

WPR21LA299

Hartzell Propeller Exam Report

Accident

NTSB File No. WPR21LA299

Date: July 30, 2021

Location: Tracy, CA

Aircraft: Schweizer/Grumman G-164B Ag Cat with Honeywell TPE331-6 conversion

Aircraft Registration: N3629F

Aircraft S/N: 745B

Propeller Examination

Location: Haley Flying Services

15971 S Tracy Blvd

Tracy, CA 95304

Date: October 19, 2022

Participants: Les Doud – Hartzell Propeller Air Safety Investigator

Will Spivey – FAA ASI, Oakland, CA FSDO

Amanda Bailey – FAA ASI, Oakland, CA FSDO

Justin Horn – FAA ASI, Oakland, CA FSDO

Propeller Description

The propeller examined is a 106.5” diameter, Steel Hub Turbine Series, 3-blade, feathering, reversing, pressure to decrease pitch propeller. 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 start locks to keep propeller blade angle low to minimize the starting torque. The blades are of aluminum construction. The hub and clamps are made of steel alloy. Hartzell Installation Data Sheet No. 934 specifies angles for the propeller model installed via STC SA7987SW (Agri-Jet Power).

Model: HC-B3TN-5E / T10282N+4

Assembly S/N: BVA8080 (DOM 12/30/2002, sold as replacement hub to Johnson & Sons Propeller)

Blades S/Ns:

#1 – J81096 (DOM 10/10/2002), Clamp S/N EM14288

#2 – J54286 (DOM 10/25/2000), Clamp S/N EM14095

#3 – J54284 (DOM 10/25/2000), Clamp S/N EM14284

The propeller logbook was not available during this examination so TSN, TSO and last inspection is unknown. A decal on one blade indicated the propeller was serviced and/or overhauled by Stockton Propeller. The condition of the seals, paint, plating and bearing grease suggested the propeller was assembled relatively recently.

Propeller Examination

The propeller was presented for examination as shown in Photo #1. The propeller was removed from the engine propeller shaft flange prior to this examination. The spinner dome and beta tube were not presented for examination. The propeller presented in the feathered position. There were no indications the blades had slipped in the clamps (Photo #2). All three blades exhibited varying degrees of chordwise/rotational scoring. Blade #2 had approximately 3" of the tip fracture-separated; the fragment was not recovered or not presented for examination. Blade #2 also exhibited some S-bend characteristics and all three blades were bent aft at the tip. Blades #1 and #3 exhibited some bending opposite rotation and twisting towards low pitch. The #1 link screw/link arm forcefully contacted the piston guide collar and left a dent/gouge. All three start lock bracket assemblies were fractured and the start lock plates had signatures of forceful impact with the start lock pin (Photo #3)

All three link arms were attached at both the link screw and link pin ends with no remarkable damage. There was no evidence of oil leaks around the hydraulic unit components. No attempt was made to cycle the propeller with air pressure. The spinner bulkhead was rotationally displaced on the hub such that the mounting bolt holes and dowel pin holes were not aligned but there was no evidence this condition occurred during impact and was likely rotation after removal from the propeller shaft flange.

The blades were numbered 1-2-3 in a counter-clockwise direction (aft looking forward with #1 to the right of the assembly S/N). This piston nut was removed to release the feathering spring tension. The link arms were disconnected from the piston and the piston was removed. The link arms, link screws and link pins appeared intact and undamaged. With the link arms detached from the piston, all three blade/clamp assemblies rotated smoothly by hand force. The start lock pins could be actuated by a screwdriver and when the blade/clamp assemblies were rotated only blade #2 would occasionally lock near the start lock angle. Both #1 and #3 start lock plates would pass by the displaced pin/bracket without locking.

The piston was removed without difficulty and the piston guide rods were slightly but visually bent in the direction of rotation. The feathering spring assembly was removed without difficulty, was intact and loaded with the forward and aft spring retainers in-place (Photo #5).

There were two marks on the internal surface of the piston (Photo #4) that may suggest a blade angle at impact. There was a distinctive scuff mark on the cylinder wall approximately 1.85-1.9" from the top corner (Photo #6). These marks translated to a blade angle with corresponding confidence levels are summarized below in Table #1. For reference, at 110 KTAS (127 mph), 15.6° at 2000 RPM, SL/ISA this propeller model is absorbing approximately 47 Hp, at 40 KTAS it is absorbing 300 Hp.

The internal ceiling of the piston and the feather stop screws (Photo #7) were not damaged indicating the propeller was not feathered at impact.

All three clamps and counterweights appeared intact and undamaged (Photo #8).

Photo #1 –Propeller as-presented



Photo #2 - Blade slip indicators

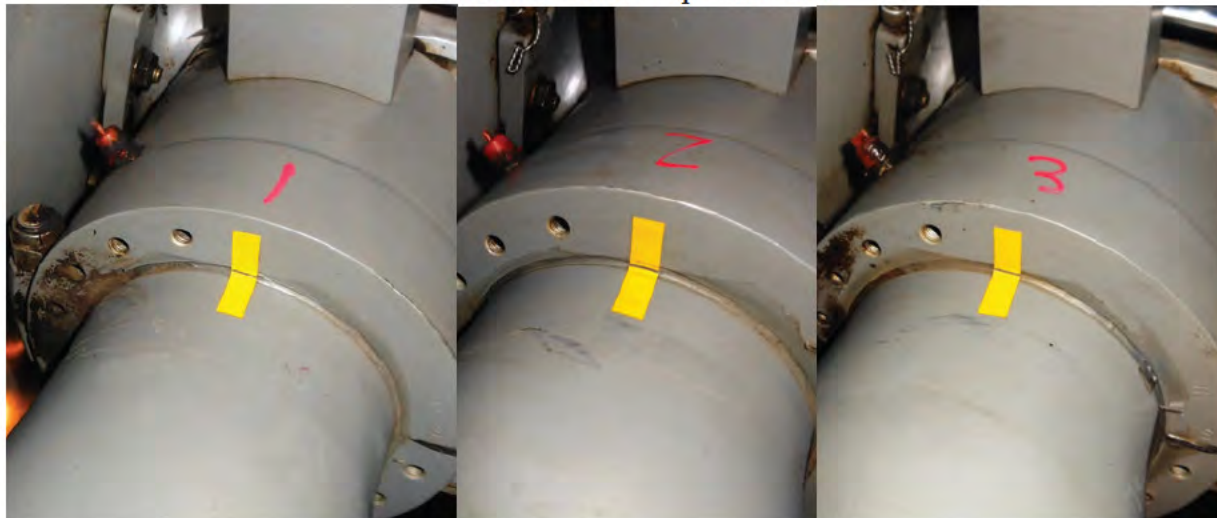


Photo #3 – Start lock plate - pin impact marks



Table #1 - Summary of Piston/Cylinder Signatures

Internal Marks from Bottom Piston Edge	Approximate Equivalent Blade Angle	Pre-impact Confidence Level / Why?
1.85"	$\sim -1^\circ$	High to Medium – Near start lock angle of 2.0°
2.35"	$\sim +15.6^\circ$	Low – Mark does not appear to be from cylinder corner, blade angle at low impact speeds is not consistent with pilot's "power loss" statement.
Cylinder circumferential from top at 1.9" (Photo #6)	~ -1 to $+0.7^\circ$	High to Medium – matches piston marks and consistent with blade damage and near start lock angle

Photo #4 – Piston bore with marks



Photo #5 - Feathering spring/pitch change rod assembly



Photo #6 - Cylinder mark at ~1.9 below top corner



Photo #7 – Feather stop screws (4) undamaged



Photo #8 – Propeller clamps, counterweights and link screws/arms



All three start lock brackets were fractured (Photo #9). Based on a photo provided by the Honeywell ASI, the propeller was shown on the start locks after recovery and before the propeller was removed (Photo #10). A counterweight puncture in the spinner dome is consistent with a low blade angle when the spinner impacted terrain (Photo #10). In subsequent Honeywell photos the start lock brackets appeared fractured with the start lock plate loaded against the pin before propeller removal (Photo #11); those fractures occurred either during the impact sequence or aircraft recovery. Signatures on the start lock bracket indicated forceful contact in the high pitch direction.

Photo #9 - Start lock brackets and plungers



Photo #10 - Propeller on start locks after recover and before removal
(Photo provided by Honeywell ASI)

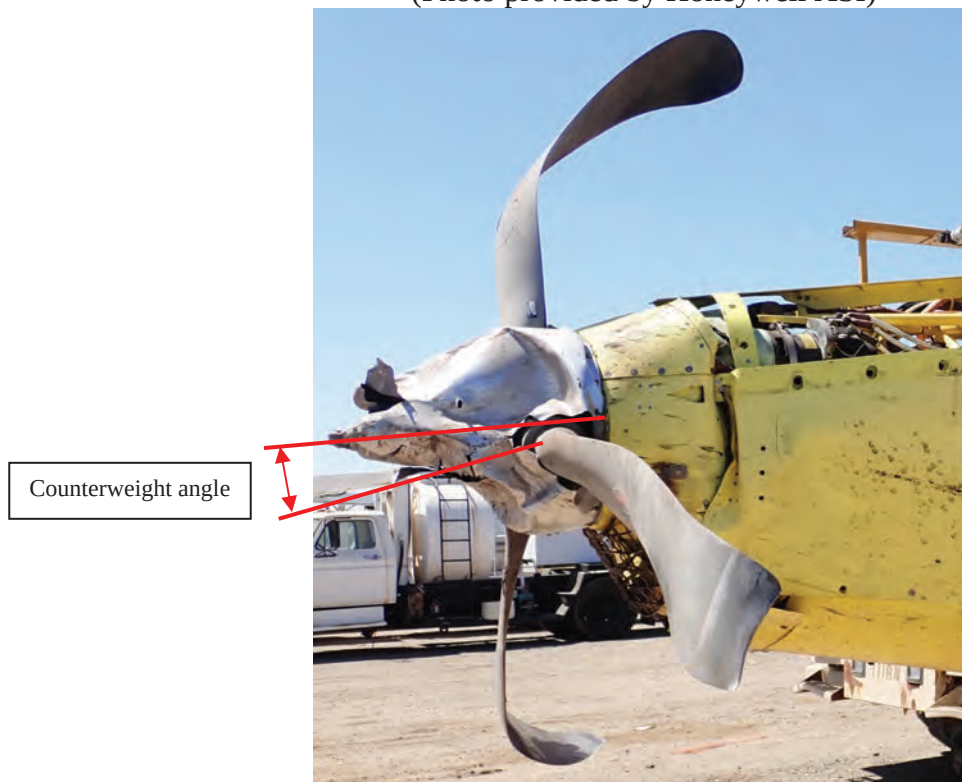
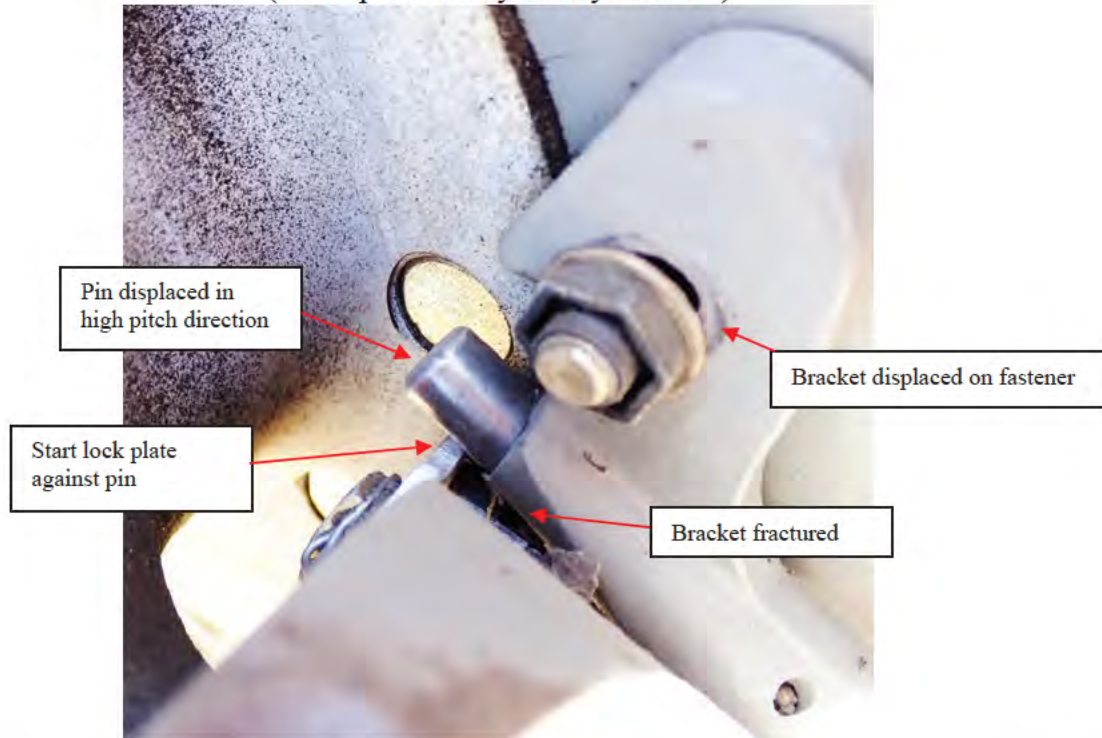


Photo #11 - Start lock bracket before propeller removal
(Photo provided by Honeywell ASI)



All three pilot tubes and bearing assemblies were intact. There were no remarkable hub-to-butt impact crescent marks, only indentations around the pilot tube/bearing bore on each blade butt. The spinner mounting plate had one indication the propeller shaft flange drive dowel made forceful contact in the direction of rotation (Photo #12). A dowel pin hole on the propeller hub had a corresponding contact mark (Photo #13) in the direction of rotation.

Photo #12 - Mounting dowel pin impact mark on spinner bulkhead mounting plate
(in direction of rotation)

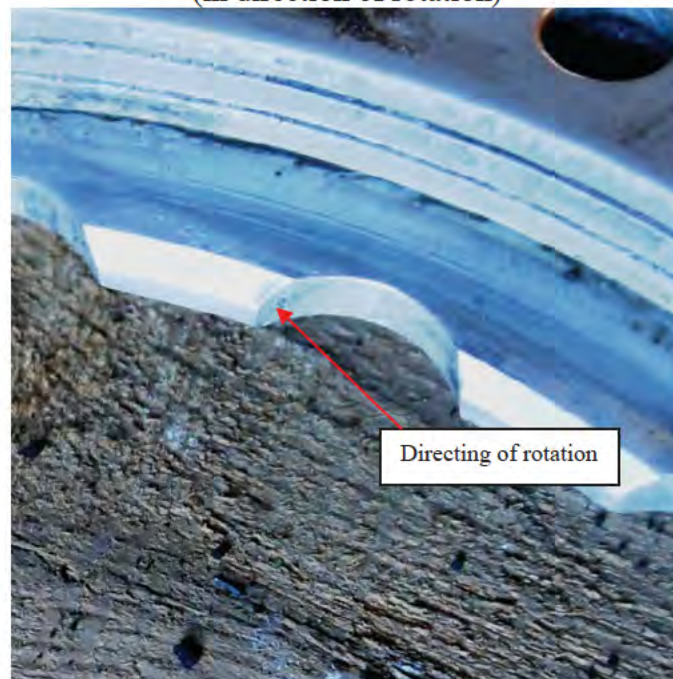
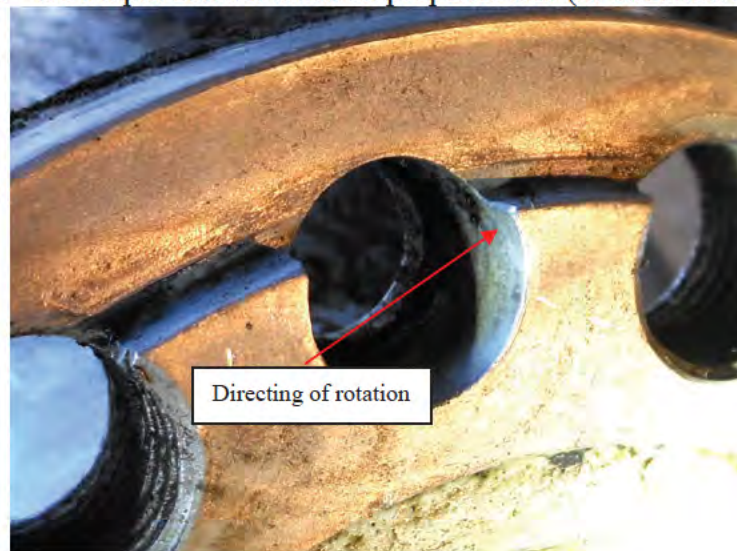


Photo #13 - Down pin contact mark on propeller hub (in direction of rotation)



All three blades had chordwise/rotational scoring on the camber-side, primarily near the tip stripe area (Photos #14 and #15). Blade #2 had approximately 3" of the tip fracture-separated; the fragment was not recovered or not presented for examination. Blade #2 also exhibited some S-bend characteristics and all three blades were bent aft at the tip. Blades #1 and #3 exhibited some bending opposite rotation and twisting towards low pitch. Blade #1 had small, buckling wave-type bends near the tip. None of the blades had remarkable face-side rotational scoring, only some localized scuffing/abrasion (Photo #16). The blades when laid in sequence of rotation 2-3-1 exhibited progressive bending and twisting (Photo #17 and #18).

Photo #14 – Propeller blades camber side



Photo #15 - Blade camber side near tip stripes



Photo #16 - Propeller blades face side



Photo #17 - Propeller blades trail edge view 2-3-1 (left-to-right) progressive bending



Photo #18 - Propeller blades trail edge view 2-3-1 (foreground to background) progressive bending

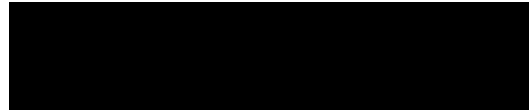


Conclusions

There were no visible discrepancies noted that would prevent or degrade normal propeller operation prior to impact. All visible damage was consistent with high impact forces while rotating at low power. Signatures that indicate rotation at low power are:

1. Compound bending aft/opposite rotation and twisting on blades #1 and #3.
2. Chordwise/rotational scoring primarily on the camber side.
3. No slip of the blades in the clamps and no remarkable link arm/pin/screw damage.
4. All three pilot tubes were intact and minimal blade-to-hub contact marks.
5. Blade #2 tip fracture indicating rotation at relatively high RPM.
6. Some deformation of one drive dowel hole in the direction of rotation.

Damage to the start lock brackets, start lock plates and a contact mark on the internal surface of the piston suggested the propeller was on or below the start lock angle at impact.



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