

Date of Accident: June 1, 2022

Location: Allport, AR

NTSB File No.: CEN22LA228

Aircraft: Air Tractor AT-602

Registration No.: N5007R

Serial No.: 602-0501 (Year of Manufacture 1998)

Operator: per FAA registry:
Webb Flying Service
[REDACTED]
Coy, AR 72037-0150

Written by: Les Doud
Air Safety Investigator – Hartzell Propeller Inc.

Report Date: January 13, 2023

Contents:	Page
Propeller Examination Information	2
Accident Synopsis.....	2
Summary and Analysis of Findings.....	3
Conclusions.....	4
General Information	5
Propeller Exam Factual Findings	6
APPENDIX A – Service History Summary	23

PROPELLER EXAMINATION INFORMATION

Date of Examination: January 10-11, 2023

Location: Pratt & Whitney Engine Services
[REDACTED]
Bridgeport, WV 26303

Propeller Model: HC-B5MP-3C with M10876ANS Blades

Representatives: Les Doud Hartzell Propeller Inc. ASI
Mike Hodges NTSB Investigator in Charge
Robert Hunsberger NTSB Powerplant Specialist
Brady Freeman PWC ASI

ACCIDENT SYNOPSIS

The following is excerpted from the NTSB preliminary report.

“On June 1, 2022, about 1700 central daylight time, an Air Tractor AT-602 airplane, N5007R, sustained substantial damage when it was involved in an accident near Allport, Arkansas. The pilot sustained minor injury. The airplane was operated as a Title 14 Code of Federal Regulations Part 137 aerial application flight.

The pilot reported he was on the 35th flight of the day and the airplane had been performing all day with no issues noted. The airplane was refueled two flights prior, and at the time of the accident, each wing fuel tank was about half full of fuel. The airplane’s 6,500 lb hopper was loaded with 3,600 lbs of urea. For the accident flight, the pilot intended to fly to a rice field near Humnoke, Arkansas, to apply fertilizer. Immediately after the takeoff from the private airstrip, the pilot heard a “loud pop” noise emit from the turboprop engine and he observed flames emit from the left side of the airplane. The pilot confirmed that a loss of engine power occurred, he made sure the flaps were down, and he began to scan the area to perform a forced landing.

During the forced landing sequence, the pilot reported that it felt like there was a “slight recovery” of engine power, but then the engine ceased producing power. The pilot retarded the throttle and landed to a flat field consisting of grass, dirt, and mud. During the landing, the airplane nosed over and came to rest inverted. The pilot was able to egress from the airplane without further incident.

The airplane sustained substantial damage to the left wing, the fuselage, and the empennage. The Federal Aviation Administration responded to the accident site and noted a strong odor consistent with fuel. The

wreckage was recovered from the accident site for future examination work. At the time of the accident, the estimated density altitude for the airstrip was 2,672 ft above msl."

SUMMARY AND ANALYSIS OF FINDINGS

The accident propeller remained attached to the engine propeller shaft flange throughout the impact sequence with all five blades attached as shown in Photo #1. The aircraft wreckage was recovered to Dawson Aircraft Parts & Salvage in Clinton, AR as shown in Photo #2. The blades were cut approximately 12" outboard of the blade clamps (Photo #3) to facilitate shipping to the Pratt & Whitney Engine Services (PWC) in Bridgeport, WV. The propeller was removed from the engine shaft flange and disassembled at PWC to remove the piston, blade clamps and shanks. Measurements of impact marks on the cylinder surface and piston internal surface were recorded and analyzed to aid in blade angle determination. Blade damage was assessed to aid in determination of blade section impact angles and thus engine power state at initial impact.

All four blades were bent aft in varying degree without any fractures, no remarkable twisting and no bending opposite rotation. There was also an absence of any remarkable chordwise/rotational scoring or abrasion, and no remarkable leading edge nicks or gouges. Additionally, impact forces were not sufficient to slip the blades in the retention clamps or fracture any pilot tubes. All of the damage indicated impact with terrain forced blade rotation to the mechanical reverse stop.

There were cylinder and piston impact marks that indicated the propeller was operating at a low blade angle before impact. There was no damage to indicate the propeller was feathered at the time of impact.

All of the damage is consistent with relatively low RPM rotation with low or no power and at negative blade section impact angles.

Photo #1 - Aircraft in-situ (Photo Provided by FAA)



Photo #2 - Aircraft after recovery at Dawson's (photo provided by NTSB)



Photo #3 – Propeller blades cut to facilitate shipping (Photo provided by NTSB)



CONCLUSIONS

There were no discrepancies noted that would prevent or degrade normal operation prior to impact with terrain. Piston/cylinder marks and blade damage indicated the propeller was operating at low blade angles with low or no power at initial impact. All damage was consistent with high impact forces.

GENERAL INFORMATION

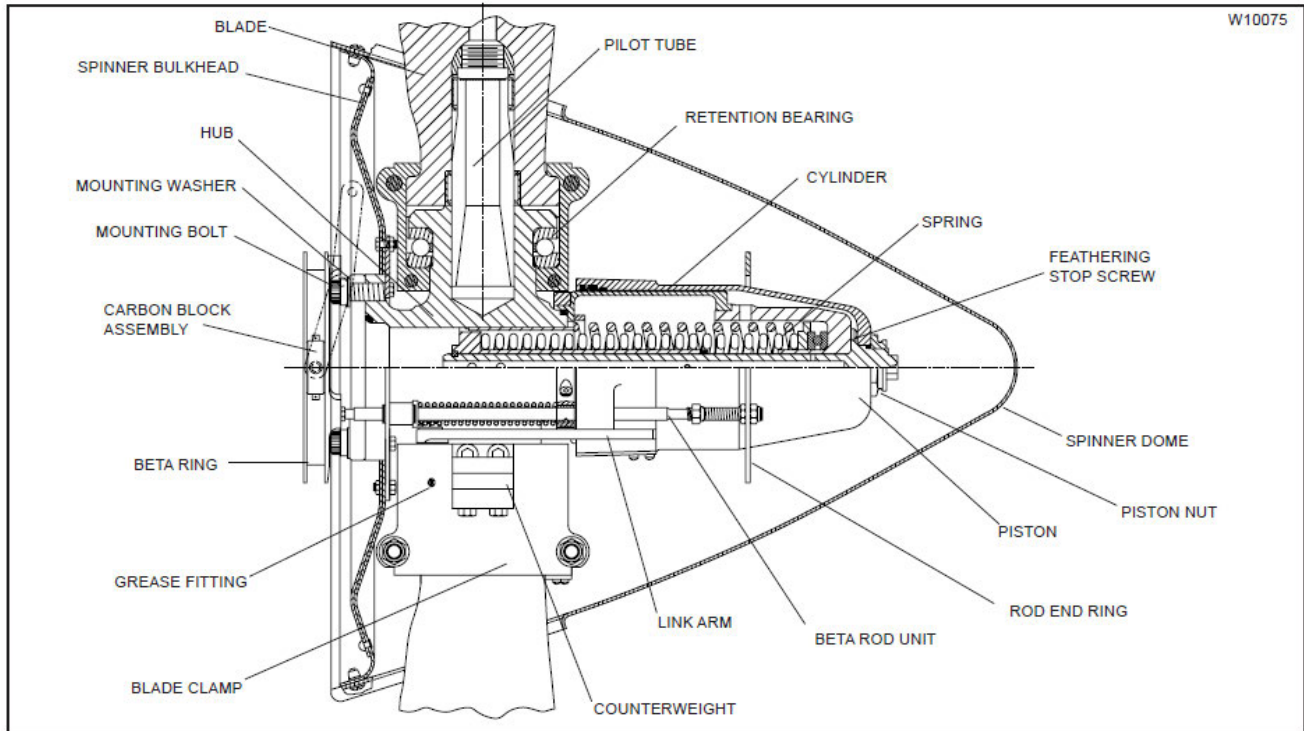
Propeller Description: The Hartzell Propeller Model HC-B5MP-3C/M10876ANS installed on the accident airplane is a 111.2" diameter, 5-blade, single-acting, hydraulically operated, constant speed model with feathering and reversing capabilities. Oil pressure from the propeller governor is used to move the blades to the low pitch (blade angle) direction. Blade mounted counterweights and feathering springs actuate the blades towards the high pitch direction in the absence of governor oil pressure. The propeller incorporates a Beta mechanism that actuates when blade angles are lower than the flight idle position. The blades are of aluminum construction. The hub and blade clamps are steel. Propeller rotation is clockwise as viewed from the rear. A propeller cutaway sketch is shown in Figure 1.

Installation Data: Refer to Hartzell Installation Data Sheet No. 1442 and Aircraft TCDS A19SW for the propeller settings referenced below:

(Angles referenced at the 42-inch radius)

Reverse:	-11.0 ± 0.5 degrees
Low Pitch/Beta Pick-Up:	16.5 ± 0.1 degrees
Feather:	79.0 ± 0.5 degrees
Counterweight:	Positive

Figure 1 – Propeller Cutaway Sketch



PROPELLER EXAM FACTUAL FINDINGS

Propeller Model: HC-B5MP-3C with M10876ANS Blades

Propeller Assembly S/N: EVA2241

Service History: The propeller was built and inspected as-new on 4/3/1998. Review of the logbooks found the propeller had been inspected, repaired and serviced somewhat regularly with an overhaul in 2008. The blades were replaced in September 2012. Since 2015 it appears the propeller had been maintained under Service Letter 253 guidance. The service times were not determinable but based on a utilization rate of 400 hours per year average, the propeller is estimated to have approximately 11,500 hours TTSN. A summary of the service history is included in Appendix A.

	<u>S/N</u>	<u>Date of Manufacture</u>	<u>TTSN</u>	<u>TSO</u>
Hub/Factory	B1843A	4/3/1998	~11,500	Unknown
Blade 1	L19916	12/10/2011	~4,000	Unknown
Blade 2	L19909	12/10/2011	~4,000	Unknown
Blade 3	L19913	12/10/2011	~4,000	Unknown
Blade 4	L19914	12/10/2011	~4,000	Unknown
Blade 5	L19910	12/10/2011	~4,000	Unknown

Blade Orientation: The blades were identified as 1-2-3-4-5 clockwise as viewed from the rear of the propeller. The hub serial number was between the #1 and #2 blades.

“As Received” Condition: The propeller remained attached to the engine propeller shaft flange throughout the impact sequence and is shown in-situ in Photo #1. The aircraft was recovered to Dawson Aircraft Parts & Salvage for examination and disassembly as shown in Photo #2. All blades were cut at approximately 12” from the blade clamp to facilitate shipment inside of the engine crate. The propeller was shipped to Pratt & Whitney Canada in Bridgeport, WV and arrived for examination as shown in Photo #4.

All five blades were subjected to impact forces that bent them aft (camber-to-face) in varying degrees. There was no remarkable chordwise/rotational scoring, leading edge gouging or blade fractures. The spinner dome sustained minimal impact damage and was found attached to the spinner bulkhead with no remarkable counterweight impressions noted. Blade #4 was in a low pitch position, two blades (#2 and #3) had rotated towards low pitch, beyond the reverse stop until contacting the spinner bulkhead, and two blades (#1 and #5) were in a high pitch/feather position.

The spinner and cowling were removed at Dawson’s to document the propeller condition in preparation for shipping. Four of the five link arms fractured from the link pin/piston connection. The #4 link arm remained attached at the piston and link screw. The #5 link arm separated from both the piston and clamp link screw and was recovered in the wreckage.

There appeared to be propeller control continuity via the propeller governor beta arm, carbon block and beta ring. All were intact and properly positioned under the retaining

Aircraft Accident/Incident Report No.: 220601

pin (Photo #5). All eight propeller mounting bolts were secure and lockwired with no evidence of oil leaks from the propeller or propeller flange.

The piston was extended approximately 2.55 inches from the beta rod guide collar. Blade #4 link arm was still connected at the piston and clamp and loaded in the feathering direction against the #3 counterweight arm/slug, thus preventing movement of the #4 and #3 blade clamps. Blades #1, #2 and #5 link arms were not connected at the piston and could be rotated by hand force.

Three fragments of the piston at the link pin connections and the #5 link arm were recovered in the wreckage and shipped loose as shown in Photo #6. The slip indicators on all five blades showed no slippage/rotation of the blades within the clamps.

Spinner Dome: The spinner dome was intact with relatively little damage as shown in Photo #7. There was one, small puncture near the nose. There were no discernable counterweight impressions in the dome.

Spinner Bulkhead: The spinner bulkhead was intact and had some localized bending of the dome mounting flange (Photo #8). The bulkhead remained secure to the hub unit. There were three counterweight impact marks adjacent to the #1, #2 and #3 blade arms indicating over-rotation of those clams past the reverse stop sometime during the impact sequence.

Propeller Cycling: Propeller cycling was not attempted due to damage of the link arm connections at the piston.

Engine/Propeller Mounting: The propeller mounting flange had all eight mounting bolts secure and lockwired. The flange appeared intact and undamaged with no remarkable dowel or mounting bolt hole deformation (Photo #9). All four dowel pins remained in the engine propeller shaft flange. There appeared to be some corrosion on the flange but there was no indication it affected sealing, mounting and torque.

Blade/Clamp Rotation:

Blade	Blade/clamp Angle As-Received	Blade Slip in Clamp?	Rotation of clamp possible?
1	Feather	No	Yes
2	Rotated beyond the reverse stop	No	Yes
3	Rotated beyond the reverse stop	No	No, restrained by #4
4	Low pitch/near beta range	No	No
5	High pitch approaching feather	No	Yes

Pitch Stops:

Low Pitch/Reverse Stop: The beta pick-up nuts, beta guide ring, beta guide collar and beta rods appeared intact and undamaged. The beta ring had a localized bend on the aft wall similar in width of the carbon block. The reverse stop sleeves were observed through the feathering spring and appeared intact and undamaged.

Feather Stop Screws: The feather stop screws appeared to have some lighter damage due to contact with the piston but not consistent with damage associated with being at/near the feather position at impact with terrain (see Photo #10).

Beta rods: The beta rods appeared intact and undamaged. The rods traveled smoothly through the guide collar and guide lugs with no binding or sticking. On two guide lugs the retaining snap ring was dislodged and found loose between the spinner bulkhead and beta ring lock nut.

Piston: The piston remained securely attached to the pitch change rod with the nut intact and torque striped. The #1, #2, #3 and #5 link pin attachment points fractured from the piston; three pieces were recovered in the wreckage. The four, fractured areas and link pin holes indicated the link arm was rotated to low pitch and pulled down from the impact forces rotating the blade/clamp towards low pitch. When received the piston was jammed forward 2.55" from the beta guide collar by over-rotation of the #3 clamp binding against the #4 counterweight. The piston otherwise appeared intact and capable of holding oil pressure. There were several circumferential marks on the internal surface made by contact with the top corner of the cylinder during the impact sequence (see Photo #11). The marks measurements and interpretation are presented in the following Table #1.

Table #1 - Summary of Piston Impact Signatures

Marks from Bottom Piston Edge OR from Cylinder top corner	Approximate Equivalent Blade Angle	Pre-impact Confidence Level / Why?
1.5 – 1.6" from bottom of piston. There was a corresponding cylinder crease at ~1.6" from top corner.	< -11°	Low – Propeller would not have been near the reverse stop after takeoff. This is likely a result of the impact forces rotating blades and forcing the piston forward to the reverse mechanical stop.
Scuffs starting at approximately 2.35" from top corner of cylinder	Approx. 13°	High – blade angle at or near the expected running flight idle blade angle, consistent with a low power, underspeeding condition.

Link Arms: See Photo #12

Link Arm	Link Arm Condition
1	Attached at link screw, pulled from link pin. Appeared normal, no remarkable bending or twisting, link screw bushing torn.
2	Attached at link screw, pulled from link pin. Appeared normal, no remarkable bending or twisting, link screw bushing torn.
3	Attached at link screw, pulled from link pin. Appeared normal, no remarkable bending or twisting, link screw bushing torn.
4	Attached at both link screw and pin. Appeared normal, no remarkable bending or twisting, link screw bushing torn.
5	Separated from link screw and pin, found loose in wreckage. Link screw hole elongated, bushing pulled/missing

Feathering Spring Assembly: The feathering spring assembly had been forcefully pulled from the cylinder during the impact sequence and was sitting loose on top of the cylinder (Photo #13). The forward spring retainer threads were stripped with loose, remnant thread whiskers laying on the cylinder. The spring remained secure and loaded with both fore and aft spring retainer in-place (Photo #14). The spring was not removed from the assembly.

Cylinder: The cylinder was removed from the hub during the examination. There was a crease in the cylinder wall at approximately 1.6" from the top corner (Photo #15) which corresponded with one of the piston marks noted in Table #1. There was scuffing on the cylinder wall starting at approximately 2.35" from the top corner which corresponds to a running flight idle blade angle position. The cylinder remained threaded on the hub and was removed without difficulty.

Pitch Change Rod: The pitch change rod appeared intact and undamaged.

Clamps and Counterweights: See Photo #16. All clamp bolts were present and secure.

Clamp Pos.	Clamp S/N	Clamp Condition	Counterweight Condition
1	F9810	Intact and undamaged	Intact, random scratches
2	F9836	Intact and undamaged	Intact, random scratches
3	F9835	Intact and undamaged	Intact, random scratches
4	F9834	Intact and undamaged	Intact, random scratches
5	F9833	Link screw sheared at cotter pin hole plane (Photo #17)	Intact, random scratches

Hub Unit: The hub unit/spider was intact with no remarkable fractures or visible cracks (Photo #18). All four pilot tubes were intact and appeared undamaged. The blade shanks were removed without the need for a wedge. The cylinder attachment appeared undamaged. The blade retention bearings were intact with adequate grease except for blades #1 and #5 bearings appeared to be underserviced with grease. There were no discernable impression marks on a blade arm flange.

Blade Properties: All blades were cut at approximately 13" from the butt to facilitate shipping. See Photos #19 through #24

Blade # 1

Camber side	Some vegetation varnish streaking in the chordwise/rotation direction otherwise not remarkable
Face side	Not remarkable
Bend	Aft
Twist	Not remarkable
Lead edge damage	Not remarkable
Trail edge damage	Not remarkable
Blade bearings	Not remarkable, underserviced with grease
Butt/shank impact marks	There was a shallow pilot tube bore shoulder impression around the blade bore
De-Ice boot	NA

Blade # 2

Camber side	Some vegetation varnish streaking in the chordwise/rotation direction otherwise not remarkable
Face side	Not remarkable
Bend	Aft
Twist	Not remarkable
Lead edge damage	Not remarkable
Trail edge damage	Not remarkable
Blade bearings	Not remarkable
Butt/shank impact marks	There was a shallow pilot tube bore shoulder impression around the blade bore
De-Ice boot	NA

Blade # 3

Camber side	Some vegetation varnish streaking in the chordwise/rotation direction otherwise not remarkable
Face side	Not remarkable
Bend	Aft
Twist	Not remarkable
Lead edge damage	Not remarkable
Trail edge damage	Not remarkable
Blade bearings	Not remarkable
Butt/shank impact marks	There was a shallow pilot tube bore shoulder impression around the blade bore
De-Ice boot	NA

Blade # 4

Camber side	Some vegetation varnish streaking in the chordwise/rotation direction otherwise not remarkable
Face side	Not remarkable
Bend	Aft
Twist	Not remarkable
Lead edge damage	Not remarkable
Trail edge damage	Localized wave bends from camber-to-face direction
Blade bearings	Not remarkable
Butt/shank impact marks	There was a shallow pilot tube bore shoulder impression around the blade bore
De-Ice boot	NA

Blade # 5

Camber side	Some vegetation varnish streaking in the chordwise/rotation direction otherwise not remarkable
Face side	Not remarkable
Bend	Aft
Twist	Not remarkable
Lead edge damage	Not remarkable
Trail edge damage	Localized wave bends from camber-to-face direction
Blade bearings	Not remarkable, underserviced with grease
Butt/shank impact marks	There was a shallow pilot tube bore shoulder impression around the blade bore
De-Ice boot	NA

Photo #4 – Propeller as-presented



Photo #5 – Propeller mounting flange and beta ring

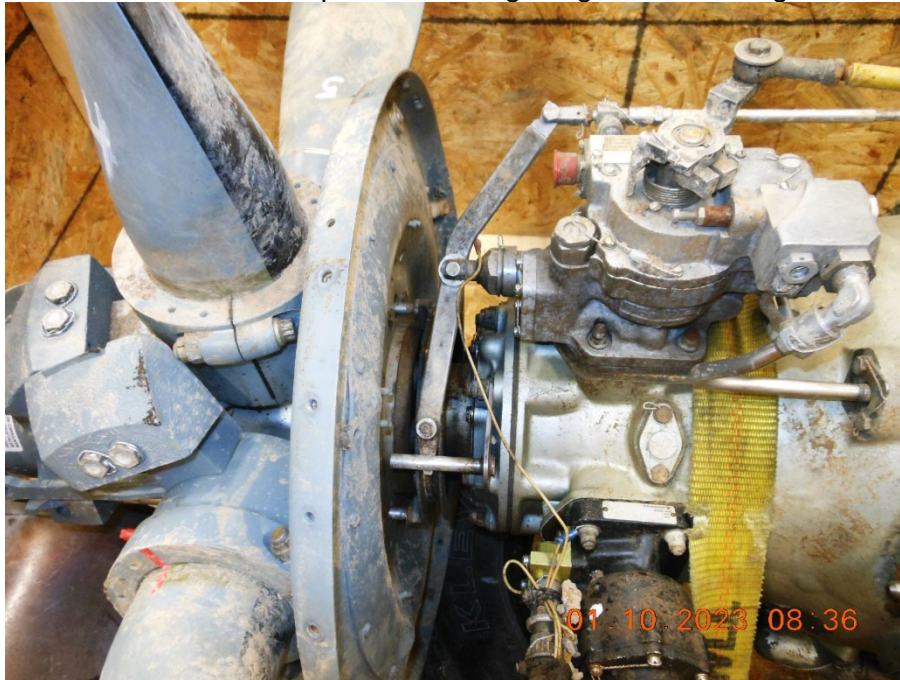


Photo #6 - Link arm and piston fragments shipped loose in bag



Photo #7 – Spinner dome



Photo #8 - Spinner bulkhead



Photo #9 - Propeller mounting flange



Photo #10 – Feather stop screws

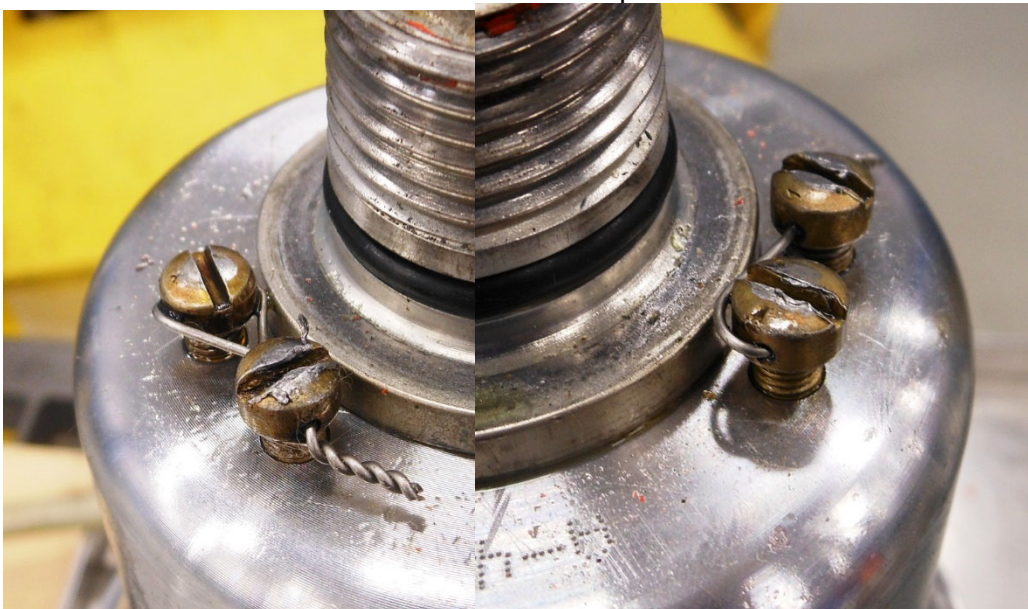


Photo #11 – Representative impact marks on internal surface of piston



Photo #12 - Link Arms



Photo #13 - Spring retainer cup pulled from cylinder mount



Photo #14 - Feathering spring assembly



Photo #15 – Cylinder crease

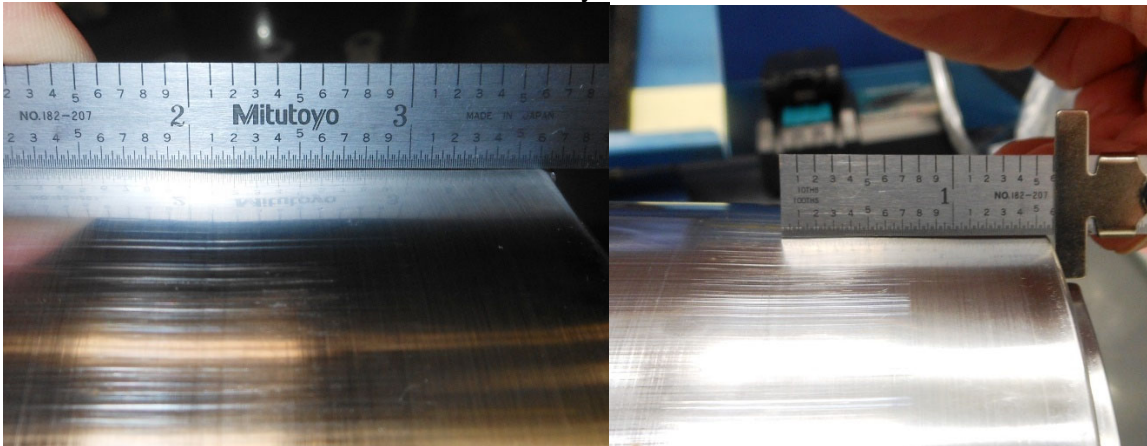


Photo #16 – Blade retention clamps & counterweights

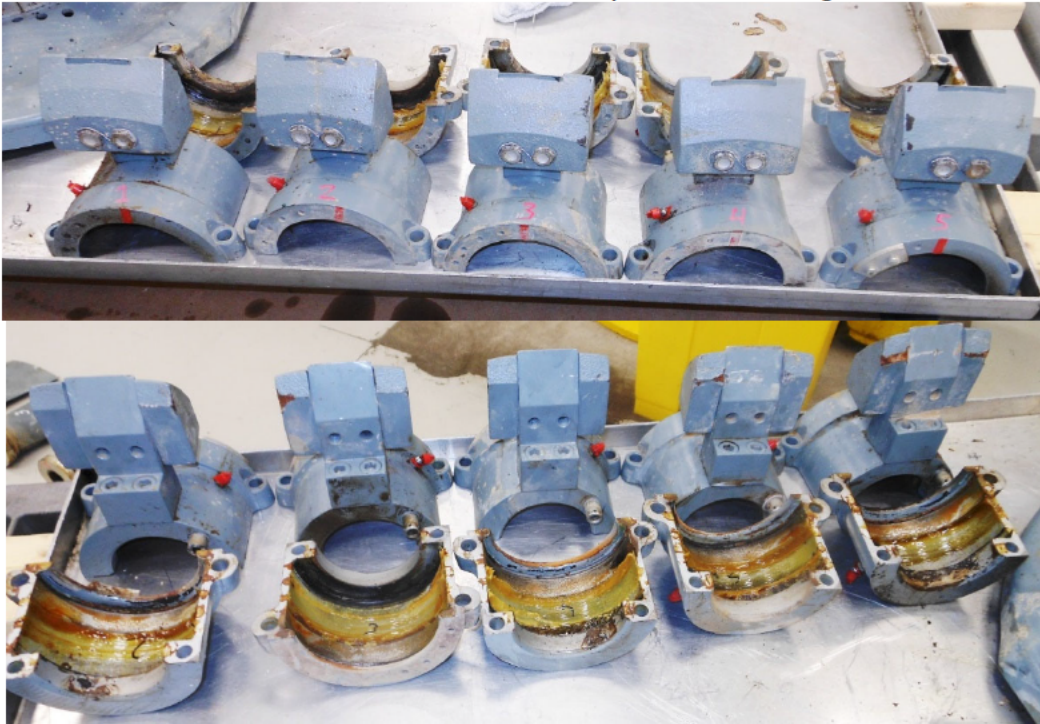


Photo #17 - Clamp #5 sheared link screw

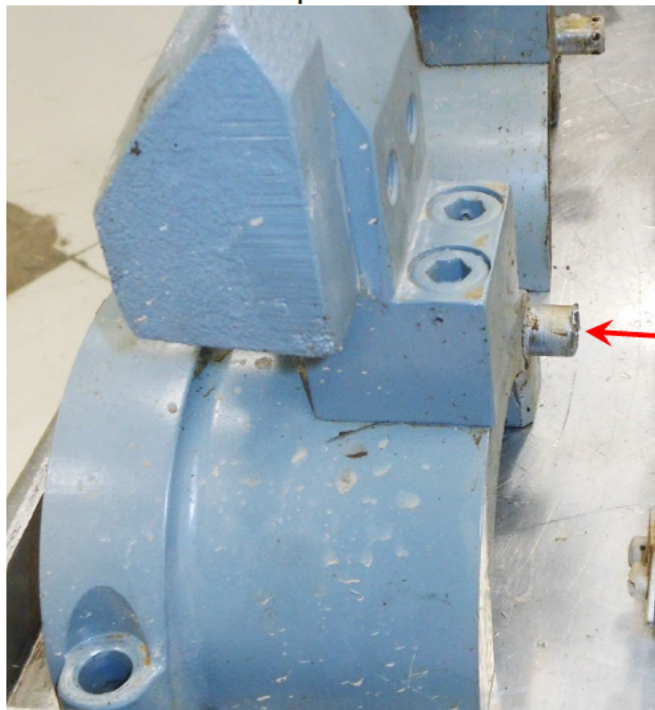


Photo #18 - Hub unit



Photo #19 - Blade butts

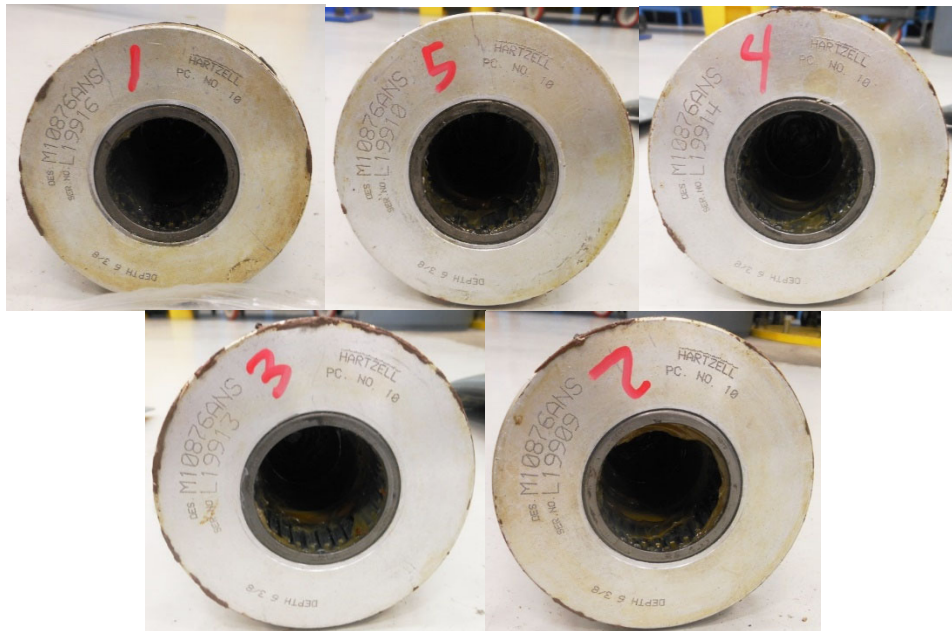


Photo #20 – Blade shanks



Photo #21 – Blade bend leading edge view (4-3-2-1-5 right to left)



Photo #22 – Blades camber side



Photo #23 - Blades tip camber area



Photo #24 – Blades face side



APPENDIX A

HC-B5MP-3C/M10876ANS

Summary of Propeller Service History

CEN22LA228 - AT-602 N5007R, June 1, 2022		
Propeller Logbook/Service History HC-B5MP-3C / M10876ANS S/N EVA2241		
Date	Time	Description
4/3/1998	0	Assembly Inspection Record at Hartzell - Propeller New with Blade S/Ns J13034, J13031, J13025, J13028, J13026
11/20/1998		Dynamic Balanced
11/24/1999		Repair at Memphis Propeller w/ 8130-3
10/23/2001	Hobbs 2341	Repair at Memphis Propeller w/ 8130-3
12/17/2002	Hobbs 2893	Repair at Memphis Propeller w/ 8130-3
1/3/2003		Dynamic Balanced
3/4/2005		Serviced at Mid America Propeller
4/2/2005	Hobbs 4005.0	Dynamic Balanced
5/22/2006	Hobbs 4836	100 Hr. Inspection
6/13/2006	Hobbs 4935	100 Hr. Inspection
7/18/2006	Hobbs 5062	100 Hr. Inspection
11/6/2006	Hobbs 5246.6	100 Hr. Inspection
12/28/2006		Dynamic Balanced
1/18/2008		EVA2241 Overhaul my Mid America w/ 8130-3
1/21/2008	Hobbs 5996.1	Installed prop EVA2241 and Dynamic Balance
2/16/2009	Hobbs 6490.7	100 Hr. Inspection
9/9/2009	Hobbs 6936.9	100 Hr. Inspection
2/2/2010	Hobbs 6940.1	100 Hr. Inspection
1/18/2011		Repair at Memphis Propeller w/ 8130-3
1/21/2011	Hobbs 7359.1	Installed prop EVA2241
1/24/2011		Dynamic Balanced
1/31/2012	Hobbs 7748.3	Annual? Inspection
9/7/2012		Repair at Memphis Propeller w/ 8130-3, new/accident blades installed L19916, L19909, L19913, L19914, L19910
10/20/2015		Repair at Mid America w/ 8130-3
11/2/2015	Hobbs 9150.3	Prop R&I from Stallings Prpeller
10/6/2017		Repair at Stallings Propeller w/ 8130-3
10/31/2017	Hobbs 9819.1	Prop R&I from Stallings Prpeller
12/6/2019		Repair at Stallings Propeller w/ 8130-3
12/21/2019	512 Tach??	Prop R&I from Stallings Prpeller
10/6/2021		Repair at Stallings Propeller w/ 8130-3
10/20/2021	1330.2 Tach??	Prop R&I from Stallings Prpeller
	1429.5	Hobbs display when aircraft recovered
		Hartzell Service Letter HC-SL-61-61Y recommends TBO 3000 hours / 36 months for steel-hub Ag props
		OR
		Hartzell Service Letter HC-SL-61-253 can extend recommended TBO 3000 hours / 60 months with scheduled maintenance/repair