

Date of Accident: December 8, 2017

Location: Geneva, FL near Orlando Sanford International (KSFB)

NTSB File No.: WPR18FA045

Aircraft: Beechcraft C90 King Air

Registration No.: N19LW

Serial No.: LJ-991 (Year of Manufacture 1981)

Operator: per FAA registry:
Plane Marketing LLC
[REDACTED]
Vero Beach, FL 32968-9519

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

Report Date: February 23, 2018

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PROPELLER TEARDOWN REPORT

Date of Investigation: February 21-22, 2018

Location: Florida Air Recovery
[REDACTED]
Jacksonville, FL 32225

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

Representatives:	Les Doud	Hartzell Propeller Inc. ASI
	Josh Cawthra	NTSB Investigator in Charge
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	Steve Reindel	Hartzell Senior Tech Rep.

ACCIDENT SYNOPSIS

The following is excerpted from the NTSB preliminary report.

"On December 8, 2017, about 1115 eastern standard time, a Beech C90, N19LW, was destroyed when it impacted the waters of Lake Harney, near Geneva, Florida. The airplane was registered to Planemarketing LLC, Vero Beach, Florida, and operated by L3 Airline Academy as CONN900 as a 14 Code of Federal Regulations Part 91 instructional flight. The Flight Instructor and two commercial pilots receiving instruction were fatally injured. Instrument and visual meteorological conditions prevailed in the area, and an instrument flight rules flight plan was filed for the flight, which originated from Sanford, Florida, about 0753.

Review of preliminary information provided by the Federal Aviation Administration revealed that following an uneventful flight to Milledgeville, Georgia, the flight returned to the Orlando Sanford International Airport (SFB) and conducted a practice instrument approach to runway 09. After the flight completed the instrument approach, the active runway was changed to 27R and Air Traffic Control (ATC) controllers vectored the flight for a practice ILS Runway 27R instrument approach. About 2 minutes after the flight was given a vector to intercept the localizer and cleared for the approach, the controller issued a low altitude alert and advised the flight to climb to 1,600 feet. Following a second low altitude alert with instructions to immediately climb to 1,600 feet, the flight responded that "I am sir, I am." Shortly after, radar and radio communication with the accident airplane was lost.

A witness, who was located on a boat near the north end of Lake Harney reported hearing a low flying airplane approach his position at a low altitude. The witness stated that he could not see the airplane initially due to low clouds and light ground fog, however, he observed the airplane below the cloud ceiling at 250 to 300 feet above ground level, and then climb rapidly. The witness further stated that they were looking in the general direction of the engine noise when they observed the airplane dive vertically into the lake south of their position.

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The wreckage was recovered from Lake Harney and transported to a secure location for further examination.”

According to recovery personnel the propellers were buried several feet into the lake bottom which consisted of shells and mud. The lake contained brackish water and the propellers were submerged for approximately two days.

Aircraft Damage: Destroyed
Injuries: Three onboard; one CFI and two students, all three fatal injuries

SUMMARY AND ANALYSIS OF FINDINGS

The propellers from the accident aircraft were recovered and presented for examination at Florida Air Recovery in Jacksonville, FL. The propellers were examined on February 21 and 22, 2018. The propellers were disassembled to assess the condition of and damage to the propellers as-recovered.

Both propellers exhibited similar damage; blades bent aft, bent opposite rotation and twisted leading edge down (Photo #1). Additionally, the hydraulic unit and spinner dome were separated from both propellers in a similar fashion.

In addition to examining the propellers, the engine controls and instruments were examined for power and RPM information. The engine instruments suggested power and RPM at the time of impact with the tachometers frozen at 2000 RPM for left and 1940 for the right propellers (Photo #2).

CONCLUSIONS

There were no discrepancies noted that would prevent or degrade normal propeller operation prior to impact with water. All damage on the propeller components examined was consistent with high impact forces. Propeller blade damage indicated the propeller was rotating with power on.

Photo #1 – Blade damage symmetry



Photo #2 – Engine Instruments as-recovered

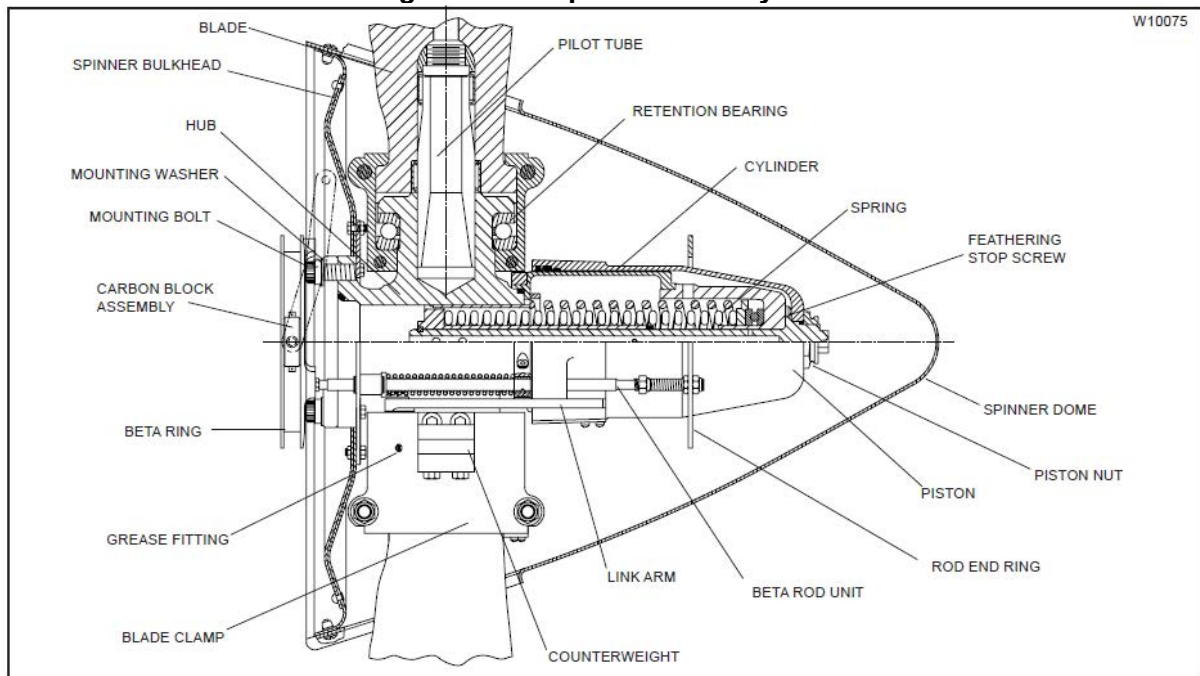


GENERAL INFORMATION

Propeller Description: The C90 propellers examined are 93.5-inch diameter, 3-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 provide moments and forces 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. See Figure 1 for a Propeller Cutaway Sketch.

Installation Data: Refer to Hartzell Installation Data Sheet No. 2623 and Aircraft TCDS 3A20 for propeller settings referenced below (blade angles are measured at the 30-inch radius):

Reverse:	-11.0 ± 0.5 degrees
Low Pitch:	20.2 ± 0.2 degrees
Flight Idle:	Adjusted for installed torque at 2000 RPM
Secondary Idle:	Adjusted for 210 RPM higher at 70% N_1 (when installed)
Feather:	87.0 ± 0.5 degrees
Counterweight:	Positive

Figure 1 – Propeller Cutaway Sketch

PROPELLER FACTUAL FINDINGS**Position** Right**Propeller Model:** HC-B3TN-3B with T10173NB-8 blades**Propeller Assembly S/N:** BUA28707

Service History: The propeller was last overhauled on 12/19/16 by Sunstate Propeller Inc. in St. Petersburg, FL. The last propeller service was a Beechcraft Phase 4 inspection conducted on 10/13/17 by Aeronautical Repairs.

	<u>S/N</u>	<u>Date of Manufacture</u>	<u>TTSN</u>	<u>TSO</u>
Hub/Factory	C6663A	4/22/04	4346.2	595.0
Blade R1	K02979	4/5/04	4346.2	595.0
Blade R2	K02976	4/5/04	4346.2	595.0
Blade R3	K02978	4/5/04	4346.2	595.0
Note 1: Times are at inspection conducted on 10/13/17				

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 right propeller as recovered and presented for examination is shown in Photo #3. The propeller had fractured from the engine propeller shaft; the propeller shaft flange remained attached to the propeller with all bolts present and saftied. The hydraulic unit, spinner components and all the beta system hardware had separated and were not recovered. Blade R2 fractured from the assembly near the top of the balance bore and the fractured portion of the blade was recovered at the crash scene aircraft wreckage field. Blades R1 and R3 appeared to be bent aft and twisted leading edge down. Blade R3 appeared to have slipped in the clamp approximately 180°.

Spinner Dome: The spinner dome was not presented for examination, presumably not recovered.

Spinner Bulkhead: The spinner bulkhead and de-ice slip-ring were not presented for examination, and presumably not recovered. The spinner bulkhead mounting plate remained attached to the hub unit and was bent.

Propeller Cycling: Propeller cycling was not possible due to the absence of the hydraulic unit and pitch change components.

Engine/Propeller Mounting: The engine propeller shaft flange fractured from the propeller shaft and remained attached to the propeller. The propeller mounting flange appeared to be intact with all six mounting bolts present and safety-wired.

Blade/Clamp Rotation:

Blade	Blade/clamp Angle As-Received	Blade Slip in Clamp?	Rotation of clamp possible?
R1	Clamp/counterweight was in a position/angle higher than feathered position.	The blade appears to have slipped approximately 30-40° towards low pitch.	Yes
R2	Clamp/counterweight was near but slightly lower than feathered position.	The blade appears to have slipped approximately 40° towards low pitch.	Yes
R3	Clamp/counterweight was near the feathered position.	The blade appeared to have slipped approximately 180° towards low pitch (Photo #4)	Yes

Hydraulic Unit and Pitch Change Mechanism: As shown in Photo #3, the hydraulic unit (cylinder and piston) and all pitch change mechanism (pitch change rod, pitch stops, link arms, beta rods and beta ring) hardware was missing and presumed not recovered. One feathering spring assembly was recovered on the lake bed but it wasn't determined which propeller it came from (Photo #5).

Clamps and Counterweight Condition: (Photo #6). All the clamps appeared to be coated with a brownish-yellow substance that was not identified.

Clamp Pos.	Clamp S/N	Clamp Condition	Counterweight Condition
R1	EK6387	Intact, all bolts safetied, top of link screw sheared towards low pitch	Intact, gouges on inboard, trailing edge corner/edge
R2	EK6535	Intact, all bolts safetied, head of link arm cotter pin sheared	Intact
R3	EK6544	Intact, all bolts safetied, top of link screw sheared towards low pitch	Intact, gouge on inboard, trailing edge corner/edge

Hub Unit: The hub unit had some surface corrosion, primarily on and around threaded areas and areas where the cadmium plating was removed or damaged. Some areas of the hub appeared to be coated with the same unidentified brownish-yellow substance as the clamps. The mounting flange appeared intact and undamaged. The propeller shaft flange remained attached to the hub with safety wire present at all eight bolts (Photo #7). The safety wire was removed but no attempt was made to remove the mounting bolts and prop shaft flange. The cylinder attachment boss and threads appeared intact and undamaged.

There were several material transfer marks from blade butts. There was an impact crescent mark in the trailing edge quadrant on the R3 blade arm flange (Photo #8). There were crescent impact marks in the trailing edge and leading edge of the R1 blade arm flange. The pilot tube was jammed into the blade butt/shank of the R1 blade and pulled out of the hub arm when the blade shank was removed from the assembly. There were impact crescents in the aft/face/trailing edge quadrant on the R1 blade arm flange.

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The impact marks on blade butt and hub arms were evaluated for possible determination of pre-impact blade angle. None of the marks were considered useful for pre-impact blade angle determination due to the amount of blade-clamp slippage that occurred during the impact sequence.

Blade Properties: Photos #9 through #11

Blade # R1

Camber side	Chordwise/rotational paint abrasion
Face side	Chordwise/rotational scoring
Bend	Aft and opposite rotation
Twist	Leading edge down
Lead edge damage	Not remarkable
Trail edge damage	Not remarkable
Blade bearings	Corroded
Butt/shank impact marks	Crescent impact "smiles" in all quadrants, pilot tube shoulder impression
De-Ice boot	Intact

Blade # R2 – This blade was fractured 3.5-4.5" from the blade butt, it appeared to be an overload fracture in the aft direction (Photo #12)

Camber side	Chordwise/rotational scoring
Face side	Chordwise/rotational scoring near tip
Bend	S-bending characteristics (Photo #11)
Twist	Leading edge down
Lead edge damage	Not remarkable
Trail edge damage	Nicks and gouges mid-blade
Blade bearings	Hub-side races fracture/crack with ball imprints in the forward/leading edge quadrant (Photo #13)
Butt/shank impact marks	Crescent impact "smile" in the trailing edge/face side quadrant
De-Ice boot	Torn

Blade # R3

Camber side	Paint abrasion, leading edge chordwise/rotational scrapes/dents
Face side	Chordwise/rotational scoring near tip
Bend	Aft and opposite rotation
Twist	Leading edge down
Lead edge damage	Gouges and nicks
Trail edge damage	Buckling, waviness
Blade bearings	Corroded, hub-side race cracked
Butt/shank impact marks	Impact "smile" in leading edge quadrant
De-Ice boot	Torn near outboard end

Photo #3 – Right propeller as-presented



Photo #4 – Right propeller as-presented



Photo #5 – Feathering spring recovered with aircraft wreckage



Photo #6 – Right propeller clamps

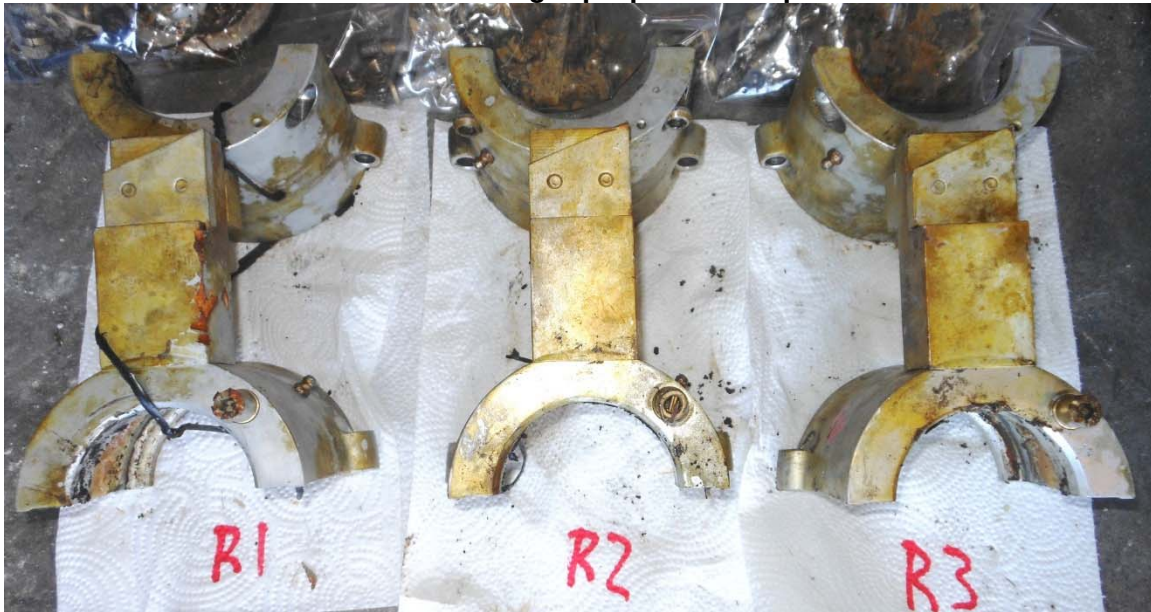


Photo #7 – Right propeller shaft mounting flange and hardware



Photo #8 – R3 blade arm impact crescent mark



Photo #9 – Right propeller blades face side view



Photo #10 – Right propeller blades camber side view



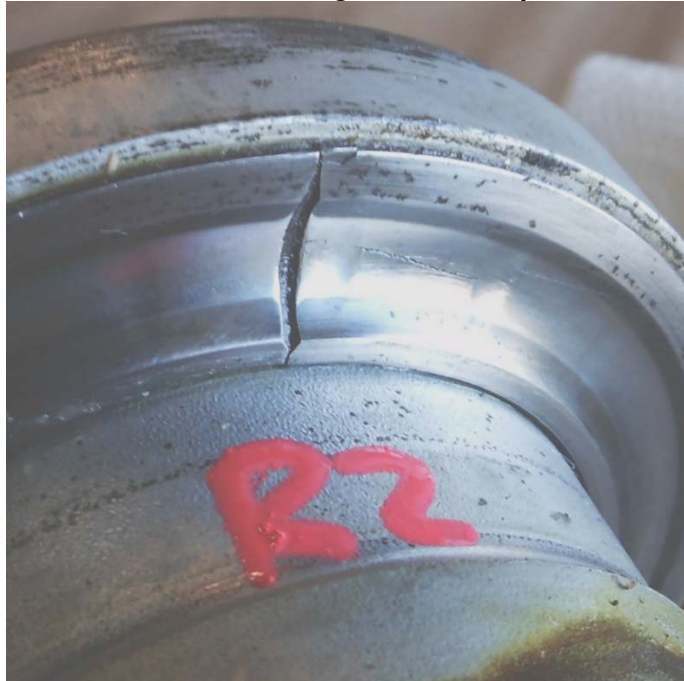
Photo #11 – Blade R2 bending characteristics



Photo #12 – Blade R2 fracture surface



Photo #13 – Blade R2 bearing race ball imprints and cracks



Position **Left**

Propeller Model: HC-B3TN-3B with T10173B-8 blades (No N-Shank Mod)

Propeller Assembly S/N: BUA28767

Service History: The propeller was last overhauled on 12/19/16 by Sunstate Propeller Inc. in St. Petersburg, FL. The last propeller service was a Beechcraft Phase 4 inspection conducted on 10/13/17 by Aeronautical Repairs.

	<u>S/N</u>	<u>Date of Manufacture</u>	<u>TTSN</u>	<u>TSO</u>
Hub/Factory	C6770A	4/22/04	4346.2	595.0
Blade L1	F86700	3/23/87	8597.8	595.0
Blade L2	F86698	3/23/87	8597.8	595.0
Blade L3	F85174	3/23/87	8597.8	595.0
Note 1: Times are at inspection conducted on 10/13/17				

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 left propeller as recovered and presented for examination is shown in Photos #14 and #15. The propeller had fractured from the engine propeller shaft; the propeller shaft flange remained attached to the propeller with all bolts present; some bolt heads and safety wire were damaged. The hydraulic unit, spinner dome and most of the beta system hardware had separated and were not recovered (Photo #16). All three blades were bent aft, twisted leading edge down and appeared to have slipped in the clamps towards low pitch. Blade L2 had a fractured tip; the fractured segment was not recovered. Blades L1 and L3 had leading edge gouges.

Spinner Dome: The spinner dome was not presented for examination and presumably not recovered.

Spinner Bulkhead: The spinner bulkhead and de-ice slip-ring remained attached to the propeller assembly but were torn and bent as show in Photos #15 and #18. There was a clamp bolt gouge in the spinner bulkhead adjacent to blade L2.

Propeller Cycling: Propeller cycling was not possible due to the absence of the hydraulic unit and pitch change components.

Engine/Propeller Mounting: The engine propeller shaft flange fractured from the propeller shaft and remained attached to the propeller. The propeller mounting flange appeared to be intact with all six mounting bolts present but with damage to the bolt heads and some safety wire (Photo #18). There was severe corrosion on the flange and some mounting bolts.

Blade/Clamp Rotation:

Blade	Blade/clamp Angle As-Received	Blade Slip in Clamp?	Rotation of clamp possible?
L1	Clamp/counterweight was in a position higher than the feathered position.	The blade appears to have slipped approximately 90° towards low pitch.	Yes but stiff, required mallet to rotate.
L2	Clamp/counterweight was near the feathered position.	The blade appears to have slipped approximately 90° towards low pitch.	Yes but stiff, required mallet to rotate.
L3	Clamp/counterweight was in a position/angle in the normal range of operation.	The blade appeared to have slipped approximately 45° towards low pitch.	Yes but stiff, required mallet to rotate.

Hydraulic Unit and Pitch Change Mechanism: Similar to the right propeller, the hydraulic unit (cylinder and piston) and all pitch change mechanism (pitch change rod, pitch stops, link arms, and beta rods) hardware was missing and presumably not recovered (Photo #16). The beta ring remained jammed in between the propeller mounting flange and the de-ice slip ring conductors and was bent and smashed in some areas as shown Photo #18.

Clamps and Counterweights: (Photo #17). All the clamps appeared to be coated with a brownish-yellow substance that was not identified.

Clamp Pos.	Clamp S/N	Clamp Condition	Counterweight Condition
L1	EL8131	Intact, all bolts safetied, top of link screw sheared towards low pitch	Intact, nick on inboard, trailing edge corner/edge
L2	EL8063	Intact, all bolts safetied, top of link screw fractured toward low pitch	Intact, nicks and gouges on inboard leading edge corner
L3	EL8076	Intact, all bolts safetied, top of link screw sheared towards low pitch	Intact, gouge on inboard, trailing edge corner/edge

Hub Unit: The hub unit had some surface corrosion, primarily on and around threaded areas and areas where the cadmium plating was removed or damaged. Some areas of the hub appeared to be coated with the same unidentified brownish-yellow substance as the clamps. The mounting flange appeared intact and undamaged. The propeller shaft flange remained attached to the hub with all eight bolts present (Photo #18). The safety wire was removed but no attempt was made to remove the mounting bolts and prop shaft flange. The cylinder attachment boss and threads appeared intact and undamaged. The L2 pilot tube was fractured and a portion remained in the hub arm.

There were several impression marks from blade butts. There was an impact crescent mark in the aft/face and aft/face leading edge quadrant on the L3 blade arm flange. There were crescent impact marks in the aft/face trailing edge and leading edge quadrants of the L1 blade arm flange as shown in Photo #19. There were impact crescents in the aft/face/leading edge quadrant on the L2 blade arm flange.

The impact marks on blade butt and hub arms were evaluated for possible determination of pre-impact blade angle. None of the marks were considered useful for pre-impact

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blade angle determination due to the amount of blade-clamp slippage that occurred during the impact sequence.

Blade Properties: Photos #20 through #22

Blade # L1

Camber side	Paint abrasion, some score marks ~9-10" from tip
Face side	Chordwise/rotational scoring tip area (Photo #22), paint abrasion mid-blade
Bend	Aft and opposite rotation
Twist	Leading edge down
Lead edge damage	Leading edge fractured at tip, gouged, nicks and dents
Trail edge damage	Compression wrinkling/buckling near tip
Blade bearings	Hub side race fractured, ball imprints on camber side (Photo #23)
Butt/shank impact marks	Face side/trailing edge quadrant crescent impact "smile," pilot tube shoulder impression
De-Ice boot	Torn off, only small fragment remains near butt

Blade # L2 – Approximately 6-8" of tip fractured

Camber side	Chordwise/rotational abrasion
Face side	Chordwise/rotational scoring near fracture
Bend	Aft, opposite rotation
Twist	Leading edge down
Lead edge damage	Nicks, gouges
Trail edge damage	Not remarkable
Blade bearings	Hub-side race fractured
Butt/shank impact marks	Crescent impact "smile" in the face side quadrant, blade slip shaving material damned-up at end point, fragment of fractured pilot tube jammed in pilot tube/balance bore
De-Ice boot	Torn near butt

Blade # L3

Camber side	Paint abrasion mid-blade to tip
Face side	Random abrasion, scratches
Bend	Aft, opposite rotation
Twist	Lead edge down
Lead edge damage	Gouges and nicks
Trail edge damage	Buckling, waviness near tip
Blade bearings	Hub-side race cracked, ball imprints
Butt/shank impact marks	Impact "smile" in face side quadrant
De-Ice boot	Not remarkable

Photo #14 – Left propeller as-presented



Photo #15 – Left propeller as-presented



Photo #16 – Left propeller clamps



Photo #17 – Left propeller clamps



Photo #18 – Left propeller shaft mounting flange and hardware



Photo #19 – L1 blade arm impact crescent mark



Photo #20 – Left propeller blades face side view



Photo #21 – Left propeller blades camber side view



Photo #22 – Blade L1 face side chordwise/rotational scoring



Photo #23 – Blade L1 bearing race ball imprints and cracks



LIST OF PHOTOS

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>
DSCN7079.JPG	Right propeller as-presented A
DSCN7080.JPG	Right propeller as-presented B
DSCN7081.JPG	Left propeller as-presented A
DSCN7082.JPG	Left propeller as-presented B
DSCN7083.JPG	Left propeller aft side of bulkhead, slip ring, mounting flange
DSCN7084.JPG	R3 blade position in clamp
DSCN7085.JPG	R2 blade position in clamp
DSCN7086.JPG	Right propeller shaft flange and mounting hardware
DSCN7087.JPG	L3 blade position in clamp
DSCN7088.JPG	L2 blade position in clamp
DSCN7089.JPG	L1 blade position in clamp
DSCN7090.JPG	Right S/N and model
DSCN7091.JPG	Left S/N and model
DSCN7092.JPG	Left spinner bulkhead aft side
DSCN7093.JPG	Left spinner bulkhead front side
DSCN7094.JPG	Right blades face side
DSCN7095.JPG	Left blades face side
DSCN7096.JPG	R1 blade butt
DSCN7097.JPG	R2 blade butt
DSCN7098.JPG	R3 blade butt
DSCN7099.JPG	L1 blade butt
DSCN7100.JPG	L2 blade butt
DSCN7101.JPG	L3 blade butt
DSCN7102.JPG	Right blades camber side A
DSCN7103.JPG	Left blades camber side
DSCN7104.JPG	Left clamps
DSCN7105.JPG	Left hardware bags
DSCN7106.JPG	Right clamps
DSCN7107.JPG	Right hardware bags
DSCN7108.JPG	R2 blade arm flange
DSCN7109.JPG	R1 blade arm flange
DSCN7110.JPG	R3 blade arm flange
DSCN7111.JPG	L1 blade arm
DSCN7112.JPG	L1 blade face side
DSCN7113.JPG	L1 hub bearing races
DSCN7114.JPG	L3 blade face side

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DSCN7115.JPG	L3 leading edge damage
DSCN7116.JPG	R2 blade leading edge view
DSCN7117.JPG	R2 blade trailing edge view
DSCN7118.JPG	R2 hub side bearing race A
DSCN7119.JPG	R2 hub side bearing race B
DSCN7120.JPG	R2 blade fracture surface OB side A
DSCN7121.JPG	R2 blade fracture surface IB side A
DSCN7122.JPG	R2 blade fracture surface OB side B
DSCN7123.JPG	R2 blade fracture surface IB side B
DSCN7124.JPG	R1 blade face side
DSCN7125.JPG	R3 blade arm flange impact mark location
DSCN7126.JPG	R1 blade arm flange impact mark location
DSCN7127.JPG	R2 blade arm flange impact mark location
DSCN7128.JPG	Left blades camber side
DSCN7129.JPG	Left blades leading edge view
DSCN7130.JPG	L1 blade camber side paint abrasion
DSCN7131.JPG	L2 and L3 blades camber side
DSCN7132.JPG	L2-L3-L1 estimated impact sequence
DSCN7133.JPG	Right blades camber side B
DSCN7134.JPG	Right blades leading edge view
DSCN7135.JPG	Right blades trailing edge view
DSCN7136.JPG	Feathering spring
DSCN7137.JPG	Power controls quadrant A
DSCN7138.JPG	Power controls quadrant B
DSCN7139.JPG	Aircraft overall wreckage A
DSCN7140.JPG	Aircraft overall wreckage B
DSCN7141.JPG	Aircraft tail wreckage
DSCN7142.JPG	Power instruments A
DSCN7143.JPG	Power instruments B
DSCN7144.JPG	Aircraft overall wreckage C
DSCN7145.JPG	Aircraft overall wreckage D
DSCN7146.JPG	Aircraft overall wreckage E
DSCN7147.JPG	Aircraft overall wreckage F