

Hartzell Propeller Air Safety Investigator Exam Report

Accident

NTSB File No.: ERA22FA350
Accident Date: 8/2/2022
Location: Near South Haven Regional Airport, MI
Aircraft: Smith Aerostar 600
Aircraft S/N: 60-0416-143
Aircraft Registration: N9784Q
Total Time: Unknown at time of exam

Propeller Examination

Location: South Haven Regional Airport (KLWA)
73020 Co Rd 380
South Haven, MI 49090
Exam Date: October 3, 2022
Participants: Les Doud – Hartzell Propeller Air Safety Investigator
Robert Holdridge – FAA ASI, Grand Rapids FSDO

Propeller Description

The propellers examined are 78” diameter, Compact Model Series, 3-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 aircharge 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 hub and blades are of aluminum construction. Propeller rotation is clockwise as viewed from the rear. Hartzell Propeller Installation Data Sheet No. 875 provides additional propeller installation data.

Left Propeller

Model: HC-C3YR-2UF/FC8468-8R
Assembly S/N: CK659 (date of manufacture 5/21/1974 sold to OEM/Ted Smith)
Blades S/Ns: The propeller was not disassembled so blade S/Ns are unknown.
Service History: The propeller logbooks were not available so service history is unknown

Right Propeller

Model: HC-C3YR-2UF/FC8468-8R
Assembly S/N: CK989 (date of manufacture 8/7/1975 sold to OEM/Ted Smith)
Blades S/Ns: The propeller was not disassembled so blade S/Ns are unknown.
Service History: The propeller logbooks were not available so service history is unknown

Propeller Examinations

The aircraft components were recovered from the crash scene and stored in an airport hangar prior to this examination. Both propellers remained attached to the engine and all major propeller components were recovered at the crash scene.

Left Propeller

The left propeller remained attached to the engine crankshaft flange with all six studs secure and lockwired. It was presented for examination as shown in Photo #1. All three blades remained secure in the hub with counterweights attached, and there were no visible, external fractures in the hub. All three blades were intact with no remarkable fractures. The cylinder was intact with random, localized scratches.

The blades were identified LA, LB, and LC in a counter-clockwise direction when looking at the front of the propeller. The propeller assembly S/N was between the LA and LC blades. Blades LA and LC appeared to be at same angle, approximately the start lock position. Blade LB appeared at a lower than a start lock angle and could be partially rotated by hand force indicating a fractured pitch change knob.

The spinner dome as-presented had been removed prior to this exam and was sitting next to the engine. The spinner dome was crushed and torn. The dome cap was missing, presumed not recovered or in the other aircraft wreckage. The air valve was damaged and there was no aircharge remaining. Blade LA was bent aft with relatively minor chordwise/rotational abrasion on the camber side, no remarkable scoring on the face side. Blade LB was also bent aft with minor chordwise/rotational abrasion on the camber side, no remarkable scoring on the face side. Blade LC was also bent aft with the highest degree of chordwise/rotational abrasion on the camber side, no remarkable scoring on the face side. None of the three blades exhibited any remarkable twisting damage, bending opposite rotation, and there were no remarkable leading edge gouges. See Photos #3 and #4 for relative blade damage)

The low pitch stop was removed from the cylinder and it showed impact damage with the cap screw holding the feather and start lock sleeve to the pitch change rod (Photo #2). This impact damage suggests the propeller was at near the low pitch stop at impact.

The start lock sleeve and feather stop washer was removed and the propeller allowed to actuate toward feather. A relatively dark, dirty, sludge-like oil drained from the governor pad as the propeller actuated toward feather. The propeller was then actuated with air pressure through the governor pad port. Blades LA and LC actuated normally from feather to low pitch. Blade LB moved slightly confirming a fracture in the pitch change components.

The spinner dome had counterweight impression marks at approximately 12° and 17° (Photos #5 and #6) which are equivalent to blade angles of -1° and 4°, both below the mechanical low pitch stop of the assembly and indicating forceful rotation towards low pitch.

The propeller was not removed from the engine and no further disassembly was conducted.

Photo #1 – Left propeller as-presented for examination



Photo #2 – Low pitch stop impact mark



Photo #3 – Left propeller blades – face side



Photo #4 – Blades LA and LC after feathering showing simple aft bends with no twist



Photo #5 - Left spinner dome counterweight impression at 12°



Photo #6 - Left spinner dome counterweight impression at ~17°



Right Propeller

The right propeller remained attached to the engine crankshaft flange with all six studs secure and lockwired. It was presented for examination as shown in Photo #7. The spinner dome and dome cap remained attached but were crushed and torn. The air valve with cap intact punctured through the dome cap. All three blades remained secure in the hub with counterweights attached, and there were no visible, external fractures in the hub. Two blades exhibited tip fractures. The cylinder was intact with random, localized scratches.

The blades were identified RA, RB, and RC in a clockwise direction when looking at the front of the propeller. Blades RA and RC appeared to be at same angle, approximately the start lock position. Blade RB was rotated towards high pitch, beyond the feather position and could be partially rotated by hand force indicating a fractured pitch change knob.

A small air leak could be heard when the air valve cap was removed but a measured, 17.5 psig aircharge remained in the cylinder.

Blade RA was bent aft and twisted towards low pitch, with remarkable chordwise/rotational abrasion on the camber side in the tip region (Photo #9). There was also some chordwise/rotational scoring on the face side. Blade RB was bent forward and twisted toward high pitch with some chordwise/rotational scoring on the camber and face sides (Photo #10). There was a gouge in the leading edge approximately 3" from the tip with material deformation toward low pitch. Approximately 0.5" of the tip was fracture-separated. Blade RB also exhibited remarkable ~45° chordwise scoring and abrasion on the face side in the mid-blade region. Blade RC did not exhibit any remarkable bending or twisting. There was chordwise/rotational abrasion on the camber and face sides (Photo #11). Approximately 2" of the tip was fracture-separated.

The low pitch stop was removed from the cylinder and it showed impact damage with the cap screw holding the feather and start lock sleeve to the pitch change rod (Photo #8). The impact damage was offset from the centerline. This impact damage suggests the propeller was at near the low pitch stop at impact.

An attempt was made to remove the start lock sleeve and feather stop washer. Although the cap screw unthreaded from the pitch change rod, it could not be removed from the assembly and the propeller would not feather from spring force alone. Rubber mallet strikes on the counterweights were required to move the propeller toward feather. Blades RA and RC moved simultaneously toward feather and RB did not move (Photo #12). The inability to remove the start lock sleeve and the sluggish movement toward feather suggested a bent pitch change rod. Because the governor was not removed from the engine no attempt was made to actuate the propeller with air pressure.

The spinner dome had counterweight impression marks at approximately 28° and 44° (Photos #13 and #14) which are equivalent to blade angles of 15° and 31°. Per Installation Data Sheet No. 875, the mechanical low pitch stop should be set to 14°

The propeller was not removed from the engine and no further disassembly was conducted.

Photo #7 – Right propeller as-presented for examination



Photo #8 - Right propeller low pitch stop

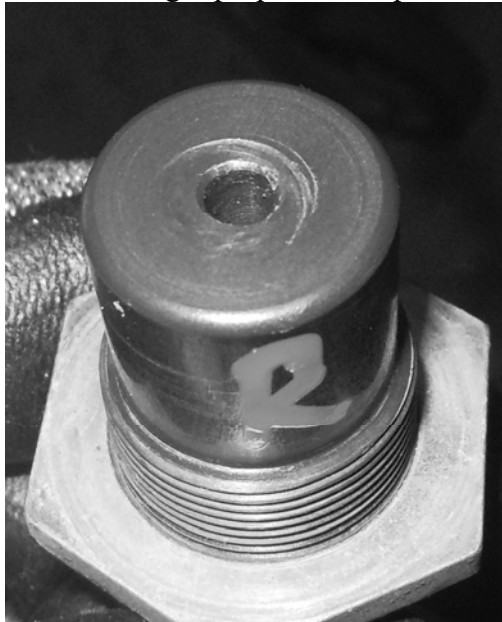


Photo # 9 – Blade RA camber and face side

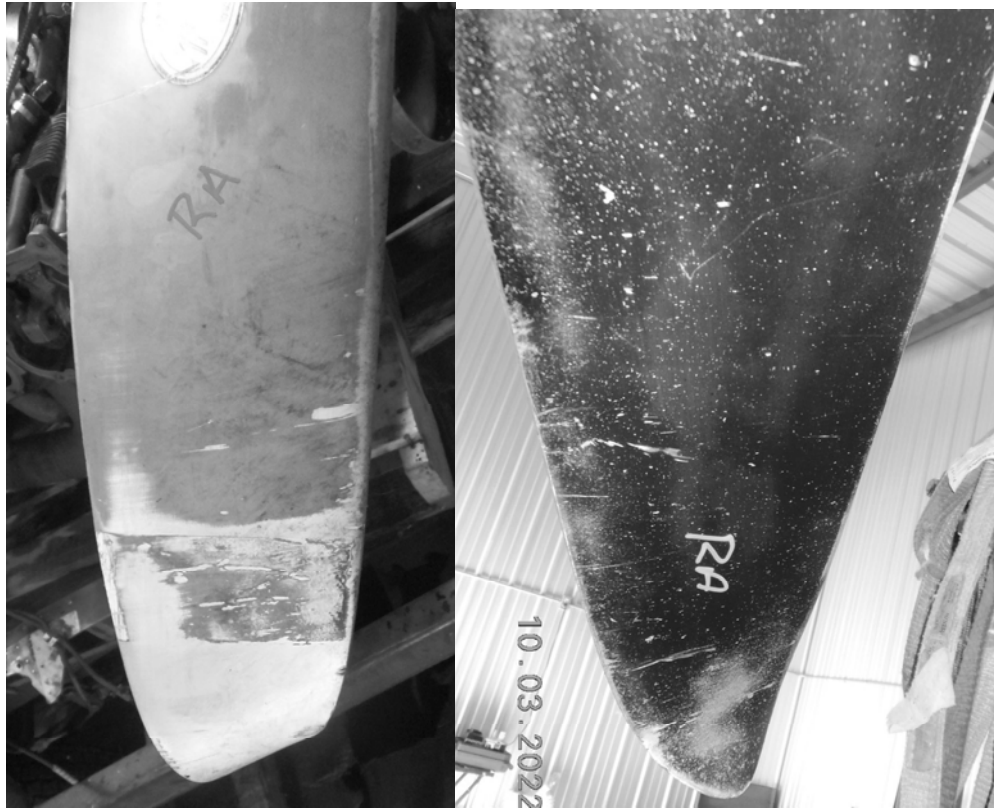


Photo #10 – Blade RB camber and face sides



Photo #11 – Blade RC camber and face side near tip



Photo #12 - Right propeller after feathering RA and RC

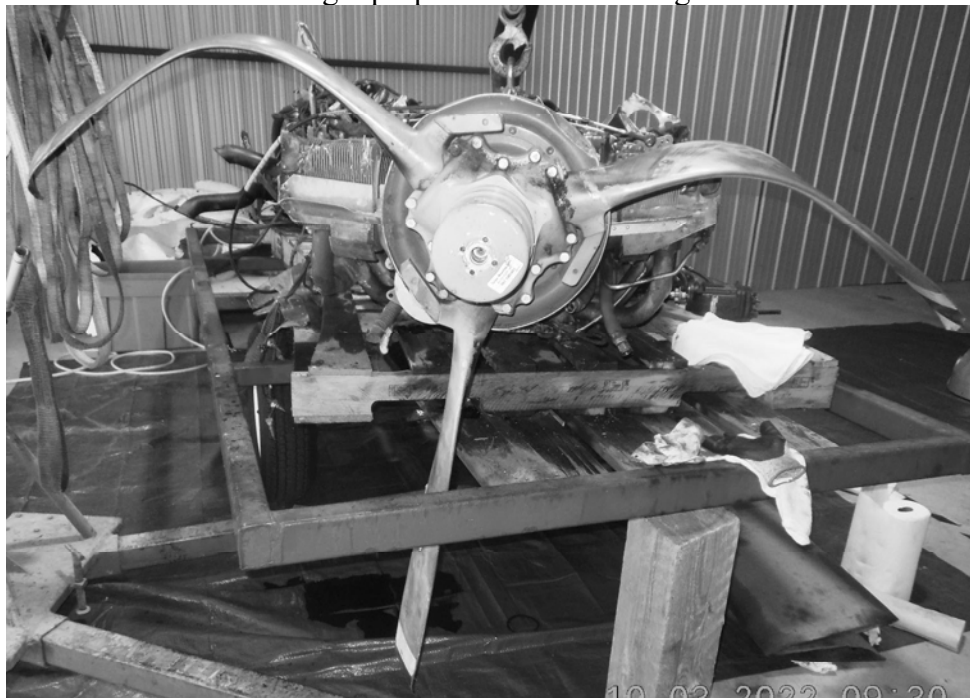


Photo #13 - Left spinner dome counterweight impression at ~28°

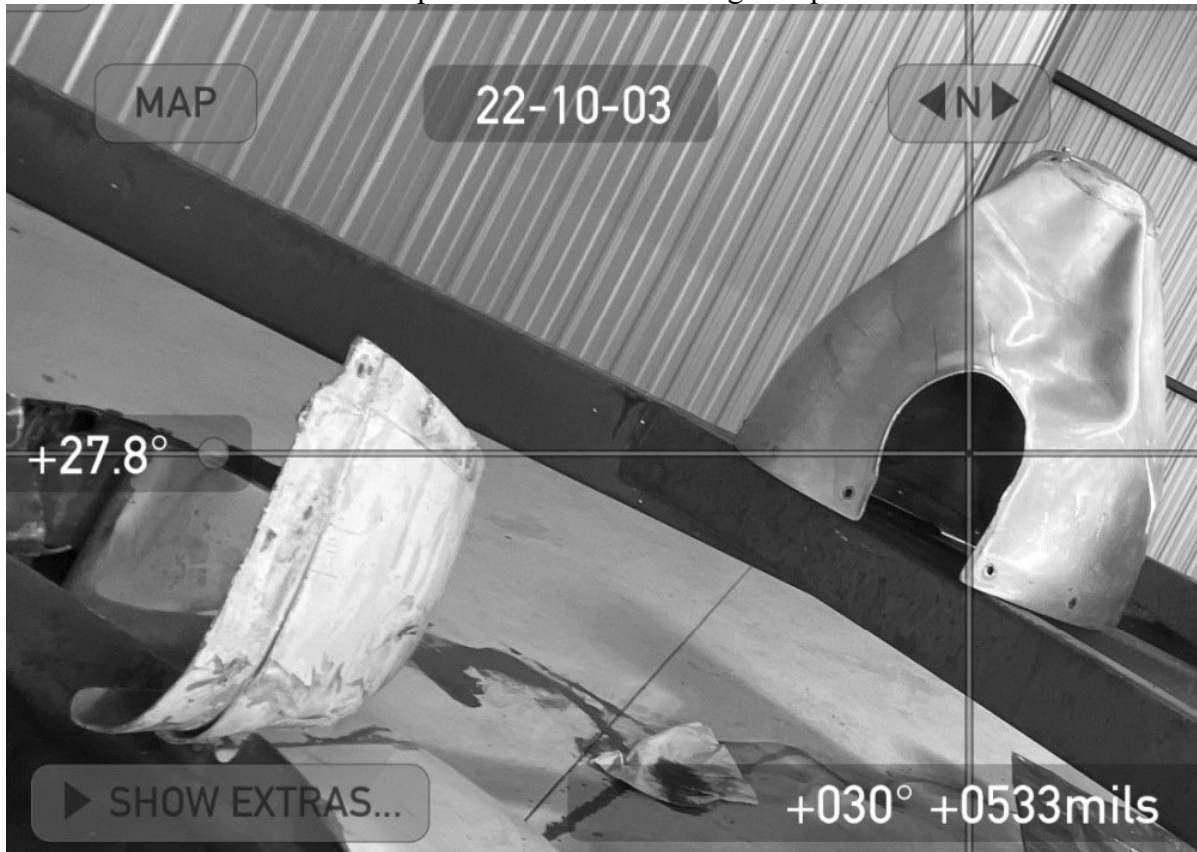


Photo #14 - Left spinner dome counterweight impression at ~44°



Propeller Governors

Both propeller governors were examined and their service history is unknown.

Left Governor
Model: F-6-5A
S/N: 7185T

The left governor had been removed by previous investigators before this exam. It appeared undamaged. The governor pump shaft rotated smoothly with “gurgling” sounds indicating pump action. The control arm also rotated thru full-range without difficulty. There was nothing found that would preclude normal operation.

Right Governor
Model: F-6-5A
S/N: B3289T

The right governor remained attached to the engine. It also appeared undamaged except for the control arm being bent forward. After the control cable was removed and the control arm straightened, the control arm moved thru full-range without difficulty.

Conclusions

All visible damage on both propellers was consistent with high impact forces caused by terrain or portions of the airframe during the impact sequence. There were no visible discrepancies on the propeller components examined that would indicate a propeller failure prior to impact, or prevent propeller operation. Thick, sludge-type oil that was forced out of the left propeller may have contributed to slow or less precise RPM control but would not prevent function.

The left propeller had signatures of rotation with low or no power (windmilling), such as chordwise/rotational scoring and only simple, gradual aft bends with no twisting or remarkable leading edge damage. Damage indicated the left propeller was on or near the low pitch stop and not feathered at impact. The right propeller had signatures of rotating with power, such as chordwise/rotational scoring, tip fractures, compound bend and twist patterns in two blades, forward bending on one blade, leading edge gouging, and indications of a bent pitch change rod. Damage indicated the right propeller was near the low pitch stop and not feathered. Damage indicated the left propeller was at low/no power compared to the right propeller at a higher power level. The propeller governors appeared intact and relatively undamaged. The left propeller governor appeared and sounded functional, and the right governor appeared functional.

**Leslie A.
Doud**

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