

*Cockpit Controls:*

Hobbs hour meter - 1,256.2 hours

Fuel selector - left tank position

Emergency fuel pump switch - ON

Flaps - Retracted

Landing gear lever - Bent and in the gear retracted position

Throttle - Full forward

Propeller - Full forward (the propeller governor linkage was intact and was found in the fine pitch position at the governor)

Mixture - Full forward position

Left and right magneto switches - ON



**Photo 18 - Cockpit instruments and flight displays.**



**Photo 19 - Throttle control quadrant with all levers full forward.**



**Photo 20 - Throttle quadrant and flap selector set to zero.**



**Photo 21 - Fractured pilot control column and fuel selector.**



**Photo 22 - Close-up view of landing gear selector in UP position.**

### *Seats and Restraints:*

The left front pilot seat (occupied) remained partially attached to the mounting rails. The seat frame was bent to the left. Impact damage and bending of the cabin floor at the seat rails was noted. The outboard and inboard lap belt anchors separated from their floor mounts. Both anchors revealed deformation consistent with overload. The shoulder harness had been cut by emergency personnel to facilitate extraction of the

pilot. The shoulder harness remained attached to the lap belt. The shoulder harness inertial reel remained attached to the airframe and was moveable by hand.

The additional 5 cabin seats and restraints remained in place and attached to the cabin floor.



**Photo 23 - Fractured pilot seatbelt anchors.**



**Photo 24 - Pilot seatbelt still fastened to buckle.**

#### *Airframe Fuel System:*

Both the right and left wing fuel tanks were breached in several areas, and the fuel tank caps remained seated in place. Light blue fuel was recovered from both wings. Both left- and right-wing header tank fuel pumps were tested and operated when power was applied to them.

### *Other Systems:*

The emergency locator transmitter (ELT) remained in the aft fuselage of the airplane. It was in the armed position and remained attached to the ELT antenna.

### **Offsite Airframe Examination**

This portion of the airframe examination was conducted under the authority of NTSB Investigator Eric Alleyne at the Atlanta Air Salvage in Griffin, Georgia on January 4, 2024.

### *Airframe Fuel System:*

The emergency fuel pump and fuel strainer were found intact and in-place on the lower right firewall location. All fuel lines were attached, and the fittings were found to be secure. The safety wire on the mounting hardware and securing hardware was in place. The emergency fuel pump and fuel strainer were removed for examination and testing. The emergency fuel pump was tested with a 24-volt battery and was found to run without issue. The pump was further tested using 100LL aviation fuel.



**Photo 25 - Emergency fuel pump tested using 100LL fuel and 24 volt power source.**

The pump operated normally and pumped fuel successfully. The fuel strainer contained about 3 drops of fuel. The fuel strainer was opened, and the interior screen appeared clean.



**Photo 26 - Fuel strainer fuel screen.**

The left fuel header tank had been compressed and deformed inboard during the impact sequence and was torn open. The left header tank did not contain any fuel. The header tank was crushed inboard of the normal wing root mounting location. Using tools, the header tank was exposed, and the left header tank fuel pump appeared undamaged. A 12-volt battery was attached to the fuel pump electrical wires and the pump operated successfully. No fuel was used during this test.

The right fuel header tank was intact and appeared undamaged. The access panel to the header tank was opened and the header tank pump appeared undamaged. The wing and header tank were resting inverted on the recovery trailer during this examination. Approximately 1 inch of blue fuel was found in the header tank. A sample of this fuel appeared clean. A test for the presence of water in the fuel sample was conducted using water detecting paste. No color change was noted during the test indicating no presence of water in the sample. A 12-volt battery was attached to the right header pump electrical wires and the pump operated successfully. No fuel was used during this test.

The fuel selector on the instrument panel was found in the left tank selected position. This position was verified at the fuel selector valve, which is located near the leading edge of the right wing, in the right outboard edge of the fuselage.

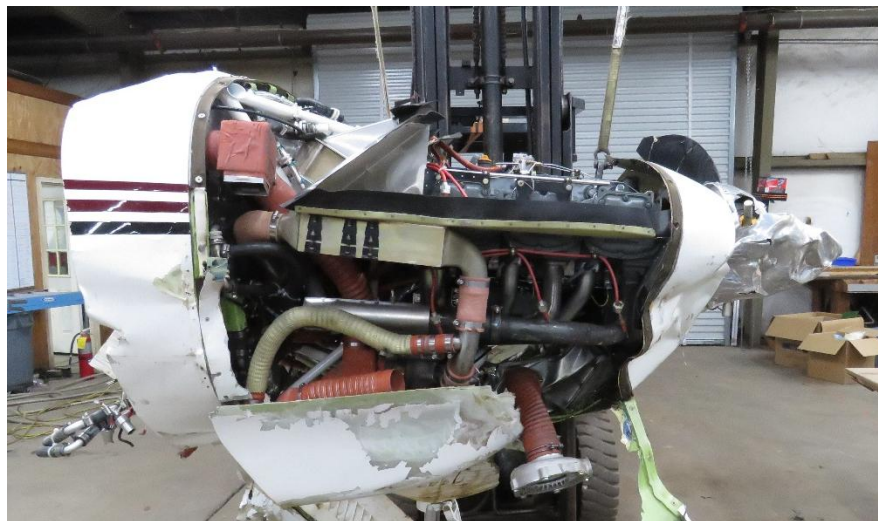
Low pressure air was flowed from the left wing root fuel line to the fuel selector valve and firewall fuel line. Air could be heard escaping from a breach in the line about 24 inches inboard of the left wing root. Low pressure air was then flowed from the firewall

fuel line leading to the fuel selector valve and left wing root location. Air was heard to escape from the same breached location, approximately 24 inches inboard of the left wing root. The fuel selector valve was then switched to the right tank position. Low pressure air was then flowed from the firewall fuel line to the fuel selector valve and out of the fuel selector valve on the right wing fuel line fitting. No obstructions were found in the fuel lines tested using low pressure air.

## **F. ENGINE EXAMINATION AND PHOTOS**

Review of the maintenance records and airframe revealed that the engine had been operated 47.6 hours since overhaul at Lycoming Engine on July 14, 2023.

At first view at the recovery company, the Lycoming TIO-540-AE2A engine had been separated from the fuselage and hoisted in the air with straps. The engine was visually inspected prior to the examination. The engine exhibited signs of crush damage on the forward bottom portion of the engine. The intake scat tubing on the left side turbo was intact but showed signs of crush damage. The engine cowling and airframe baffling were removed to facilitate further examination of the engine.



**Photo 27 - Hoisted engine before examination.**



**Photo 28 - Cylinder Nos. 2, 4 and 6 with rocker covers removed.**

*Engine:*

No impact damage was observed from the starter ring gear noted on starter assembly. Engine rotated by hand smoothly through multiple 360-degree rotations. Finger compressions were good on all six cylinders. Performed borescope inspection of each cylinder, no anomalies noted. Removed rocker box covers and verified exhaust and intake valves moved equal distance on all six cylinders. Performed internal timing check IAW SSP-475, found crankshaft to camshaft timing correct. Idler gears observed through magneto mounting points, and while rotating the engine, no discrepancies were noted with teeth or movement of gears. The top sparkplugs were removed and showed signs of heavy carbon on the sparkplug ends. Valvetrain continuity was observed throughout the engine. The cylinders were borescope, and no anomalies were noted within the cylinders.

*Engine fuel components:*

The engine driven fuel pump was removed and rotated freely by hand. The fuel pump did not contain any fuel. The fuel pump was removed and tested for flow with a drill. The pump operated, but the exact pressure of the flow was not tested. The emergency fuel boost pump was removed and operated when power was applied.

Although the fuel lines were breached, air was applied and flowed throughout the lines.

When the fuel flow divider was removed and disassembled, a small amount of fluid consistent with aviation gasoline was found in the flow divider. No contamination was noted, and the diaphragm was in good condition.

The throttle and mixture linkages of the fuel servo, a Precision model RSA-10ED1, S/N: 70007902, remained attached to the fuel servo and could be manipulated from stop to stop by moving the throttle and mixture controls at the throttle quadrant. The fuel servo was intact and undamaged. Upon removal, fluid consistent with aviation gasoline was observed coming from the inlet to the servo fitting and from the fuel pressure sensor fitting. The throttle plate moved appropriately when the throttle arm was actuated. The fuel servo screen was removed and inspected, with no contamination noted.



**Photo 29 - The fuel servo screen was unobstructed.**



**Photo 30 - Fuel injector servo**

The fuel line to the fuel distribution manifold contained a few drops of fuel. The fuel line fittings to the fuel distribution manifold and to all six injector nozzles were found secure. The manifold was opened for examination and revealed an intact and pliable rubber diaphragm. A few drops of fuel were found in the fuel distribution manifold. All six fuel injector nozzles were found clean and open. The fuel injection nozzles were removed and inspected, with no blockage or abnormal condition noted with the nozzles.



**Photo 31 - Fuel injectors**

### *Ignition:*

All ignition wires were found intact and remained attached to the magnetos and to the corresponding spark plugs. Both magnetos and drives were intact and remained attached to the aft engine accessory drive locations. The timing of both magnetos and the internal timing of the engine were correct. Both magnetos produced spark from all leads when rotated using a power drill.

All 12 spark plugs were carbon fouled and displayed dark black soot consistent with operation of the engine with an overly rich mixture.



**Photo 32 - The spark plugs were carbon fouled.**

### *Lubrication System:*

The oil suction screen was removed and free from contamination. The oil filter paper element was removed and examined with no contamination noted. The oil filter was dated October 24, 2023.



**Photo 33 - Oil filter element free from debris.**

*Air:*

The airframe air filter was deformed by impact forces. The filter element was found clean.



**Photo 34 - Air induction filter.**

The scat tubing from the air filter to each compressor wheel of the turbocharger displayed damage consistent with impact and was partially collapsed due to deformation of the interior wire of the tubing.



**Photo 35 - Left side scat tubing from induction airbox to the left turbocharger compressor section.**



**Photo 36 - Left side intercooler hose with missing clamp, with arrow pointing to clamp location  
(Photo Source: Lycoming Engines)**

The induction hose that connects to the left side intercooler was missing the clamp, and the hose was displaced from the intercooler. The clamp was not observed during the examination.

#### *Turbochargers:*

Both turbocharger compressor cases were heavily damaged from impact. The compressor housing was broken away from the turbocharger assembly. The housing was still attached to the scab tubing and inside of the housing showed signs of compressor blade scaring. The compressor blades showed signs of impact damage and the compressor wheel did not rotate freely.

The compressor blades of the turbocharger showed signs of impact damage. The compressor wheel turned when force was applied but did not turn freely. There were signs of impact damage on the compressor blades and on the interior of the compressor housing. Both compressor wheels displayed blade damage consistent with rotation at the time of impact.

The power turbine side of both turbos were intact and showed signs of impact damage.

### **G. PROPELLER EXAMINATION AND PHOTOS**

The Hartzell composite propellers were examined. One blade remained attached to the propeller hub and displayed chordwise tears. Two blades separated from the hub

at the root ends. One blade was fractured. The blades were free from chordwise abrasion, twisting or bending. No leading edge damage was observed on any of the propeller blades.



**Photo 37 - One propeller blade remained attached to the propeller hub.**



**Photo 38 - Propeller blade separated from the propeller hub and fractured.**



**Photo 39 - Propeller blade separated from the propeller hub and intact.**