

Date of Accident: April 20, 2020

Location: Billings, MT

NTSB File No.: WPR20LA128

Aircraft: Piper PA-31T1 Cheyenne

Registration No.: N926K

Serial No.: 31T8004046 (Year of Manufacture 1980)

Operator: per FAA registry:
FMR Aviation LLC
[REDACTED]

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

Report Date: August 3, 2020

Contents:

	Page
Propeller Teardown Report	2
Accident Synopsis	2
Summary and Analysis of Findings	3
Conclusions	7
General Information	8
Propeller Factual Findings	9
Right Propeller	9
Left Propeller	18
List of Photos	30

PROPELLER TEARDOWN REPORT

Date of Examination: July 27-29, 2020

Location: Pratt & Whitney Engine Services
[REDACTED]

Propeller Model: HC-B3TN-3B with T10173(N)B-8 Blades

Representatives:	Les Doud	Hartzell Propeller Inc. ASI
	Jerry Morgan	FAA ASI – Charleston, WV FSDO
	Jeff Davis	PWC Air Safety Investigator
	Karel Currey	PWC Air Safety Investigator

ACCIDENT SYNOPSIS

The following is excerpted from the NTSB preliminary report.

“On April 20, 2020 about 0950 mountain daylight time, a Piper PA-31T1 airplane, N926K, was destroyed when it was involved in an accident about 1-1/2 miles west of Billings Logan International Airport (BIL), Billings, Montana. The airline transport pilot was fatally injured. The airplane was operated as a Title 14 Code of Federal Regulations Part 91 local flight.

According to ATC information, the pilot requested to taxi to runway 28L for takeoff, and then perform pattern work, and land on runway 28R at BIL. After the pilot held short of runway 28L, the controller cleared the pilot for takeoff with instructions to extend the upwind leg. Shortly after takeoff, the pilot was instructed to enter the left traffic pattern for runway 28R twice, with no response. A subsequent attempt was made to establish communication, with no response. About a minute and a half after the airplane departed, a column of smoke was observed west of the airport.

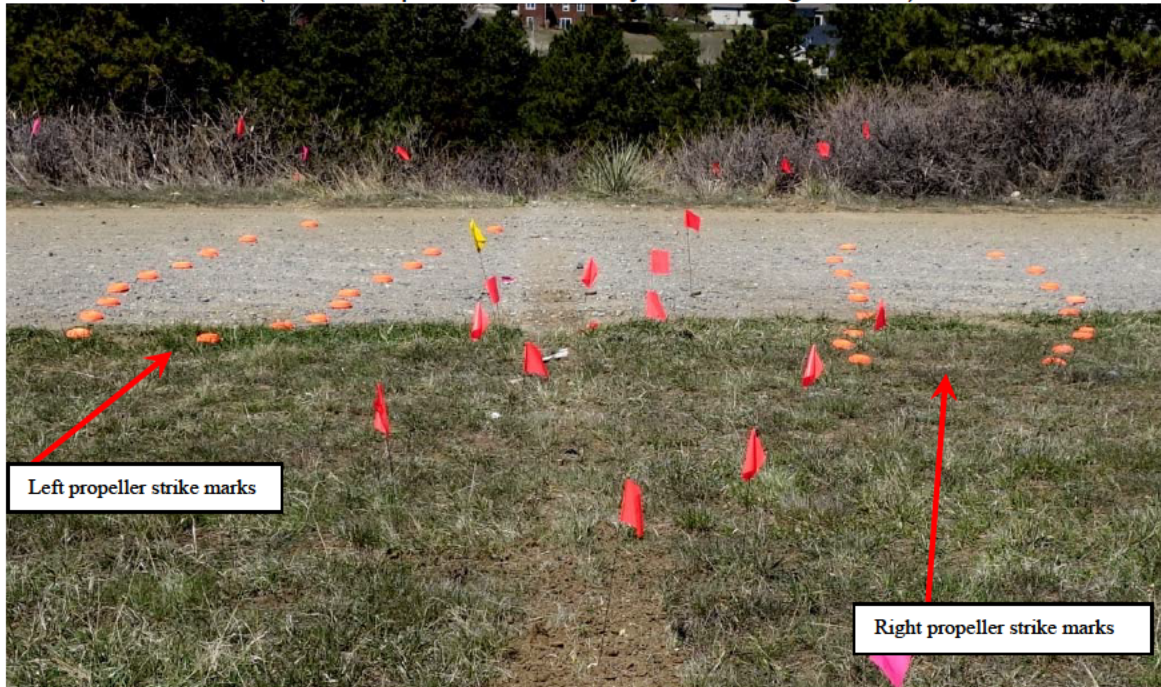
Radar data showed the airplane departing runway 28L and remaining on runway centerline heading for the length of the flight. The airplane's altitude climbed to about 100 ft above ground level and the airplane's groundspeed increased to 81 knots soon after departure, and then decreased to 70 knots before dropping off radar.

Witnesses located near the departure end of runway 28L watched the airplane through a window, depart the runway with its gear not retracted. The airplane was lower than normal as it neared the end of the runway. All the witnesses moved outside to watch as the airplane flew away from their location. One of the witnesses stated that the airplane had a "slow descent trajectory and a slight-nose up attitude." The airplane passed over a hill and out of view. None of the witness reportedly saw the accident sequence but saw the column of smoke rising from the accident site. Another witness who was sitting in his vehicle near the accident site saw the airplane pass about 250 ft in front of his position. The airplane's wings were level and the landing gear was up when it struck the ground. He lost sight of the airplane as it flew into a nearby coulee.

Ground scars found near the top of a coulee consisted of the airplane's fuselage impact mark and symmetrical propeller strikes consistent with the airplane impacting the ground in a shallow, nose-up, wings-level attitude. The airplane then continued over the coulee about 410 ft, and about 75 ft down before impacting the side of the coulee where a postimpact fire ensued. All major structural components of the airplane were located within the debris field."

As stated in the NTSB Preliminary Report, there were somewhat symmetrical propeller strike marks in the dry, hard-pack soil and gravel road at the initial point of impact (Photo #1).

Photo #1 – Symmetrical propeller strike marks – Piper ASI Photo
(strike end points identified by small orange cones)



SUMMARY AND ANALYSIS OF FINDINGS

The accident propellers were recovered from the accident scene, shipped with the engines and presented for examination as shown in Photos #2 and #3 at PWC Engine Services in Bridgeport, WV on July 27, 2020.

The propellers were disassembled to remove this piston and blades, examine the pitch change components and evaluate impact signatures for indications of blade angle. Blade damage was assessed to aid in determination of blade section impact angles and thus engine power state at initial impact.

Photo #2 – Right propeller as-presented for examination



Photo #3 – Left propeller as-presented for examination



The cylinder and piston impact marks found were not useful in determining blade angle prior to impact and only indicated the propeller was forcefully rotated toward the low pitch/reverse stop at initial impact. There was no damage to indicate either propeller was feathered at the time of impact. All blades remained attached via the retention clamps. No pilot tubes were fractured and there were no blade fractures due to impact. Blade damage that included camber side chordwise/rotational scoring, bending aft, bending opposite rotation, leading edge gouging with most material deformation toward low pitch, and progressive compound bent/twisting towards low pitch was consistent with impact at a relatively shallow aircraft impact angle while rotating under power. The damage to blades and pitch change mechanisms indicated forceful rotation towards low pitch during the impact sequence. All damage was consistent with the blade tip region initially hitting terrain at a zero-to-negative section angle of attack. A comparison of blades L2 and R3 bend and twist also suggested some degree of power symmetry between left and right engines. Photo #4 shows the degree of bend and twist. Photo #5 shows the extent of bending opposite rotation is similar.

Photo #4 – Blades R3 and L2 relative bend and twist



Photo #5 – Blades R3 and L2 amount of bend opposite rotation



The propeller strike marks at the initial impact location were measured by the Piper Air Safety Investigator (Photo #6). The Investigator stated the first three strike marks for both the left and right propeller were equally spaced and approximately 1' apart. Calculations using the strike mark dimension and the estimated ground speed from radar/ADS-B data of approximately 65-70 Knots suggested an RPM between 2100-2300 at initial impact.

Photo #6 – Left and Right Strike Mark Measurements (Piper Photo)



The aircraft was equipped with PT6A-11 engines with a takeoff rating of 500 SHP at 2200 RPM.

The weather conditions near the time of the accident were:

Field Elevation: 3662 ft.
Altimeter Setting: 29.98
Temp: 14° (ISA+~6°)
Winds 290° @ 14 Kts.

Assuming the propellers were being governed at the 2200 RPM rating, the minimum possible blade angle range would be between the running flight idle blade angle of approximately 15.2° and the beta/low pitch angle of 20.2°. At 70 KGS (~84 KTAS with ~14 Kts. headwind) the power and thrust at 15.2° blade angle would be approximately 152 Hp and 388 lbs. At 20.2° blade angle the power and thrust would be approximately 340 Hp and 956 lbs. of thrust. For comparison, the blade angle at takeoff rated power of 500 Hp and 2200 RPM is approximately 23.3° producing 1302 lbs. of thrust.

The degree and nature of the blade damage is consistent with a low aircraft impact angle and repeated propeller strikes into hard soil/gravel at low-to-moderate power. Ball bearing impact marks in the bearing races of the left propeller are typically seen with RPM in the normal operating range. Damage typically associated with high power such as fractured blades and fractured pilot tubes, and/or fractured pitch change hardware was not present on either propeller examined.

CONCLUSIONS

There were no discrepancies noted during examination of the left and right propellers that would prevent or degrade normal operation prior to impact with terrain. Blade damage indicated the propellers were operating in the low blade angle range of normal operation with low-to-moderate power at initial impact. Other damage indicated the blades were forcibly rotated to low pitch/reverse during the impact sequence. All damage was consistent with high impact forces and/or heat exposure to the post-crash fire.

GENERAL INFORMATION

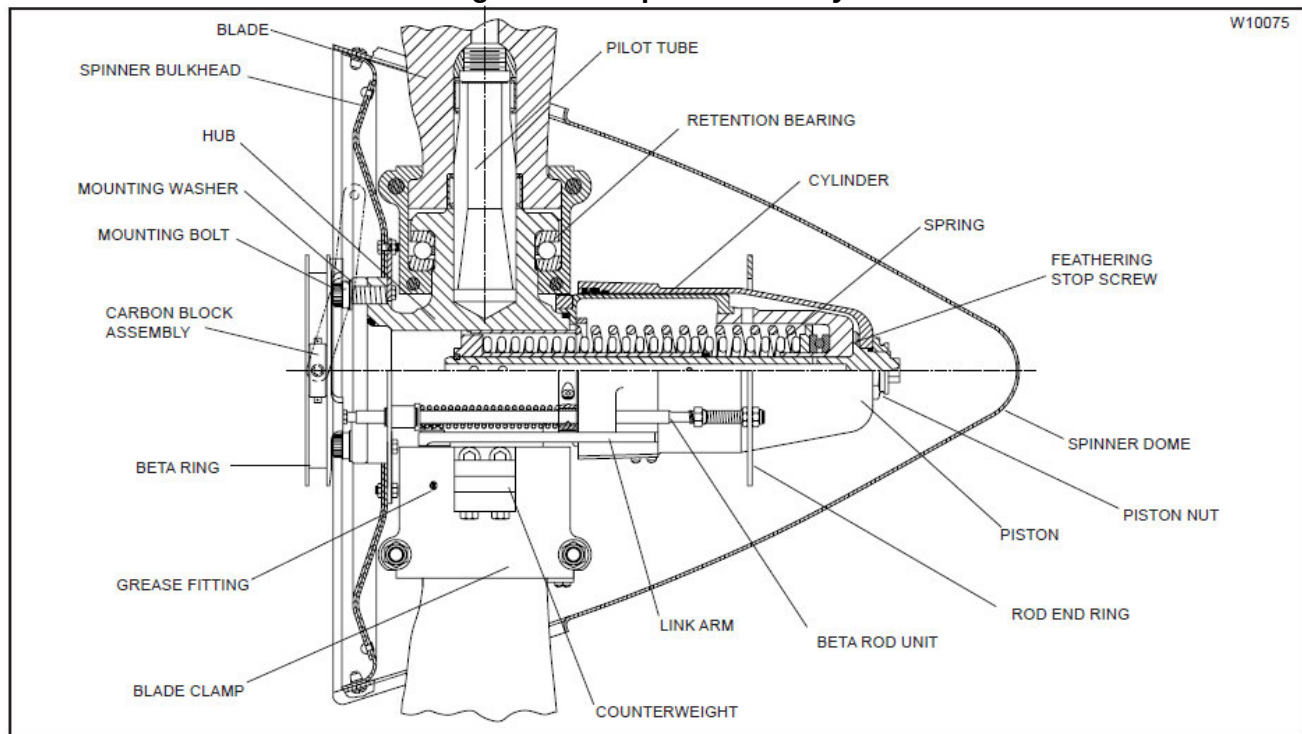
Propeller Description: The propellers examined are used on the PT6A-11 powered PA-31T1 Cheyenne and are 93.5" diameter, 3-blade, single-acting, hydraulically operated, constant speed models with feathering and reversing capabilities. Oil pressure from the propeller governor is used to move the blades 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. 820 and Aircraft TCDS A8EA for the propeller settings referenced below:

(Angles referenced at the 42-inch radius)

Reverse:	-11.0 ± 0.5 degrees
Low Pitch/Beta Pick-Up:	20.2 ± 0.1 degrees
Feather:	87.0 ± 0.5 degrees
Counterweight:	Positive

Figure 1 – Propeller Cutaway Sketch



PROPELLER EXAM FACTUAL FINDINGS**Position** **Right****Propeller Model:** HC-B3TN-3B with T10173NB-8 blades**Propeller Assembly S/N:** BUA27227

Service History: The propeller assembly included a hub and blades that had been replaced over time for unknown reasons. Time Since New for each individual component could not be determined with the logbook information available at the time of this examination. Propeller logbook records implied the propeller was last overhauled by Rocky Mountain Propeller on or about February 2014. It was last inspected on November 25, 2019 at a Hobbs Time of 4696.8 hours. TSO times below are based on that aircraft date/time.

	<u>S/N</u>	<u>Date of Manufacture</u>	<u>TTSN</u>	<u>TSO</u>
Hub/Factory	C4846A	4/11/2003	Unknown	385.6
Blade R1	K92399	9/16/09	Unknown	385.6
Blade R2	K92403	9/16/09	Unknown	385.6
Blade R3	K92401	9/16/09	Unknown	385.6

Blade Orientation: The blades were identified as 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 propeller was presented for examination while still attached to the engine propeller shaft flange as shown in Photo #2. All mounting hardware appeared intact and present. The beta arm was in the proper position under the guide pin and the beta block was in the beta ring. The de-ice slip ring potting compound was consumed and the slip rings were resting loose around the mounting flange area. No attempt was made to remove the propeller from the engine propeller flange. The piston was in the feathered position. The propeller exhibited extensive thermal damage. The beta guide ring was mostly consumed. The piston had a hole burned/melted through adjacent to R2. Blade R1 was thermally consumed ~13” outboard of the clamp and was in the feathered position. Blade R2 was thermally consumed ~21” outboard of the clamp and was in the feathered position. Blade R3 bent/curled aft and opposite rotation and also in the feathered position. Blade R3 had leading edge gouges and buckling wave bends along the trailing edge. There were no visible slip indicators on the clamps but blade R3 appears to have been forcibly slipped toward low pitch. All three link arms were present and attached at both the link screw and link pin locations. The beta guide rod collar was gouged by all three link arms in a similar fashion. The spinner dome was mostly consumed and all three counterweight assemblies were present and secure. Photo #7 shows the propeller prior to disassembly with components numbered.

Spinner Dome: The spinner dome was thermally consumed and only small remnants remained between two blade clamps.

Spinner Bulkhead: The spinner bulkhead was partially consumed by the post-crash fire and appeared bent aft in some areas.

Propeller Cycling: Propeller cycling was not attempted due to thermal damage of the piston.

Engine/Propeller Mounting: The propeller mounting flange appeared intact with all mounting hardware present. There was no attempt to remove the propeller from the engine propeller mounting flange.

Blade/Clamp Rotation: (all link arms remained attached preventing any clamp rotation prior to disassembly)

Blade	Blade/clamp Angle As-Received	Blade Slip in Clamp?	Rotation of clamp possible?
R1	Feathered	No	No
R2	Feathered	No	No
R3	Feathered	Yes – toward low pitch	No

Pitch Stops:

Low Pitch/Reverse Stop: The beta rods and pick-up nuts were present but had heat discoloration. The beta guide ring was consumed. The reverse stop sleeve(s) were not removed or observed.

Feather Stop Screws: The feather stop screws appeared intact and undamaged but were charred/sooted. (see Photo #8).

Piston: The piston was in the feathered position when presented for examination with a hole burned through the piston wall adjacent to blade R2. The piston nut was intact but loose. There were a few circumferential marks on the internal surface likely made by contact with the top corner of the cylinder during initial impact and following impact sequence (see Photo #9). The marks measurements and interpretation are presented in the following Table #1.

Table #1 - Summary of Piston Impact Signatures

Internal Marks from Bottom Piston Edge	Approximate Equivalent Blade Angle	Pre-impact Confidence Level / Why?
1.47"	< reverse stop	Low – location suggests it was made after initial forceful rotation to low pitch
2.13"	7°	Medium –below the running flight idle blade angle of ~15° so likely made after initial impact

Aircraft Accident/Incident Report No.: 200420

Link Arms: All three link arms remained attached at their link screw and link pin attach points. All three link arms contacted the beta guide collar (Photo #11).

Link Arm	Link Arm Condition
R1	Charred/sooted, bent slightly in compression
R2	Charred/sooted with no remarkable damage
R3	Charred/sooted, bent slightly in compression

Cylinder: The cylinder was not removed from the hub during the examination and was charred/sooted from heat exposure. There were scuff marks on the cylinder wall at approximately 1.44" and 1.63" from the top corner (Photo #10).

Feathering Spring Assembly: The feathering spring was not removed or observed. However, the feathering spring appeared intact and compressed in the as-presented condition based on the presence of spring tension on the pitch change rod.

Pitch Change Rod: The pitch change rod was not removed or observed except for that portion forward the spring cup. Based on spring tension, it appeared the pitch change rod was intact with the spring retainers present.

Clamps and Counterweights: (see Photo #12) All three link screws appeared undamaged.

Clamp Pos.	Clamp S/N	Clamp Condition	Counterweight Condition
R1	EK2463	Charred/sooted, outboard lead-edge camber-side bolt ear fractured	Intact
R2	EK2299	Charred/sooted, outboard lead-edge face-side bolt ear fractured	Intact
R3	EE844	Charred/sooted, outboard lead-edge face-side bolt ear fractured	Intact

Hub Unit: The hub unit/spider remained intact but was heavily charred/sooted. The R1 blade could not be entirely removed from the hub. It appears the R1 pilot tube was being pulled from the hub during removal of the blade before movement stopped and prevented complete removal. The R2 pilot tube pulled from the hub during blade removal and remained lodged in the blade bore. The R3 pilot tube remained intact in the hub. The cylinder was intact and remained attached to the hub but was charred/sooted. The guide collar was intact but exhibited impact gouges at each of the three link arm/link screw locations due to forceful rotation to low pitch. The forward spring cup, pitch change rod and spring appeared intact and was not removed.

There were no impact marks on the blade butts or hub arm flanges that could be used for blade angle estimation.

Blade Properties: Photos #13 through #15 (all three blades showed charring, sooting and scorching heat discoloration and damage)

Blade # R1 – blade outboard of 14” from butt consumed/melted, blade could not be removed from hub

Camber side	Not remarkable other than heat damage
Face side	Not remarkable other than heat damage
Bend	Not remarkable, could not discern based on remaining blade
Twist	Not remarkable, could not discern based on remaining blade
Lead edge damage	Not remarkable, could not discern based on remaining blade
Trail edge damage	Melted/dripping appearance
Blade bearings	Intact, dry, heat discoloration
Butt/shank impact marks	Pilot tube bearing shoulder impact depression
De-Ice boot	Burned/consumed

Blade # R2 – blade outboard of 22” from butt consumed/melted

Camber side	Spanwise scoring in mid-blade region
Face side	Not remarkable other than heat damage
Bend	Aft
Twist	Toward low pitch
Lead edge damage	Not remarkable
Trail edge damage	Heat deformation
Blade bearings	Intact, dry, heat discoloration
Butt/shank impact marks	Pilot tube bearing shoulder impact depression
De-Ice boot	Burned/consumed

Blade # R3

Camber side	Chordwise/rotational scoring outboard half of blade
Face side	Not remarkable other than heat damage
Bend	Aft and opposite rotation curling
Twist	Curled toward low pitch
Lead edge damage	Gouging, material deformation neutral/toward low pitch
Trail edge damage	Gouged, torn, dented, buckling-type wave bends
Blade bearings	Intact, coked grease, heat discoloration ball spacer melted
Butt/shank impact marks	Pilot tube bearing shoulder impact depression
De-Ice boot	Burned/consumed

Photo #7 – Right propeller components numbered prior to disassembly



Photo #8 – Feather stop screws



Photo #9 – Representative impact marks on internal surface of piston



Photo #10 – Cylinder scuffing marks



Photo #11 - Right prop gouge in guide collar
(typical all three locations)



Photo #12 – Blade retention clamps



Photo #13 – Blade #R3 camber-side scoring



Photo #14 – R2 and R3 trail-edge view, compound bend and twist



Photo #15 – Blade R1 could not be removed from hub/pilot tube



Position**Left**

Propeller Model: HC-B3TN-3B with T10173B-8 blades
(no evidence of N-shank modification stamp on blades)

Propeller Assembly S/N: BUA27230

Service History: The propeller assembly included a hub and blades that had been replaced over time for unknown reasons. Time Since New for each individual component could not be determined with the logbook information available at the time of this examination. Propeller logbook records implied the propeller was last overhauled by Rocky Mountain Propeller on or about February 2014. It was last inspected on November 25, 2019 at a Hobbs Time of 4696.8 hours. TSO times below are based on that aircraft date/time.

	<u>S/N</u>	<u>Date of Manufacture</u>	<u>TTSN</u>	<u>TSO</u>
Hub/Factory	C4849A	4/11/2003	Unknown	385.6
Blade L1	F90716	8/18/1987	Unknown	385.6
Blade L2	F90718	8/18/1987	Unknown	385.6
Blade L3	F90717	8/18/1987	Unknown	385.6

Blade Orientation: The blades were identified as 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 fractured from the propeller shaft during the impact sequence, was recovered and shipped with the engines to PWC Engine Services in Bridgeport, WV for examination as shown in Photo #3. Because the propeller separated from the main wreckage it was not subjected to the post-crash fire as shown in the on-scene photos. The spinner dome was intact but dented. All three blades and clamps were in the feathered position. There were no slip indicators on the clamps. All three blades exhibited similar bending and twisting; curled aft, opposite rotation and toward low pitch. All three blades exhibited leading edge gouging and chordwise/rotational scoring on the camber side, outboard half of the blade. There were gouges in the guide collar from the link arm/link screws indicating forceful rotation toward low pitch. The beta ring was intact and all propeller mounting hardware was present and lockwired on the mount flange. The propeller is shown in Photo #17 with the spinner dome removed and components numbered prior to disassembly.

Spinner Dome: The spinner dome was intact but dented in some areas and torn on the forward side of one blade opening (see Photo #3). There was some pine/evergreen shrub debris around the propeller hub after removal of the dome. There was also some evidence of spiral scoring on the dome surface. There were no counterweight punctures or impressions in the dome that could aid in determination of blade angle.

Spinner Bulkhead: The spinner bulkhead was intact and the dome mounting flange adjacent to blade L1 was bent.

Propeller Cycling: Propeller cycling was not attempted due to lack of fixturing necessary to mount and pressurize the propeller.

Engine/Propeller Mounting: (see Photo #16) The engine shaft flange fractured from the engine shaft and remained attached to the propeller. The propeller mounting hardware was present and lockwired. No attempt was made to remove the engine shaft flange.

Blade/Clamp Rotation: All three link arms remained attached at their link screw and link pin attach points preventing any clamp rotation prior to disassembly.

Blade	Blade/clamp Angle As-Received	Blade Slip in Clamp?	Rotation of clamp possible?
L1	Feathered	NA, so slip indicator	Yes, after link arm disconnected
L2	Feathered	NA, so slip indicator	Yes, after link arm disconnected
L3	Feathered	NA, so slip indicator	Yes, after link arm disconnected

Pitch Stops:

Low Pitch/Reverse Stop: The beta pick-up nuts, beta guide ring, and beta rods appeared intact and undamaged. The reverse stop sleeves were not removed but appeared intact and undamaged.

Feather Stop Screws: The feather stop screws appeared intact and undamaged (not smashed/bent). (see Photo #18).

Piston: The piston external surface appeared intact and undamaged. It was removed without difficulty. The piston nut was intact and tight. There were several circumferential and scuff/drag marks on the internal surface made by contact with the top corner of the cylinder during the impact sequence (see Photos #19 and #20). The mark measurements and interpretation are presented in the following Table #2.

Table #2 - Summary of Piston Impact Signatures

Internal Marks from Bottom Piston Edge	Approximate Equivalent Blade Angle	Pre-impact Confidence Level / Why?
1.44" through	Lower than reverse stop	Low – location suggests it was made after initial forceful rotation to low pitch
1.69"	-8.5°	Low – location suggests it was made after initial forceful rotation to low pitch

Link Arms: All three link arms remained attached at their link screw and link pin attach points preventing any clamp rotation prior to disassembly. The cotter pin was intact at the link screw connection. Each link arm contacted the guide collar in a similar fashion as shown in Photo #21

Link Arm	Link Arm Condition
L1	Link screw hole elongated, nylon bushing smashed
L2	Nylon bushing smashed
L3	Nylon bushing smashed

Cylinder: The cylinder remained attached to the hub and was not removed from the hub during the examination. There was a crease/dent in the cylinder made by the bottom edge of the piston at approximately 1.63" from the top corner (see Photo #23).

Feathering Spring Assembly: The feathering spring forward retainer cup was forcefully pushed out of the cylinder attachment damaging the threads and leaving thread whiskers (see Photo #22). The feathering spring assembly was completely removed from the cylinder during this examination and appeared intact and undamaged other than the forward cup threads. The spring was intact with the rear spring keepers in place (Photo #25).

Pitch Change Rod: The pitch change rod appeared intact and undamaged and no attempt was made to remove it from the spring assembly (See Photo #25).

Clamps and Counterweights: (see Photo #24) All clamp bolts were present, secure and safetied.

Clamp Pos.	Clamp S/N	Clamp Condition	Counterweight Condition
L1	EE3979	Intact, link screw slightly marred/deformed on low pitch side	Intact
L2	EL456	Intact, link screw slightly marred/deformed on low pitch side	Intact
L3	EE4149	Intact, link screw slightly marred/deformed on low pitch side	Intact

Hub Unit: The hub unit/spider was intact. All three pilot tubes were intact and remained in the hub. All three blades were removed without difficulty. The cylinder remained attached to the hub. There was only one impression mark on a blade arm flange at blade #L1 (see Photo #26) corresponding to the "DEP" in the word "DEPTH" stamping on the blade butt. That mark was located on the face-side leading edge quadrant and indicated the blade was in a low pitch position at the time the mark was made. There were also clamp-to-hub impact marks on the trailing edge side of each blade arm. There were also contact marks on the blade arm where the link arm contacted from forceful rotation to low pitch.

Blade Properties: Photos #27 through #30

Blade # L1

Camber side	Chordwise/rotational scoring
Face side	Not remarkable
Bend	Aft and opposite rotation
Twist	Curled toward low pitch
Lead edge damage	Gouges with material deformation neutral/toward low pitch
Trail edge damage	Dents, gouges and tearing
Blade bearings	Intact, ball imprints in blade side race lead-edge/camber quadrant
Butt/shank impact marks	"DEP" letter transfer, pilot tube shoulder impact mark
De-Ice boot	Intact

Blade # L2

Camber side	Chordwise/rotational scoring
Face side	Not remarkable
Bend	Aft and opposite rotation
Twist	Curled toward low pitch
Lead edge damage	Gouges with material deformation neutral/toward low pitch
Trail edge damage	Dents, gouges and tearing
Blade bearings	Intact, ball imprints in blade side race lead-edge/camber quadrant
Butt/shank impact marks	Pilot tube shoulder impact mark
De-Ice boot	Intact

Blade # L3

Camber side	Chordwise/rotational scoring
Face side	Not remarkable
Bend	Aft and opposite rotation
Twist	Curled toward low pitch
Lead edge damage	Gouges with material deformation neutral/toward low pitch
Trail edge damage	Dents, gouges and tearing
Blade bearings	Intact, ball imprints in blade side race lead-edge/camber quadrant
Butt/shank impact marks	Pilot tube shoulder impact mark
De-Ice boot	Intact, cut by contact with spinner dome blade aperture

Photo #16 – Left propeller mounting flange area as-presented



Photo #17 – Left propeller components numbered prior to disassembly



Photo #18 – Left feather stop screws



Photo #19 – Left impact marks on internal surface of piston

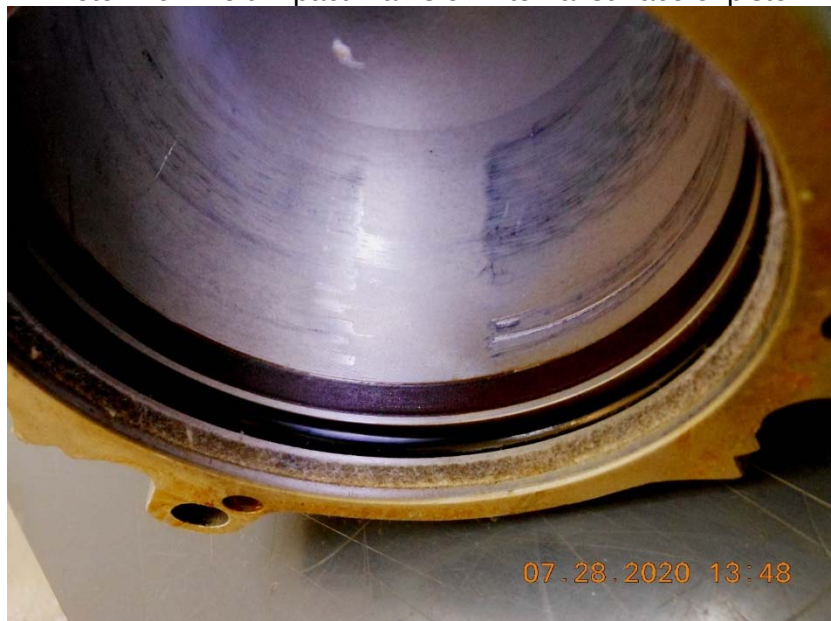


Photo #20 – Left impact marks on internal surface of piston (opposite side)



Photo #21 - Left guide collar gouge (typical three locations)



Photo #22 – Left forward spring cup forced from cylinder mount



Photo #23 – Left cylinder crease/dent from piston edge



Photo #24 – Left blade retention clamps and bearings



Photo #25 - Left feathering spring assembly



Photo #26 - Blade L1 hub arm flange letter transfer mark



Photo #27 – Blade L3 typical degree of gouging and scoring on camber side of tip region



Photo #28 – Left blades trail-edge view, compound bend and twist



Photo #29 – Left blades camber side of tip region



Photo #30 – Left blades face side of tip region



PHOTOGRAPHIC SUMMARY

NOTE: The following is a list of the original and unedited digital photographs. The photographs are available in digital format (CD, memory stick/card, FTP). The numbering sequence may not be chronological as some may have been deleted if out-of-focus, too dark, redundant, etc. Photos used in the text of this report are taken from photos on this list but may have been adjusted from the original. Modifications to images used in the report are limited to cropping, magnification, file compression, or enhancement of color, brightness, or contrast for the sole purpose to improve clarity of the report. No other alterations are permitted.

<u>Picture File Name</u>	<u>Description</u>
DSCN01071.JPG	Right propeller as-presented A
DSCN01072.JPG	Right propeller as-presented spinner dome fragments
DSCN01073.JPG	Right propeller as-presented B
DSCN01074.JPG	Right propeller mounting flange area A
DSCN01075.JPG	Right propeller mounting flange area B
DSCN01076.JPG	Right propeller beta arm and guide pin A
DSCN01077.JPG	Right propeller beta arm and guide pin B
DSCN01078.JPG	Right propeller beta arm and low pitch switch assembly A
DSCN01079.JPG	Right propeller beta arm and low pitch switch assembly B
DSCN01080.JPG	Right propeller components numbered prior to disassembly
DSCN01081.JPG	Right piston heat damage A
DSCN01082.JPG	Right piston internal surface as-removed
DSCN01083.JPG	Right piston internal surface impact marks A
DSCN01084.JPG	Right piston heat damage B
DSCN01085.JPG	Right cylinder
DSCN01086.JPG	Right link arm gouge on guide collar A
DSCN01087.JPG	Right link arm gouge on guide collar B
DSCN01088.JPG	Right link arm gouge on guide collar C
DSCN01089.JPG	Right link arm gouge on guide collar D
DSCN01090.JPG	Right link arm gouge on guide collar E
DSCN01091.JPG	Right link arm gouge on guide collar F
DSCN01092.JPG	Right feather stop screws A
DSCN01093.JPG	Right feather stop screws B
DSCN01094.JPG	Right feather stop screws C
DSCN01095.JPG	Right feather stop screws D
DSCN01096.JPG	Right piston hole
DSCN01097.JPG	Right piston internal surface impact marks B
DSCN01098.JPG	Right piston internal surface impact marks C
DSCN01099.JPG	Right piston feather stop screw marks
DSCN01100.JPG	R1 clamp A
DSCN01101.JPG	R1 clamp B
DSCN01102.JPG	R2 clamp

Aircraft Accident/Incident Report No.: 200420

DSCN01103.JPG	R3 clamp A
DSCN01104.JPG	R3 clamp B
DSCN01105.JPG	Right marks on cylinder A
DSCN01106.JPG	Right marks on cylinder B
DSCN01107.JPG	R1 link arm
DSCN01108.JPG	R2 link arm
DSCN01109.JPG	R3 link arm
DSCN01110.JPG	Right blades camber side/trail edge view A
DSCN01111.JPG	Right blades camber side/trail edge view B
DSCN01112.JPG	Right blades tip view
DSCN01113.JPG	Right blades shank view
DSCN01114.JPG	R3 face side A
DSCN01115.JPG	R3 face side B
DSCN01116.JPG	R1 blade camber side
DSCN01117.JPG	R1 blade possible extent of removal
DSCN01118.JPG	R3 blade arm flange and pilot tube
DSCN01119.JPG	Left propeller as-presented A
DSCN01120.JPG	Left propeller as-presented B
DSCN01121.JPG	Left propeller as-presented C
DSCN01122.JPG	Left propeller with spinner dome removed @ L1
DSCN01123.JPG	Left propeller with spinner dome removed @ L2
DSCN01124.JPG	Left propeller with spinner dome removed @ L3
DSCN01125.JPG	Left propeller piston/front view prior to disassembly
DSCN01126.JPG	Left mounting flange A
DSCN01127.JPG	Left mounting flange B
DSCN01128.JPG	Left spinner dome internal surface
DSCN01129.JPG	Left spinner dome external surface
DSCN01130.JPG	Left link arm gouge in guide collar @ L1 A
DSCN01131.JPG	Left link arm gouge in guide collar @ L1 B
DSCN01132.JPG	Left link arm gouge in guide collar @ L3
DSCN01133.JPG	Left link arm gouge in guide collar @ L2 A
DSCN01134.JPG	Left link arm gouge in guide collar @ L2 B
DSCN01135.JPG	Left cylinder and forward spring cup pulled from cylinder A
DSCN01136.JPG	Left cylinder and forward spring cup pulled from cylinder B
DSCN01137.JPG	Left feather stop screws A
DSCN01138.JPG	Left feather stop screws B
DSCN01139.JPG	Left piston internal surface A
DSCN01140.JPG	Left piston internal surface B
DSCN01141.JPG	Left mounting flange hardware A
DSCN01142.JPG	Left mounting flange hardware B
DSCN01143.JPG	Left piston internal surface marks A
DSCN01144.JPG	Left piston internal surface marks B
DSCN01145.JPG	Left piston internal surface marks C
DSCN01146.JPG	Left clamps and bearing races before link arm removal
DSCN01147.JPG	Left feathering spring assembly
DSCN01148.JPG	Left forward spring cup damaged threads
DSCN01149.JPG	Left clamps
DSCN01150.JPG	Left clamps, link arms and bearing races

DSCN01151.JPG	L1 link arm
DSCN01152.JPG	L2 link arm
DSCN01153.JPG	L3 link arm
DSCN01154.JPG	Left cylinder dent/crease A
DSCN01155.JPG	Left cylinder dent/crease B
DSCN01156.JPG	Left cylinder dent/crease C
DSCN01157.JPG	Left hub unit S/N
DSCN01158.JPG	L1 blade arm flange "DEP" letter transfer mark A
DSCN01159.JPG	L1 blade arm flange "DEP" letter transfer mark B
DSCN01160.JPG	L1 link arm gouge in guide collar and blade arm
DSCN01161.JPG	L3 link arm gouge in guide collar and blade arm
DSCN01162.JPG	L2 link arm gouge in guide collar and blade arm
DSCN01163.JPG	Left blades face side view A
DSCN01164.JPG	Left blades face side view B
DSCN01165.JPG	Left blades lead edge view
DSCN01166.JPG	Left blades trail edge view
DSCN01167.JPG	Left blades trail edge view from tip/ face side of tips
DSCN01168.JPG	L1 blade butt
DSCN01169.JPG	L2 blade butt
DSCN01170.JPG	L3 blade butt
DSCN01171.JPG	L2 blade decal with Rock Mountain Propeller decal
DSCN01172.JPG	Left blades shanks
DSCN01173.JPG	Left blades tip/camber side
DSCN01174.JPG	Left blades tip/camber chordwise/rotational scoring
DSCN01175.JPG	L3 lead edge gouging
DSCN01176.JPG	L2 lead edge gouging
DSCN01177.JPG	L1 lead edge gouging
DSCN01178.JPG	Left blades tip/face side
DSCN01179.JPG	R3 v. L2 comparison A
DSCN01180.JPG	R3 v. L2 comparison B