

Photo #1 - Blade damage comparison (L2-R3 on left and L1-R2 on right)



Photo #2 - Engine tachometer (electric) showing left and right ~1300 RPM



PROPELLER EXAM FACTUAL FINDINGS**Position:** LEFT**Propeller Model:** HC-C3YR-2UF with FC8468-6R blades**Propeller Assembly Serial Number:** CK4034A

Service History: According to logbook information, the propeller was last overhauled on 4/23/2010 by American Propeller Service in Redding, CA; there were American Propeller Service decals on the blades. The propeller TTSN is unknown. The last propeller service was an annual inspection on 8/14/2020 by Aero Diesel Aviation in Pompano Beach, FL. TSO listed below is TSO on 8/14/2020 during the annual inspection.

	S/N	Date of Manufacture	TTSN	TSO
Hub/Factory	A27816A	8/4/1994	Unk	65.3
Blade L1	D77213	12/14/1977	Unk	65.3
Blade L2	D77087	12/14/1977	Unk	65.3
Blade L3	D60803	12/14/1977	Unk	65.3

Blade Orientation: The blades were arbitrarily identified L1-L2-L3 counterclockwise as viewed from the rear of the propeller. The hub serial number was between the L1 and L2 blades.

As Received Condition: The propeller remained attached to the engine crankshaft flange and was recovered to Florida Air Recovery as shown in Photo #3. All three blades remained secured in the hub. The spinner dome and hydraulic unit (cylinder, feathering spring, piston and pitch stops) were torn/fractured from the assembly; a portion of the pitch change rod protruded from the hub. The hydraulic unit was recovered at the crash scene and was crushed/compressed axially as shown in Photo #5. All three blades were forcefully rotated approximately 180° so the face side was facing forward. Two blades were bent aft, one bent forward.

Spinner Dome: The spinner dome was crushed and torn from the assembly. One fragment (Photo #4) remained attached to the spinner bulkhead. There were no discernable counterweight marks in the spinner dome fragment.

Spinner Bulkhead: The ring gear-mounted spinner bulkhead was bent, crushed and torn (Photo #4). It was cut in one place to facilitate removal and access to the propeller mounting studs.

Propeller Cycling: Propeller cycling was not possible due to damage to the hydraulic unit. The air valve was fractured from the low pitch stop assembly and not recovered.

Engine/Propeller Mounting: The propeller mounting flange was intact and appeared undamaged as shown in Photo #9. All six propeller mounting studs were secure and lockwired.

Cylinder: The cylinder fractured from the hub and was crushed as shown in Photo #5. No attempt was made to disassemble the hydraulic unit due to safety concerns.

Piston: The piston fractured from the pitch change rod and was retained within the cylinder. The aft wall of the piston was fractured as shown in Photo #9.

Aircraft Accident/Incident report No.: 200828

Pitch Change Rod: The pitch change rod was fractured aft of the piston (Photo #8). It was bent in the area of the fork threads and was not removed from the forward hub half due to damage.

Fork: The fork was intact and remained on the pitch change rod (Photo #7). The plastic bumpers were smashed and there were knob block contact marks in each of the slots (Photo #10).

Spring/Spring Guides: The feathering spring was captivated between the piston and cylinder. Due to damage and safety concerns no attempt was made to remove the spring. The spring, spring guides and retaining cup were not observed.

Pitch Stops: The pitch stops were captive between the piston and cylinder. Due to damage and safety concerns no attempt was made to remove the pitch stops.

Hub Assembly: The hub assembly was largely intact except for the cylinder mounting threads/boss (Photos #6 through #8). There were no visible cracks or fractures around the blade retention areas and all thru-bolts were present and secure. The aft hub half had preload plate shelf damage in all three blade areas (Photo #6). There were contact signatures in the aft hub blade apertures from contact with the blade shanks.

Preload Plates: All three preload plates had crushed and/or sheared lips (Photo #11).

NOTE: For this propeller model, when the blade knob is aligned with the hub parting line, the blade angle at the reference station is approximately 48.5° (knob $12^\circ + 36^\circ +$ difference between blade Station 30 and the 30" reference radius = 48.5°).

Preload Plate	Condition
L1	Knob contact mark at 25° . Fork bumper scoring in the low pitch range of operation. Fork contact mark in low pitch range and near parting line. Aft hub half web contact mark on aft corner. Knob slot fractured at the high pitch end of travel.
L2	Knob contact mark at 27.5° . Fork bumper scoring in the low pitch range of operation. Fork contact mark in low pitch range and near parting line. Knob slot dent/contact mark at high pitch end of travel.
L3	Knob contact mark at 26° . Fork bumper scoring in the low pitch range of operation. Fork contact mark in low pitch range and near parting line. Aft hub half web contact mark on aft corner. Knob slot fractured at the high pitch end of travel.

Propeller Blade Properties: See Photos #12 through #19**Blade # L1**

Camber side	Radom scrapes/scoring mid-blade and shank area
Face side	Chordwise/rotational at mid-blade bend
Bend	Aft mid-blade, forward last 2" of tip
Twist	Towards low pitch at tip
Lead edge damage	Mid-blade scrapes and squaring of lead edge radius
Trail edge damage	Not remarkable
Knob condition	Fractured, overload shear/bending (Photo #12)
Counterweight	Removed to facilitate disassembly
Blade bearings	Hub-side race in leading edge quadrant fractured with ball imprints (Photo #12)
Butt/shank impact marks	Impact crescent in the trailing edge quadrant. Hub aperture contact mark on the trailing edge side.
De-Ice boot	NA

Blade # L2

Camber side	Chordwise/rotational scoring in the mid-blade and tip area (Photo #16)
Face side	Random scrapes/scoring, mid-blade to shank
Bend	Aft
Twist	Not remarkable
Lead edge damage	Scoring along camber side approx. 1" chordwise
Trail edge damage	Nicks and gouges
Knob condition	Fractured toward low pitch
Counterweight	Removed to facilitate propeller disassembly. Dowel pin fractured, hole deformation opposite rotation.
Blade bearings	Intact
Butt/shank impact marks	Impact crescent in the trailing edge quadrant. Hub aperture contact mark on the face side (Photo #14).
De-Ice boot	NA

Blade # L3

Camber side	Random spanwise scoring
Face side	Random spanwise scoring
Bend	Forward, aft at tip
Twist	Not remarkable
Lead edge damage	Nicks and gouges
Trail edge damage	Nicks and gouges
Knob condition	Fractured toward low pitch
Counterweight	Removed to facilitate propeller disassembly. One bolt fractured. Dowel pin hole deformation opposite rotation.
Blade bearings	Intact
Butt/shank impact marks	Impact crescent in the trailing edge quadrant. Hub aperture contact mark in the trailing edge/camber quadrant. Bearing retention lip fractured (Photo #18)
De-Ice boot	NA

Photo #10 - Left fork knob block impact marks

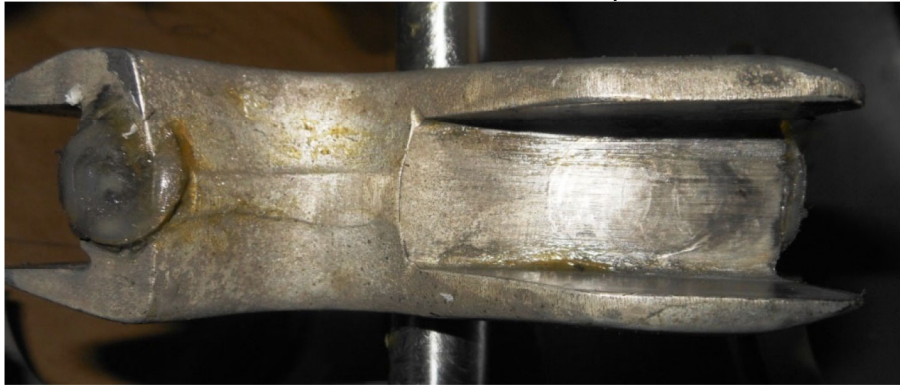


Photo #11 - Left preload plates



Photo #12 - L1 hub-side blade bearing race fracture



Photo #13 - Left propeller face side of blades



Photo #14 - L2 blade shank impact mark on face side



Position: RIGHT

Propeller Model: HC-C3YR-2UF with FC8468-6R blades

Propeller Assembly Serial Number: CK968

Service History: According to logbook information, the propeller was last overhauled on 4/29/2010 by American Propeller Service in Redding, CA; there were American Propeller Service decals on the blades. The propeller TTSN is unknown. The last propeller service was an annual inspection on 8/14/2020 by Aero Diesel Aviation in Pompano Beach, FL. TSO listed below is TSO on 8/14/2020 during the annual inspection.

	S/N	Date of Manufacture	TTSN	TSO
Hub/Factory	56942	7/7/1975	Unk	63.9
Blade R1	C64924	8/23/1974	Unk	63.9
Blade R2	C68295	8/23/1974	Unk	63.9
Blade R3	C66618	8/23/1974	Unk	63.9

Blade Orientation: The blades were arbitrarily identified R1-R2-R3 counterclockwise as viewed from the rear of the propeller. The hub serial number was between the R1 and R2 blades.

As Received Condition: The right propeller remained attached to the engine crankshaft flange and was recovered to Florida Air Recovery as shown in Photo #20. All three blades remained secured in the hub. The spinner dome was crushed on one side between blades R2 and R3. R1 was bent aft and the tip was curled spanwise. R1 was in an operational blade angle range. R2 had forcefully rotated approximately 180° so the face side was facing forward and the blade was bent aft. R3 was bent aft and at a low pitch blade angle.

Spinner Dome: The spinner dome was crushed and torn as shown in Photos #21 and #22. There was some spiral scoring and longitudinal scoring on the crushed portion of the dome (Photo #22). Although there was a counterweight puncture shape in the dome in the normal range of operation, it was not a useable contact mark for blade angle determination.

Spinner Bulkhead: The spinner bulkhead was bent and torn as shown in Photo #21. Several ring gear mounting bolt holes were torn open. The bulkhead was cut in one location to facilitate removal and provide access to the propeller mounting studs.

Propeller Cycling: During spinner dome removal it became evident the hydraulic unit had fractured from the hub mounting boss and the feathering spring was still slightly compressed. When the spinner dome screws were removed the cylinder separated from the assembly under spring force. The air valve fractured from the low pitch stop assembly and was not recovered.

Engine/Propeller Mounting: The propeller mounting flange appeared intact and undamaged as shown in Photo #26. The six mounting studs were secure and lockwired prior to removal from the engine flange.

Cylinder: The cylinder fractured from the hub mounting boss but remained attached to the dome/forward bulkhead which prevented separation from the propeller assembly during impact. It was dented/bent/creased/buckled on the same side of the dome crushing (Photo #21). The forward end of the high pitch stop bracket remained attached to forward end of the cylinder.

Piston: The piston appeared intact and undamaged (Photo #23).

Pitch Change Rod: The pitch change rod was intact but bent forward of the hub and in the area of the fork.

Fork: The fork was intact but had severe surface corrosion as shown in Photo #28.

Spring/Spring Guides: The spring retainer cup was fracture/shattered as shown in Photo #23. The spring appeared undamaged (Photo #21). The spring guide appeared intact and undamaged.

Pitch Stops:

Low Pitch Stop: The low pitch stop had an impact mark from forceful contact with the cap screw on the forward end of the pitch change rod (Photo #24).

Feather/High Pitch Stop: The feather stop washer and screw were present and appeared undamaged. The high pitch stop sleeve was bound on the pitch change rod and could not be removed with hand tools.

Start Lock: The start lock/high pitch stop bracket was fractured (Photo #23 and #24). The start lock weights and plate appeared undamaged.

Hub Assembly: There were no visible external cracks or fractures in the hub unit. There was visible corrosion in the bearing retention areas (Photo #27 and #28) consistent with the corrosion seen in the bearing races and balls. The bearing grease appeared old, hard and discolored from corrosion; the type of grease was not determined (Photo #25). There was preload plate shelf damage in all three blade retention pockets of the aft hub half (Photo #27). The cylinder mounting thread/boss was fractured (Photo #29).

Preload Plates: All three preload plates had crushed and/or sheared lips and sidewall fractures on the aft side. All three plates had severe surface corrosion (Photo #30).

NOTE: For this propeller model, when the blade knob is aligned with the hub parting line, the blade angle at the reference station is approximately 48.5° (knob $12^{\circ} + 36^{\circ} +$ difference between blade Station 30 and the 30" reference radius = 48.5°).

Preload Plate	Condition
R1	Knob contact mark at 25° . Fork bumper scoring in the low pitch range of operation. Aft hub half web contact mark on aft corner. Knob slot fractured at the high pitch end of travel.
R2	Knob contact mark at 40° . Fork bumper scoring in the low pitch range of operation. Aft hub half web contact mark on aft corner.
R3	Knob contact mark at 30° . Fork bumper scoring in the low pitch range of operation. Fork contact mark at the low pitch range of travel. Aft hub half web contact mark on aft corner.

Propeller Blade Properties: See Photos #31 through #36**Blade # R1**

Camber side	Spanwise scoring at tip
Face side	Spanwise scoring at tip, random scrapes in shank area
Bend	Tip curled over itself in spanwise/forward direction
Twist	Not remarkable
Lead edge damage	Nicks near tip
Trail edge damage	Trail edge scoring @ bend and near shank
Knob condition	Intact
Counterweight	Removed for disassembly
Blade bearings	Corroded (Photo #31)
Butt/shank impact marks	Not remarkable
De-Ice boot	NA

Blade # R2

Camber side	Chordwise/rotational scoring @ tip (Photo #36). Random scrapes mid blade to shank
Face side	Chordwise/rotational scoring @ tip
Bend	Aft mid blade, forward at tip
Twist	Not remarkable
Lead edge damage	Nicks and gouges near tip
Trail edge damage	Scoring face side near tip
Knob condition	Fractured toward low pitch
Counterweight	Removed for disassembly, impact mark inboard, dowel pin sheared
Blade bearings	Corroded (Photo #31), fractured hub side race in lead edge/face side quadrant with ball imprints
Butt/shank impact marks	Impact crescent face quadrant. Hub impact mark in face side shank Teflon rub strip
De-Ice boot	NA

Blade # R3

Camber side	Chordwise/rotational scoring and 45° scoring
Face side	Random scrapes and scoring
Bend	Aft
Twist	Not remarkable
Lead edge damage	Nicks and gouges near tip
Trail edge damage	Nicks mid blade
Knob condition	Fractured toward low pitch
Counterweight	Removed for disassembly
Blade bearings	Corroded (Photo #31)
Butt/shank impact marks	Not remarkable on butt, hub impact mark in trailing edge/face quadrant
De-Ice boot	NA

Photo #32 - Right blades face side



Photo #33 - Right blades camber side

