



Memorandum For Record

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A virtual Facetime examination of the propellers and propeller governors was performed on September 29, 2021, beginning at 0940 EDT. The examination was conducted at Anglin Air's facility in Clayton, Delaware. Present in person was an investigator from Hartzell Propeller while NTSB investigator Tim Monville was present virtually.

At the beginning of the examination the propeller blades of both propellers were in the feathered position. Both Woodward propeller governors were at the low pitch stops. The control rods were attached to both governors.

LEFT PROPELLER AND PROPELLER GOVERNOR

The left propeller governor, Woodward type 210080R/S-Y, part number (P/N) S26, serial number (S/N) 452346, control arm was noted to move freely. It had a spring that loaded it to the high rpm (low pitch stop).

Examination of the Left Propeller, Hartzell HC-C2YK-2RBF/F7666A-2, S/N BC564B, revealed that blade L2 was bent aft about 30°, exhibited leading edge polishing, and minor twisting. There was chordwise paint abrasion at the tip. The cambered side of Blade L1 exhibited chordwise erosion on the leading edge near the tip.

Following removal of the left spinner, some abrasion was noted on the spinner dome, and it exhibited a dent on the bottom. The spinner was marked with hand written notes, "L Spinner", "1 washer" and "Ind↓". The left schrader valve was intact and the protective cap was in-place. It was checked with an air pressure gauge that was not calibrated and measured 120 psi.

The propeller hub appeared normal, and both propeller blades were firm in the propeller hub. The governor was then removed and it was noted to rotate freely. Residual oil pumped from the unit during hand rotation. The gasket did not contain a screen.

LEFT PROPELLER AND PROPELLER GOVERNOR CONTINUED -

Inspection of the face side of blade L1 revealed it was good, while the face side of blade L2 contained 1 chordwise scratch about 3 inches from the tip. The cambered sides of blades L1 and L2 showed abrasion from the tip to midblade, and leading edge erosion 1 inch from the leading edge in a chordwise orientation.

The left propeller hub appeared to be a new model; the studs were secure and safety wired. Because the L1 blade was undamaged, blade angle checks were performed at the 30 inch radius¹, which for 2 bladed propellers is the same as blade station (BS) 30.

Because the air charge in the cylinder is typically measured when the propeller blades are on the start locks, the propeller blades were moved using a blade paddle to the start locks. While on the start locks, the air charge in the cylinder measured 175 psi². The L1 blade angle when on the start locks measured 19.1°³. The air charge was removed from the cylinder to check the low pitch blade angle and air pressure was applied to the governor pad to put the blades in low pitch. The low pitch blade angle measured 14.2°⁴. The feather blade angle was not recorded.

RIGHT PROPELLER AND PROPELLER GOVERNOR

Examination of the right propeller, Hartzell HC-C2YK-2RBF/F7666A-2, S/N BC664B was performed next. The propeller spinner was removed and one small area of chafing was noted which was likely done during recovery. As previously noted both propeller blades were in the feathered position. The Schrader valve was intact. There was no visible damage to either blade. In the feathered position the air charge in the cylinder with a non calibrated gauge measured 120psi.

The Propeller governor, Woodward type 210080R/S-Y, P/N S26, S/N 452357 was removed. There was no screen in the gasket, P/N SL72053. Residual oil was noted in the governor which rotated freely. Gurgling sounds were noted during rotation of the governor driven shaft.

Compressed air was applied to the governor pad and a blade paddle was used on both blades to move them onto the start locks. While on the start locks, the cylinder pressure measured 169 psi⁵. The start lock and low pitch blade angle for both propeller blades was performed at BS 30. The following results were noted for the Start Lock blade angle:

R1 – 25.5° (out of limits) during the first test and 19.1° (within limits) for the second test.

R2 - 26.1° (out of limits) during the first test and 19.6° (within limits) for the second test.

¹ The blade angles were measured with the Inclinator iPhone App and was zeroed on the face of the cylinder.

² The temperature was 72° when the measurement was taken. The specified air charge at 70° Fahrenheit is 178 psi plus or minus 2 psi.

³ Specification is 19.5° plus or minus 1.5°.

⁴ Specification is 14.0° plus or minus .2°.

⁵ The temperature was 72° when the measurement was taken. The specified air charge at 70° Fahrenheit is 178 psi plus or minus 2 psi.

RIGHT PROPELLER AND PROPELLER GOVERNOR CONTINUED -

The air charge was removed from the cylinder then air pressure was applied to put the blades at low pitch to check the low pitch blade angle with the following results:

R1 – 14.3°⁶

R2 – 14.2°⁷

Lycoming Service Instruction (SI) 1462A, “Propeller Oil Control Leak Test Procedure (With Propeller Installed on Engine)”, was performed to both engines⁸. The SI specifies to reason to perform in part is whenever the propeller is going into feather during landing rollout with reduced throttle setting. The SI also indicates that the air pressure check will show the condition of governor oil passages, front bearing clearance, and positioning of the governor circuit oil plug. The governor oil plug is located in the end of the crankshaft behind the governor oil transfer tube. Although the SI specified to run the engine and allow to warm up to the oil temperature is in the green, because the engines had been removed during recovery that was not possible. For the testing 40 psi shop air was applied and the following results were noted:

Left Engine – 11 psi (within limits)⁹. The left engine was hoisted during the testing and leakage was noted from the exhaust ports. The propeller was rotated, and then no leaking sound was noted. The test was performed again and the measured pressure was 21 psi¹⁰.

Right Engine - At 40 psi applied pressure, 14 psi was noted (within limits)¹¹.

A virtual Facetime examination of the airframe was performed on September 30, 2021, beginning at 1246 EDT. The examination was conducted at Anglin Air’s facility in Clayton, Delaware. Present in-person was Piper investigator Jon Hirsch and present virtually was NTSB investigator Tim Monville.

At the beginning of the examination the fuselage was outside, with the wings, and empennage separated. Wrinkling and buckling of the fuselage was noted at the lower leading edge of the windshield and extending down along both sides of the nose. The vertical stabilizer and horizontal stabilizer appeared intact and undamaged. The elevator had been removed from the horizontal stabilizer and appeared intact. Rudder control cable continuity was continuous from the rudder pedal torque tube arms to the cable terminations at the rudder, while the elevator pushrods remained intact from the controls in the cockpit to the empennage. Rudder and elevator trim cable continuity could not be confirmed because the control surfaces were removed. Some trim cables were disassembled at the turnbuckles on the aft side of the aft baggage compartment and some cable sections were missing from the tailcone. The left aileron direct and balance cables were cut

⁶ The maximum allowable difference between the 2 blades is .2°.

⁷ The maximum allowable difference between the 2 blades is .2°.

⁸ Lycoming personnel provided the salvage facility with the proper plate and gasket to perform the test.

⁹ The SI specified a range between 6 and 35 psi being acceptable indicating the system is operating properly.

¹⁰ According to a representative of the engine manufacturer, that is the same reading they obtain from a cold engine in the factory.

¹¹ The SI specified a range between 6 and 35 psi being acceptable indicating the system is operating properly.

at the wing root consistent with recovery, while the right aileron direct and balance cables were disassembled from the outer bellcrank. No issues were noted for the aileron flight controls. The flap actuator cylinder and rod extension measured about 17 inches, which equated to near full extension. The rudder trim indicator in the cockpit was full airplane nose right, while the elevator trim indicator was in the full nose down positions.

With respect to the elevator and rudder pitch trim settings, the rudder actuator was removed from the airplane and was not observed. The elevator trim jackscrew had ~18 threads exposed which corresponded to a full aircraft nose up trim setting. The airplane was not equipped with an aileron trim tab.

Examination of both wings revealed the left wing main landing gear was in the down and locked position, while the right main landing gear was observed in the extended position. The left fuel strainer bowl was empty while the right fuel strainer bowl had a small amount of liquid, consistent in odor and color to 100 low lead (100LL) aviation fuel. A small bubble of undetermined debris which remained separate from the fuel was visible at the bottom of the right fuel strainer bowl. Examination of the left and right fuel supply and vent systems revealed no evidence of preimpact failure or malfunction. Continuity of the engine controls for both engines from the cockpit to the end fittings in the engine compartment were confirmed.

A Virtual examination of the left front seat tracks, and right front seat and seat tracks was performed by Federal Aviation Administration inspector on March 15, 2022. Technical data for the inspection was provided by personnel of Piper Aircraft. Present in-person was an inspector from the Federal Aviation Administration (FAA) and virtually was NTSB investigator Tim Monville.

At the beginning of the examination, the seats had been previously removed from the cockpit and there were no aft seat stops on either seat track of either left front or right front seats. The left and right seat tracks of the pilot's and co-pilot's seats had holes that were not called out in the drawing.

Examination of the pilot's left seat track for position hole diameter revealed the following results¹²:

No. 01 – 0.3095 inch
No. 02 – 0.3150 inch
No. 03 – 0.3215 inch
No. 04 – 0.3220 inch
No. 05 – Not measured
No. 06 – 0.3170 inch
No. 07 – 0.3175 inch
No. 08 – Not measured
No. 09 – 0.3280 inch
No. 10 – 0.3280 inch
No. 11 – 0.3330 inch

¹² The No. 1 position was the front of the seat track as installed in the airplane and were measured in a forward and aft plane or direction. A calibrated dial caliper was not available.

Examination of the pilot's right seat track for position hole diameter revealed the following results¹³:

No. 01 – 0.3160 inch
No. 02 – 0.3155 inch
No. 03 – 0.3190 inch
No. 04 – 0.3170 inch
No. 05 – 0.3150 inch
No. 06 – 0.3175 inch
No. 07 – 0.3165 inch
No. 08 – 0.3135 inch
No. 09 – 0.3280 inch
No. 10 – 0.3245 inch
No. 11 – 0.3280 inch

The flight instructor was noted to be 65 inches tall and weighed 175 pounds¹⁴. An inspection of both seat tracks of the co-pilot's seat in the estimated area where he would have his seat positioned revealed no evidence of impact mark or impression by the seat feet or roller.

Examination of the co-pilot's left seat track for position hole diameter revealed the following results¹⁵:

No. 01 – 0.3095 inch
No. 02 – 0.3110 inch
No. 03 – 0.3140 inch
No. 04 – 0.3140 inch
No. 05 – 0.3170 inch
No. 06 – 0.3135 inch
No. 07 – 0.3120 inch
No. 08 – 0.3140 inch
No. 09 – 0.3175 inch
No. 10 – 0.3270 inch
No. 11 – 0.3160 inch

The co-pilot's right seat track hole diameter was not performed¹⁶:

No. 01 – Not Documented
No. 02 – Not Documented
No. 03 – Not Documented

¹³ The No. 1 position was the front of the seat track as installed in the airplane and were measured in a forward and aft plane or direction. A calibrated dial caliper was not available.

¹⁴ Based on FAA SPAS data.

¹⁵ The No. 1 position was the front of the seat track as installed in the airplane and were measured in a forward and aft plane or direction. A calibrated dial caliper was not available.

¹⁶ The No. 1 position was the front of the seat track as installed in the airplane. All measurements were taken in sequence front to aft. A calibrated dial caliper was not available.

No. 04 – Not Documented
No. 05 – Not Documented
No. 06 – Not Documented
No. 07 – Not Documented
No. 08 – Not Documented
No. 09 – Not Documented
No. 10 – Not Documented
No. 11 – Not Documented

Examination of the co-pilot seat revealed the left seat catch plunger extended 0.4420 inch from the housing, while the right seat catch plunger extended 0.1200 inch from the housing, which would not result in the pin extending into a seat track hole.

Examination of the co-pilot seat Tube-Seat Catch Release revealed both ends appeared to be bent. Close inspection revealed one end was bent or deformed about 0.5625 inch, while the other end was bent or deformed about 0.125 inch. Thus, it was deformed about 0.4375 inch. The forward portion of the co-pilot lower cushion was slightly deformed/wrinkled, but the seat frame and seat pan did not appear to be deformed. The inspector did not feel that the Tube-Seat Catch Release deformity occurred because of the impact. Inspection of the seat track surrounding structure revealed no evidence of damage or deformity. With the Tube-Seat Catch Release bent about 0.4375 inch, that reduced the length of seat catch plunger that could secure the seat into position.

A Virtual Teams examination of both engines was performed on April 4, 2022, beginning at 0941 EDT. The examination was conducted at Anglin Air's facility in Clayton, Delaware. Present in person was an investigator from Lycoming, while present virtually was NTSB investigator Tim Monville.

At the beginning of the examination the left engine, Lycoming IO-360-C1C, S/N L-33770-51E, was resting on a tire that was resting on a pallet with no servo fuel injector or exhaust attached.

LEFT ENGINE EXAMINATION

The magneto to engine timing was checked first. Per the engine data plate, the specified timing for both magnetos was 20° before top dead center (BTDC). The left and right magneto timing were 21° BTDC and 20° BTDC, respectively. Inspection of the inlet screen of the servo fuel injector revealed corrosion, and the housing where the inlet screen resides exhibited corrosion consistent with water contamination. All fuel injector nozzles were clear. The oil capacity registered 7 quarts¹⁷ and the oil looked good. The oil filter was removed and cut open which revealed no particles. The oil suction screen which was safety wired was clean. An oil sample was taken and retained. Inspection of the exhaust system revealed the straight exhaust pipes were clear. The propeller was removed for shipping. The left propeller governor was retained for operational testing.

RIGHT ENGINE EXAMINATION

¹⁷ Eight quarts was full.

At the beginning of the examination the right engine, Lycoming IO-360-C1C, S/N L-33769-51E, was resting on a tire that was resting on a pallet with no servo fuel injector or exhaust attached.

As first viewed the ignition leads for the Nos. 2 and 4 cylinders was removed for recovery. The magneto to engine timing was checked first. Per the engine data, the specified timing for both magnetos was 20° before top dead center (BTDC). The left and right magneto timing were 22° and 20°, respectively.

No oil was noted in the engine.¹⁸ Crankshaft, camshaft, and valve train continuity was confirmed. During rotation of the crankshaft, the left magneto, Slick model 4372, S/N 18120918 was not firing at any ignition lead, but the right magneto was firing all ignition leads. The left magneto was removed from the engine and placed on a test bench where it sparked all leads. The magneto was installed on the engine and during crankshaft rotation, sparked all ignition leads. During rotation of the crankshaft, suction at the inlet of the engine-driven fuel pump was noted.

A cold differential compression test was performed with the following results¹⁹:

No. 1 - 68/80

No. 3 - 58/80

No. 2 - 58/80

No. 4 - 60/80

The oil suction screen and oil filter element were free of debris or particles.

All fuel injector nozzles were free of obstructions. Examination of the servo fuel injector, RSA5AD1, S/N 70C50008, revealed the scat hose was in good condition. The fuel inlet screen was clean and residual 100LL fuel was noted. The regulator section which was safety wired was removed and during removal fuel leaked from the fuel side of the regulator. Some water was detected using water finding paste with the fuel in the fuel side of the regulator²⁰. The remnant of water finding paste was removed from the fuel regulator section to facilitate reassembly. Examination of the flow divider revealed it did not contain any fuel. The diaphragm was ok and the spool moved freely.

Inspection of the exhaust system revealed the straight exhaust pipes were clear. The right propeller governor was retained for operational testing. Both governors were run as received.

On February 17, 2023, examination and operational testing of the left and right propeller governors were performed with NTSB oversight at a FAA certified repair station. Both propeller governors were run-as-received. The internal leakage test could not be performed to either

¹⁸ Per recovery personnel, following recovery, the engine was placed on a tire, and the following morning they noted oil on the ground beneath the engine.

¹⁹ According to Lycoming Service Instruction No. 1191A, before performing the testing the engine should be operated until normal cylinder head and oil temperatures are attained. In this instance the engine was not operated before the test was performed.

²⁰ According to recovery personnel, the right engine remained inside since recovery, but it did rain while returning with the wreckage.

governor due to recent damage to the test bench caused by an electrical issue. Neither propeller governor were disassembled after testing.

During testing of the left governor, Woodward Type 210080R/S-Y, P/N S26, S/N 452346, revealed evidence of slight oil leak at the control shaft o-ring (slight bubbles) and the feather rod was leaking, but no leakage was noted at the relief valve. The relief valve spring was in the correct slot. The relief valve pressure check performed after warm up at 1,750 rpm revealed it was 270 psi (specification was 270 psi + or – 10 PSI). The pump capacity check was performed next and when set at 1,750 rpm and the output pressure decreased to 150 psi, the pump capacity in terms of QPM was 4.35 (minimum specification was 5.0). The high rpm check was performed and the unit was set at 2,370 rpm (specification is 2,340 + or – 10 RPM). The feather check was set at 1,370 rpm (specification of 1,375 + or – 25 RPM).

During testing of the right governor, Woodward Type 210080R/S-Y, P/N S26, S/N 452357, no leaks were noted at the control head or relief valve. The relief valve pressure check performed after warm up at 1,750 rpm revealed it was 280 psi (was within limits). The pump capacity check was performed next and when set at 1,750 rpm and the output pressure decreased to 150 psi, the pump capacity in terms of quarts-per-minute (QPM) was 4.35 (minimum specification was 5.0). The high rpm check was performed and the unit was set at 2,370 rpm (specification is 2,340 + or – 10 RPM). The feather check was set at 1,360 rpm (specification of 1,375 + or – 25 RPM).