

ERA21LA173

Hartzell Propeller Air Safety Investigator Examination **Summary Rev. A 1/26/2022 (see change bars)**

Accident

NTSB File No.: ERA21LA173

Accident Date: 4/5/2021

Location: Springfield Robertson County Airport, Springfield, TN

Aircraft: Piper PA-23-250 Aztec

Aircraft S/N: 27-2020

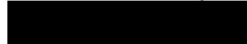
Aircraft Registration: N5018Y

Manufacture Date: 1963

Total Time: Unknown at time of exam

Propeller Examination

Location: AMF Aviation, LLC



Springfield, TN 37172-5811

Exam Date: April 22, 2021

Participants: Les Doud – Hartzell Propeller Air Safety Investigator

Angela Kachinski – FAA Aviation Safety Inspector, Nashville FSDO

Propeller Description

The propellers examined are 74" diameter, Recip Steel Hub Series, 2-blade, feathering, pressure to decrease pitch. Oil pressure from the propeller governor is used to move the blades to the low pitch (blade angle) direction. A spring and counterweights move the blades to the high pitch/feather direction in the absence of governor oil pressure. The propeller incorporates a start lock mechanism that holds the blades at a low blade angle during engine start. The blades are of aluminum construction. The hub and blade clamps are steel. Propeller rotation is clockwise as viewed from the rear. Hartzell Propeller Installation Data Sheet No. 750 provides additional propeller installation data.

Both the left (S/N HXA12) and right (S/N HXA14) propellers were overhauled by Aviation Propellers Inc. in December 1999. Both propellers had factory new hubs and blades installed at that time. The last entry in the left propeller logbook was for an annual inspection performed on 3/5/2021 indicated a propeller TTSN of 3039.47 and TSO of 1421.1.

Left Propeller

Model: HC-A2MVK-2/MV8433N-10

Assembly S/N: HXA12

Blades S/Ns

#L1 – J36639

#L2 – J36640

Right Propeller

Left Propeller

Model: HC-A2MVK-2/MV8433N-10

Assembly S/N: HXA14

Blades S/Ns

J36637 (not visually confirmed)

J36638 (not visually confirmed)

Propeller Examination

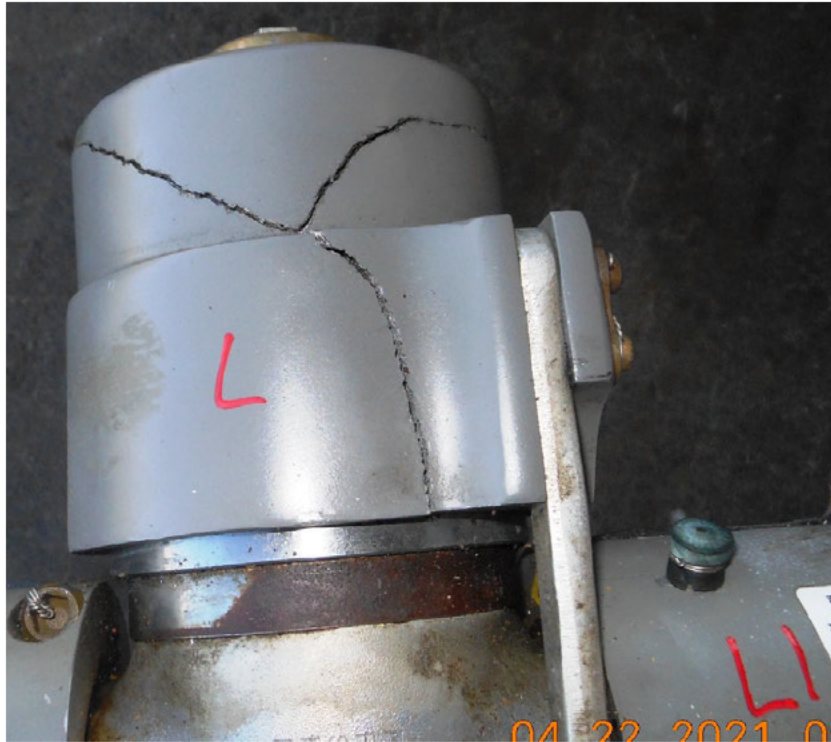
The aircraft components were recovered from the crash scene by AMF and stored at their facility on the Springfield Robertson County Airport, Springfield, TN. Only the left propeller was disassembled during this examination due to questions about state of operation of the left powerplant prior to impact. The right propeller was examined only visually/externally. The left propeller was presented for examination as shown in Photo #1. Both blades and the pitch change mechanisms were in a feathered position and the piston was fractured.

Photo #1 – Left propeller as-presented for examination



The left propeller remained attached to the engine crankshaft flange during the impact sequence and was removed by investigators prior to this examination. The spinner dome, spinner bulkhead and start lock brackets were also removed from the propeller prior to this examination. The piston was fractured around the forward/top corner and adjacent to blade L1 link arm attach point (Photo #2). Neither blade L1 or L2 had any remarkable indications of rotational damage; no remarkable chordwise/rotational scoring, no impact-related leading edge nicks or gouges and no remarkable bend or twist.

Photo #2 – Piston fractures



Both blade clamps were secure but remnant marks from slip indicator tape on blade L2 indicated a slight rotation/slippage toward high pitch (Photo #3). One of two start lock plate fasteners on clamp L2 was fractured.

Photo #3 – Blade slip indicators



Both blade L1 and L2 link screws were crushed on the side adjacent to the hub arm. There was a corresponding impact mark on the hub arm indicating forceful rotation towards high pitch/feather at impact (Photo #4).

Photo #4 – Smashed link screws



The piston bottom edge had impact marks adjacent to an inboard clamp screw on both blade clamps. There were corresponding impact marks on the screw heads (Photo #5). These marks are consistent with the piston being pulled down by forceful rotation of the blades beyond the feather position. The blade bearings had some minor corrosion (Photo #6) but were adequately lubricated and the blades rotated freely in the bearings once the link arms were disconnected.

Photo #5 – Piston impact mark (similar on other side)

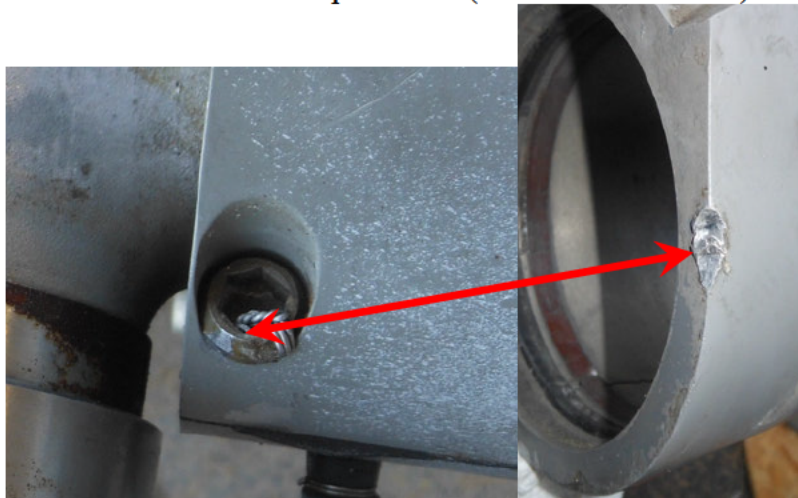


Photo #6 – Blade bearing race surface corrosion



The feather stops had impact marks from contact with the top of the piston (Photo #7). There were corresponding marks on the top of the piston (Photo #8).

Photo #7 – Feather stops with contact damage



Photo #8 – Matching feather stop-piston impact marks

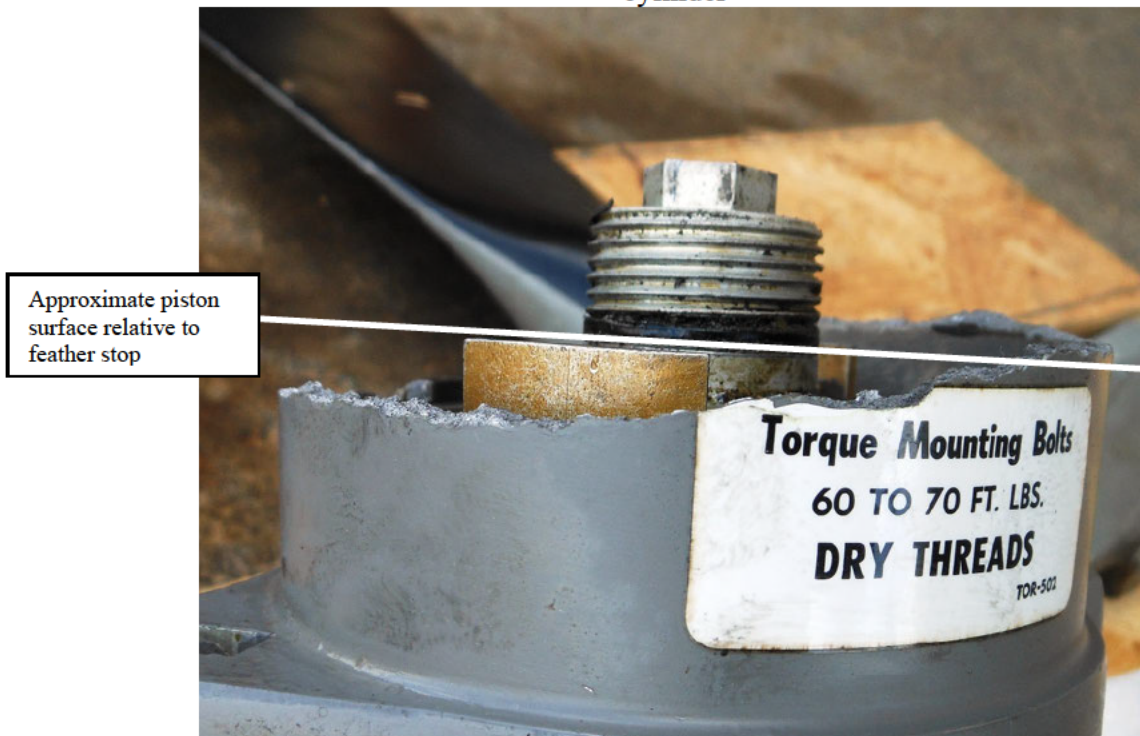


There was a contact mark on the interior surface of the piston where it contacted the top corner of the cylinder (Photo #9). This contact mark is consistent with the piston in the feathered position. Photo #10 shows the piston's position relative to the feather stops, also consistent with forceful contact between the pistons forward/top and the feather stops that contributed to the piston fractures.

Photo #9 – Piston contact mark with cylinder forward corner



Photo #10 – Piston position relative to the feather stops with ID wall contact mark aligned w/ cylinder



The interior surface of the piston was coated with a relatively heavy amount of hardened, engine oil sludge. This sludge was cleaned from the surface before Photo #11 was taken, but a noticeable amount remained packed in the piston O-ring groove. Photo #11 shows some of sludge that was scrapped out of the O-ring groove.

Photo # 11- Hardened sludge removed from piston O-ring groove



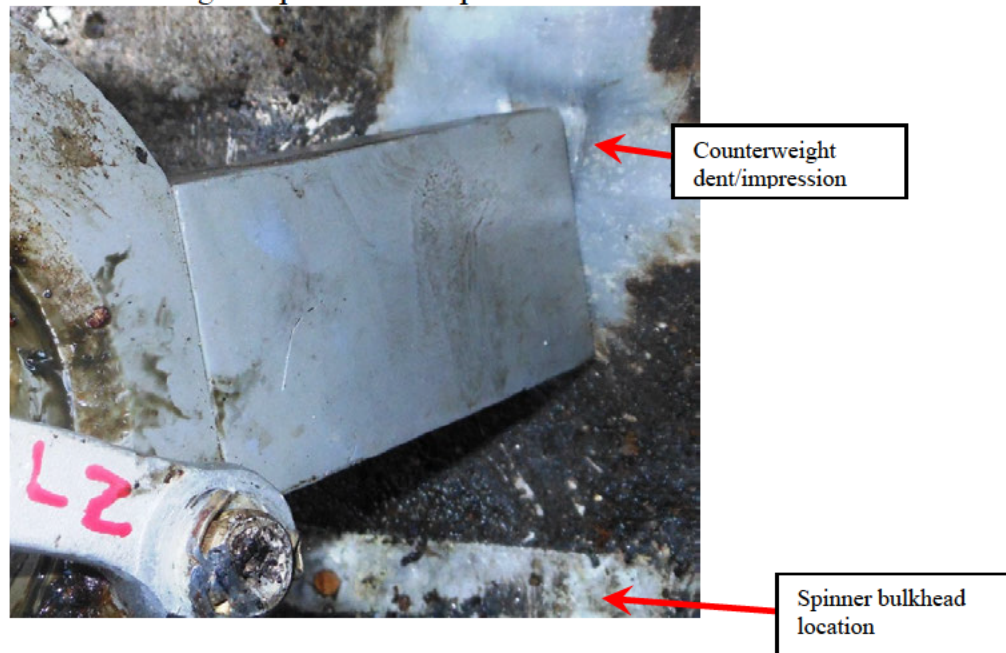
The start lock brackets were intact with relatively little damage (Photo #12). There were no remarkable bends or fractures on either bracket. One start lock plunger moved freely with finger force. The other start lock plunger moved freely in a limited range of travel but if depressed into the housing it would bind and not extend. There was a small crimp on the end of the plunger housing that appeared to be made by forceful contact with the start lock plate. The plunger could easily be extended with a small center punch through the top or a small tap against a table top surface. There was no evidence the start lock plate was in contact with the start lock plunger at impact. Videos of the start lock plunger action were taken at the examination.

Photo # 12- Start lock brackets and plungers



The spinner dome had a counterweight impact impression in a location consistent with the counterweight in the feathered position (Photo #13).

Photo # 13 - Counterweight impact mark in spinner dome internal surface



The hub assembly was intact with both pilot tubes intact (Photo #14). The cylinder remained secure on the hub and there was some surface corrosion on the cylinder near the feather end of piston travel (this portion would be exposed to the environment when on the start locks after shutdown). The feathering spring was not removed or observed but the spring keepers were present and there was spring tension on the pitch change rod when removing the piston top. The mounting flange appeared intact and undamaged with some sludge in the pilot bore (Photo #15).

Photo #14 – Hub assembly



Photo #15 – Mounting flange with sludge in bore

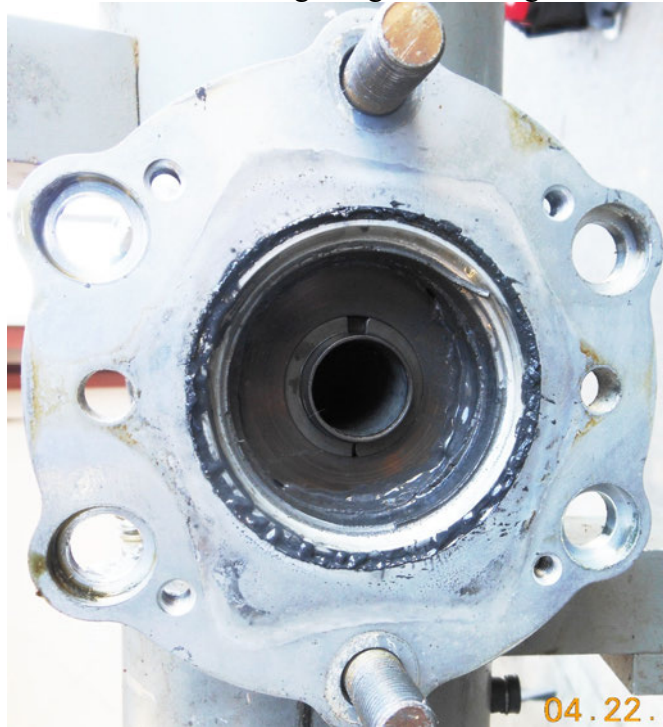


Photo #16 and #17 show the unremarkable and relatively undamaged conditions of the blade camber and face sides.

Photo # 16 – Blades camber side



Photo # 17 – Blades face side



The left propeller governor was visually/externally examined (Photo #18). The governor P/N is B-4, S/N 4365F. The governor gasket screen was free of debris. The governor drive shaft rotated freely by finger force and the pump “gurgled” indicating pumping action. The control arm and shaft also rotated freely by hand force from the high RPM stop to the feathered position. The governor was retained for future bench testing.

Photo # 18 –Left propeller governor



The left propeller governor S/N 4365F was bench-tested at Hartzell Propeller on 1/26/2022 using the Bauer Propeller Governor Test Stand. Angela Kachinski – FAA Aviation Safety Inspector, Nashville FSDO provided Federal oversight via GoToMeeting. Photo #18-1 shows the governor mounted to the test stand.

Photo # 18-1 –Left propeller governor S/N 4365F mounted to test stand



The governor was subjected to the Acceptance Test Procedure to record performance relative to specification. The governor functioned normally with no external oil leaks noted. The recorded performance relative to specification is provided in Table 1.

Table 1 – Left Governor S/N 4365F

Parameter	Specification (Manual 130B for Model B-4)	Measured on S/N 4365F
Relief Pressure Setting	275-300 psi	290
Low RPM Setting	1700 $\pm$ 25	1730
High RPM Setting	2330 $\pm$ 10	2331
Pump Capacity	8-12 quarts/min	8.8
Internal Leakage	< 8 oz./min	2
Lever Travel	44-48°	47

Despite having a slightly different low RPM setting of 1730 vs. 1700 $\pm$ 25, the governor had no discrepancies that prevented normal operation. The low RPM setting is the minimum RPM the governor is capable of controlling. With a governor gear ratio of 0.895:1, 1730 governor RPM is equivalent to approximately 1932 propeller RPM. The Piper Aztec operation manual does not provide information regarding continuous engine operation below 2100 RPM in climb or cruise flight, therefore the 5 RPM discrepancy in the low RPM setting does not influence normal aircraft operation.

The right propeller was visually/externally examined (Photo #19). Both blades were in a low pitch position. The pitch change mechanism (piston, link arms and link screws) were all in a low pitch position. The start lock plungers were extended but the blade/clamp positions were at a lower blade angle than the start lock angle (i.e. start lock plate not in contact with start lock plunger). Both blades were bent opposite rotation, bent aft and twisted towards low pitch (Photo #20). Both blades also exhibited a leading edge wave bend consistent with a tree/limb strike (Photo #21).

Photo #19 – Right propeller



Photo #20 – Typical right propeller blade remarkably bent opposite rotation



Photo # 21 – Wave bends in leading edge



Conclusions

All visible damage on both propellers was consistent with high impact forces. There were no visible discrepancies on the propeller components examined that would prevent normal operation. Sludge in the left propeller hydraulic section (piston, cylinder and mounting bore) may have caused slow response but did not appear to inhibit the propeller from feathering. All the damage on the left propeller was consistent with the left propeller at or near the feathered position, with no power and little or no rotation at impact. Damage to the left propeller pitch change mechanisms is consistent with impact forces rotating the blades towards higher pitch, beyond the feather stop. The left propeller governor appeared intact and undamaged. It was bench tested and met all factory specifications except for the low RPM setting which did not prevent normal operation. The right propeller damage was consistent with rotation under power at impact.

Les Doud
Air Safety Investigator
Hartzell Propeller Inc.

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