

Date of Accident: September 28, 2021

Location: Eagle River, WI

NTSB File No.: CEN21FA459

Aircraft: Rockwell Commander 690B

Registration No.: N690LS

Serial No.: 11475 (Year of Manufacture 1978)

Operator: per FAA registry:
SURDEX Corporation
520 Spirit of St. Louis Blvd.
Chesterfield, MO 63005-1002

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

Report Date: May 9, 2022

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PROPELLER EXAMINATION REPORT

Date of Investigation: November 2-3, 2021

Location: Myers Aviation Inc.
545 E Perimeter Road
Oshkosh, WI 54902

Propeller Model: HC-B3TN-5FL with LT10673B blades

Representatives:

Les Doud	Hartzell Propeller Inc.
Aaron Sauer	NTSB Investigator in Charge
Tim Spreen	FAA Milwaukee FSDO ASI
Jay Eller	Honeywell ASI
Brian Harbaugh	Twin Commander
John Boeding	Surdex Corp.

ACCIDENT SYNOPSIS

The following is excerpted from the NTSB preliminary report.

“On September 28, 2021, about 0900 central daylight time, a Rockwell International 690B airplane, N690LS, was destroyed when it was involved in an accident near Hiles, Wisconsin. The pilot and two passengers sustained fatal injuries. The airplane was operated as a Title 14 Code of Federal Regulations Part 91 aerial imagery survey flight.

According to the operator, the flight mission was to obtain aerial imagery of the forest vegetation for the Wisconsin Department of Natural Resources.

Preliminary automatic dependent surveillance-broadcast information (ADS-B) revealed the airplane departed the Rhinelander-Oneida County Airport, Rhinelander, Wisconsin, about 0850. About 0858, the airplane began to level off about 15,600 ft with a maximum groundspeed of 209 knots (kts). Between 0858 and 0900, the airplane continued level flight; however, the groundspeed decreased to about 93 kts. The ADS-B data ended at 0900:56 (see Figure 1.). According to air traffic control, a “mayday, mayday, mayday...we’re in a spin” transmission was broadcast. The airplane was not under air traffic control during the flight or at the time of the accident.

A witness, located about one mile from the accident site, reported he heard a “loud, strange sounding airplane.” He looked up and noticed an airplane “nose down at high rate of speed spinning about its longitudinal axis at about 30 to 60 rpm.” The witness lost sight of the airplane behind some trees and then heard an impact. The airplane wreckage was located during an aerial and ground search in wetlands and wooded terrain about 10 miles east of Eagle River, Wisconsin, and 1 mile west of Butternut Lake, in the Chequamegon-Nicolet National Forest. The wreckage was distributed in a diameter of about 50 yards. A majority of the main wreckage was found beneath the water surface with some debris located in the trees. The airplane wreckage was recovered for further examination.”

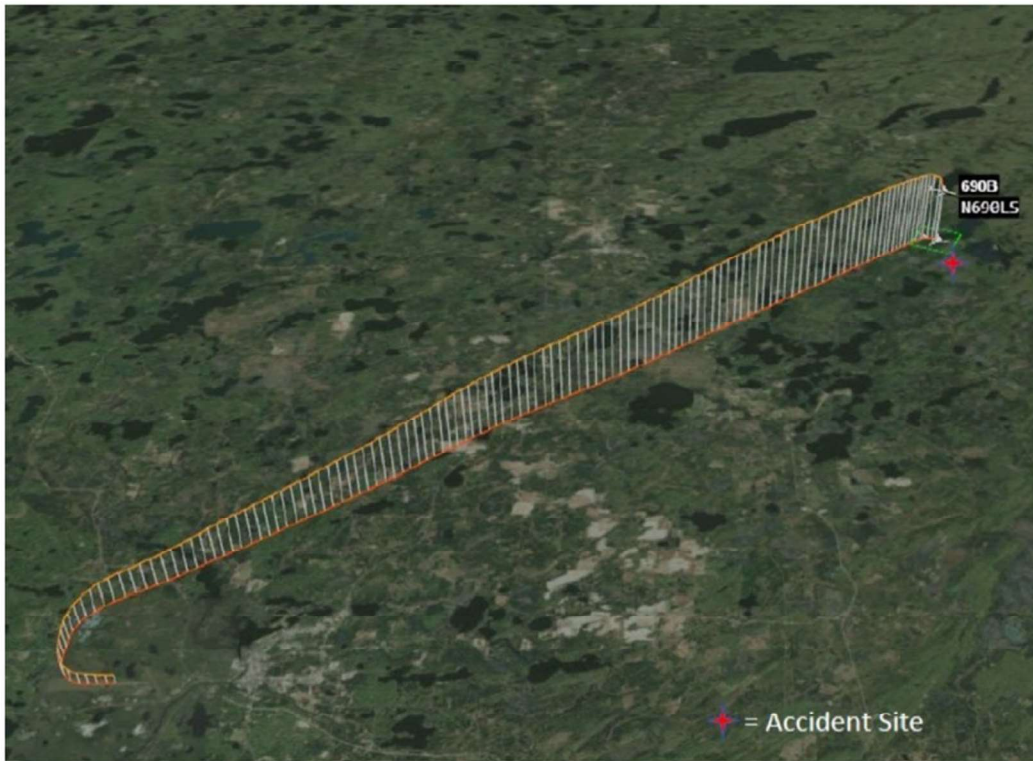


Figure 1. Airplane Flight Path and Accident Site Location

SUMMARY AND ANALYSIS OF FINDINGS

Both left and right propeller hubs and all six blades were recovered at the main wreckage site and presented for examination at Myers Aviation in Oshkosh, WI on November 2-3, 2021. The propellers were disassembled to inspect damage and look for indications of power state at time of impact. The hydraulic units on each propeller were not recovered and eliminated a possible source of blade angle information.

The comparison of bending and twisting between left and right propellers showed similar degrees and some similar characteristics, predominately aft bending and twisting to low pitch (Photo #1). Damage was consistent with rotation under low power at impact and suggested relative power symmetry.

Signatures of rotation under power on both propellers included blades separating from the clamps, pilot tube fractures, clamp fractures, compound blade bending and twisting, and leading edge gouging. Additional signatures of power were a tip fracture on the right propeller and shearing of one blade's retention radius on the left propeller.

Impact crescent marks on both the left and right propeller blade butts were of similar location and depth, also suggesting some symmetry (Photo #7 vs. Photo #17). The location of the blade butt marks indicated the impact loads were primarily in the aft direction (not helical) suggesting a low blade angle, low power and relatively steep impact angle at moderate airspeed.

Photo #1 – Relative blade damage

Left prop

Right prop



CONCLUSIONS

There were no discrepancies noted on the components examined that would prevent or degrade normal operation prior to impact with terrain. All damage was consistent with high impact forces. Both propellers exhibited signatures consistent with impact while rotating at low power.

GENERAL INFORMATION

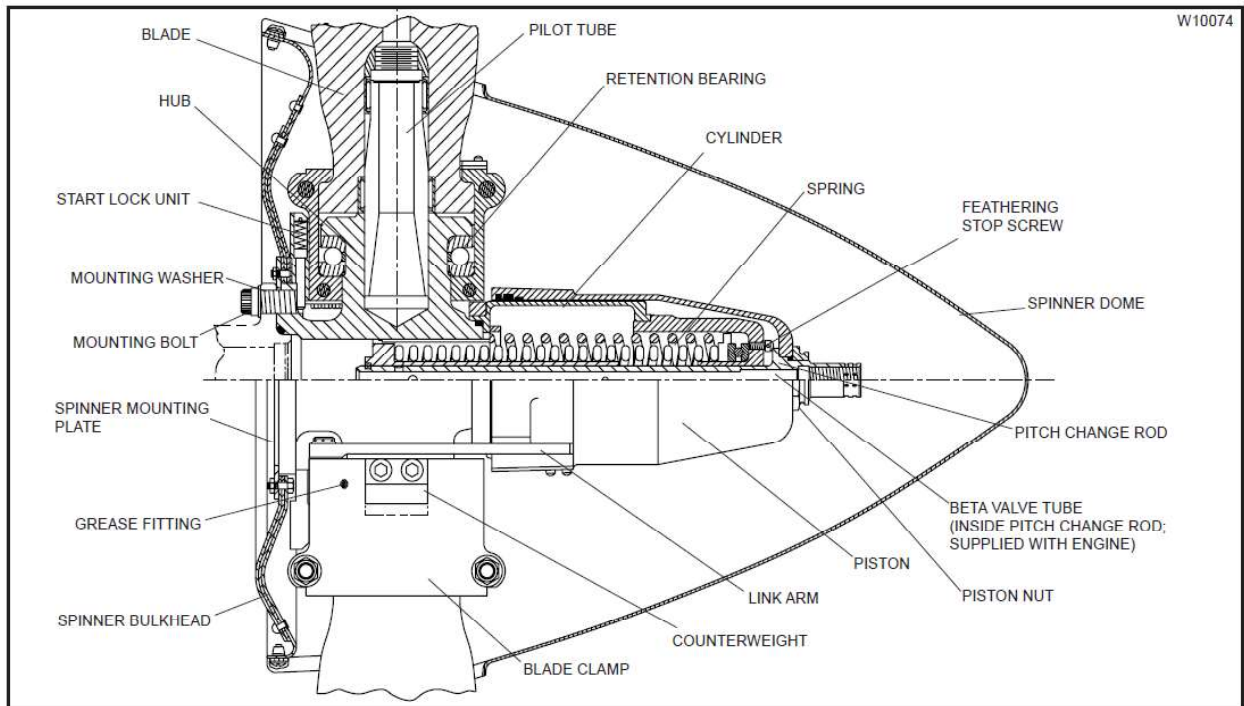
Propeller Description: The propellers examined are 106” inch diameter, 3-blade, single-acting, hydraulically operated, constant speed models with feathering and reversing capabilities. Oil pressure from the propeller governor is used to move the blades to the low pitch (blade angle) direction. Blade mounted counterweights provide a twisting moment and feathering springs provide forces that actuate the blades towards the high pitch direction in the absence of governor oil pressure. The propeller incorporates a start lock mechanism that holds the blades at a low blade angle during engine start. The propeller accommodates a beta tube that provides blade angle information to the engine-mounted propeller controls 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 counter-clockwise as viewed from the rear. See Figure #2 for a propeller cutaway sketch with the major components labeled.

Installation Data: Refer to Hartzell Installation Data Sheet No. 39, Aircraft TCDS 2A4, and STC SA546GL for propeller settings referenced below:

(Angles referenced at the 42-inch radius)

- Reverse: -14.0 ± 0.5 degrees
- Start Lock: -8.7 ± 0.5 degrees
- Flight Idle: 6.0 ± 0.5 degrees (set during propeller installation)
- Feather: 77.9 ± 0.5 degrees
- Counterweight: 8.5 ± 1.5 degrees

Figure #2 – Propeller cutaway sketch



PROPELLER EXAMINATION FACTUAL FINDINGS

Position Right

Propeller Model: HC-B3TN-5FL with LT10673B blades

Propeller Assembly S/N: BUA7358

Service History: The last propeller service was a 150 Hour Periodic Inspection conducted on July 7, 2021 by Surdex. The propeller was repaired on June 24, 2020 by H&S Propeller in White Lake, MI for a loose beta collar. The propeller was last overhauled on July 1, 2016 by Aircraft Specialists in Sellersburg, IN.

	S/N	Date of Manufacture	TTSN	TSO
Hub/Factory	B7802A	1/12/2000	Unknown	903.3
Blade R1	F18984	8/23/1982	2889.3	903.3
Blade R2	F19042	8/23/1982	2889.3	903.3
Blade R3	F19040	8/23/1982	2889.3	903.3

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

“As Received” Condition: The propeller assembly fracture-separated from the engine propeller shaft flange and was presented for examination as shown on the left side of Photo #2. The propeller was recovered near the main wreckage. One blade fracture-separated from the propeller assembly but was recovered near the main wreckage. The spinner dome, bulkhead and hydraulic unit fracture-separated from the propeller assembly and were not recovered. Blade R3 fractured from the hub and only a portion of the R3 clamp was recovered. The pilot tube for R3 was also fractured. Blades R1 and R2 remained attached to the assembly by their respective clamps. The R2 counterweight arm and slugs were fracture-separated from the clamp and not recovered. Blades R1 and R2 exhibited visual slippage in the clamp toward low pitch. All three link arms were missing and presumed not recovered.

Spinner Dome: The spinner dome was torn from the propeller assembly and only a small fragment remained attached to the spinner bulkhead which was bent around the front of the engine (Photo #3). Various fragments of spinner domes were recovered at the crash scene but it could not be determined from which propeller (left/right) they originated.

Spinner Bulkhead: The spinner bulkhead fracture-separated from the propeller hub, was bent and torn and bent around the front of the engine (Photo #3).

Propeller Cycling: Propeller cycling was not feasible without a hydraulic unit and link arms.

Engine/Propeller Mounting: The propeller hub separated from the engine propeller shaft flange. All eight mounting bolts pulled from the hub (Photo #4) and six bolts were visible in the engine propeller shaft flange.

Blade/Clamp Rotation:

Blade	Blade/clamp Angle As-Received	Blade Slip in Clamp?	Rotation of clamp possible?
R1	Rotated beyond the negative reverse stop.	Slippage toward low pitch. No visible slippage tape on clamp. See Table 1 for measurement on blade shank.	Yes, but very stiff.
R2	Rotated beyond the negative reverse stop.	Slippage toward low pitch. No visible slippage tape on clamp. See Table 1 for measurement on blade shank.	Yes, but very stiff.
R3	NA, clamp fractured only a fragment recovered	See Table 1 for measurement on blade shank.	NA

Pitch Stops: The hydraulic unit which includes the piston, cylinder, pitch change rod and feathering spring assembly were not recovered so the feather and reverse pitch stops were not observed.

Low Pitch Stop: Not observed.

Start Lock: Only fragments of one start lock bracket remained attached to the spinner bulkhead (Photo #3).

Feather Stop Screws: The feather stop screws were not recovered/observed.

Beta Tube: The aft portion of a beta tube was recovered but it was not determined from which propeller it originated.

Piston: The piston was not recovered/observed.

Link Arms: None of the three link arms were recovered/observed.

Cylinder: The cylinder was not recovered/observed.

Feathering Spring Assembly: The feathering spring was not recovered/observed.

Pitch Change Rod: The pitch change rod was no recovered/observed.

Clamps and Counterweights: (see Photo #6)

Clamp Pos.	Clamp S/N	Clamp Condition	Counterweight Condition
R1	EM23922	Intact with bolts secure. The link screw was deformed toward low pitch. There was a contact mark on the face side/inboard half. Start lock plate intact.	Intact
R2	DD922	Intact with bolts secure. The link screw was deformed toward low pitch. There was a contact mark on the face side/inboard half. Start lock plate intact.	Fracture-separated and not recovered.
R3		Fractured, only a small fragment of one half recovered.	Fracture-separated and not recovered.

Hub Unit: The hub unit separated from the propeller shaft flange. All eight bolts pulled from the hub and there were some visible thread whiskers in the bolt holes. Six of the mounting bolts were visible in the engine shaft flange. The cylinder attachment boss/thread were intact. There were several clamp-to-hub contact marks on all three blade arms in varying degrees. The R1 pilot tube was intact, the R2 and R3 pilot tubes were fractured (Photo #5). There were blade-to-hub contact marks on two hub arm flanges and are summarized in Table #1.

Table #1 - Summary of Blade Butt – Hub Arm Impact Signatures

Blade Number	Hub Arm Mark	Blade Butt Mark	Slippage	Resulting Blade Angle	Confidence Level / Why?
R1	82° from the trailing edge plane of rotation	95.5° below trailing edge split line	~88° towards low pitch	52° w/ slippage -36° w/o slippage	Medium – higher than normal ops at flight condition Low – Below the reverse stop
R2	98° from the trailing edge plane of rotation	97.5° below trailing edge split line	~67° towards low pitch	45° w/ slippage -22° w/o slippage	Medium – higher than normal ops at flight condition Low – Below the reverse stop
R3	Circular mark 101° from trailing edge plane of rotation	110° below trailing edge split line	~58° towards low pitch	26° w/ slippage -32° w/o slippage	Medium – higher than normal ops at flight condition Low – Below the reverse stop

Blade Properties: See Photos #7 through #10.

Blade # R1

Camber side	Chordwise/rotational abrasion with material that appeared like tree sap
Face side	Chordwise/rotational abrasion with material that appeared like tree sap
Bend	5" of tip bent/curled aft. Blade bent aft and opposite rotation.
Twist	Toward low pitch
Lead edge damage	Nicks, wave-like bend in outboard area
Trail edge damage	Localized bending
Blade bearings	Intact and grease appeared normal
Butt/shank impact marks	Pilot tube shoulder impression and impact crescent 82° below trailing edge split line mark. (Photo #7)
De-Ice boot	Torn

Blade # R2

Camber side	Chordwise/rotational abrasion
Face	Chordwise/rotational abrasion
Bend	Aft and opposite rotation, tip bent aft
Twist	Toward low pitch
Lead edge damage	Nicks
Trail edge damage	Nicks
Blade bearings	Intact and grease appeared normal
Butt/shank impact marks	Pilot tube fractured. Pilot tube shoulder impression and impact crescent 97.5° below trailing edge split line mark. (Photo #7)
De-Ice boot	Torn

Blade # R3 – 5" of the tip was fractured and not recovered.

Camber side	Not remarkable
Face side	Random scoring
Bend	S-bend
Twist	Outboard section twisted to low pitch
Lead edge damage	Gouging and chunking, mid-blade exhibited a mechanical shearing surface
Trail edge damage	Chunking
Blade bearings	Not recovered, ball separator remained on hub arm.
Butt/shank impact marks	Pilot tube shoulder impression (bore bearing displaced) and impact crescent 110° below trailing edge split line mark. (Photo #7)
De-Ice boot	Torn

Photo #2 - Right propeller as-presented for examination



Photo #3 - Right spinner bulkhead and one start lock bracket fragments



Photo #4 - Right propeller hub mounting flange



Photo #5 - Right propeller hub unit



Photo #6 - Right propeller clamps



Photo #7 - Right blade butt montage



Photo #8 - Right propeller blades trailing edge view (R1, R2, R3 left to right)



Photo #9 - Right propeller blades camber side (R3-R2-R1 top to bottom)



Photo #10 - Right propeller blades face side



Position **Left**

Propeller Model: HC-B3TN-5FL with LT10673B blades

Propeller Assembly S/N: **BVA6708**

Service History: The last propeller service was a 150 Hour Periodic Inspection conducted on July 7, 2021 by Surdex. The propeller was repaired on June 24, 2020 by H&S Propeller in White Lake, MI for a loose beta collar. The propeller was last overhauled on July 1, 2016 by Aircraft Specialists in Sellersburg, IN.

	<u>S/N</u>	<u>Date of Manufacture</u>	<u>TTSN</u>	<u>TSO</u>
Hub/Factory	B3201A	9/10/1998	Unknown	903.3
Blade L1	F19103	8/23/1982	2954.6	903.3
Blade L2	F92476	11/2/1983	2954.6	903.3
Blade L3	F18994	8/23/1982	2954.6	903.3

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

“As Received” Condition: The propeller, engine propeller shaft and forward section of the engine gear housing fractured from the engine during the impact sequence and was presented for examination as shown in Photo #11. The propeller mounting flange appeared intact but the propeller appeared displaced from the engine flange and several propeller mounting bolts appeared fractured. All three blades were recovered near the main wreckage. Blades L1 and L2 fracture-separated from the propeller assembly and the pilot tubes were fractured. The L1 clamp was not recovered. The L2 clamp fractured. The L3 clamp appeared intact. The spinner dome was torn from the assembly. All three blades appeared to be bent aft and twisted to low pitch. The hydraulic unit fracture-separated from the assembly and was not recovered. The L3 link arm was present, L1 and L2 link arms were not recovered.

Spinner Dome: The spinner dome was torn from the propeller assembly. Various fragments of spinner domes were recovered at the crash scene but it could not be determined from which propeller (left/right) they originated.

Spinner Bulkhead: The spinner bulkhead was bent and torn but remained attached to the hub. The de-ice slip ring also remained attached to the bulkhead/hub.

Propeller Cycling: Propeller cycling was not feasible without a hydraulic unit.

Engine/Propeller Mounting: The propeller mounting flange appeared intact but the propeller appeared displaced and several propeller mounting bolts appeared fractured (Photo #12).

Blade/Clamp Rotation:

Blade	Blade/clamp Angle As-Received	Blade Slip in Clamp?	Rotation of clamp possible?
L1	NA, clamp not recovered	NA	NA
L2	Feathered position	NA, blade fractured from clamp	NA
L3	Near the start lock/low pitch position	No apparent slippage but no slip indicator tape	Yes

Pitch Stops: The hydraulic unit which includes the piston, cylinder, pitch change rod and feathering spring assembly were not recovered so the feather and reverse pitch stops were not observed.

Low Pitch Stop: Not observed.

Start Lock: All three start lock brackets were present, bent/fractured and L3 plunger was extended (Photo #14).

Feather Stop Screws: The feather stop screws were not recovered/observed.

Beta Tube: The aft portion of a beta tube was recovered but it was not determined from which propeller it originated.

Piston: The piston was not recovered/observed.

Link Arms:

Link Arm	Link Arm Condition
L1	Not recovered
L2	Not recovered
L3	Bent laterally, no remarkable stretch or compression

Cylinder: The cylinder was not recovered/observed.

Feathering Spring Assembly: The feathering spring was not recovered/observed.

Pitch Change Rod: The pitch change rod was no recovered/observed.

Clamps and Counterweights: (Photo #13)

Clamp Pos.	Clamp S/N	Clamp Condition	Counterweight Condition
L1	Not recovered		
L2	EM12458	Fractured on face side/trailing edge quadrant. Inboard and outboard fasteners on trial edge side fractured. Start lock plate fractured from clamp, not recovered. Link screw cotter key sheared, link screw not remarkable.	Intact
L3	EM12460	Clamp intact. Start lock plate intact. Link screw cotter key sheared, link screw not remarkable.	Intact

Hub Unit: The hub unit remained attached to the propeller shaft flange. All eight mounting bolts appeared present with some fractured. The cylinder attachment boss was intact with some marring of the threads. There were several clamp-to-hub contact marks on all three blade arms in varying degrees. All three pilot tubes were fractured (Photo #15). There were blade-to-hub contact marks on two hub arm flanges and are summarized in Table #2.

Table #2 - Summary of Blade Butt – Hub Arm Impact Signatures

Blade Number	Hub Arm Mark	Blade Butt Mark	Slippage	Resulting Blade Angle	Confidence Level / Why?
L1	90° on face side of trailing edge	85° from the trailing edge clamp split line	~23° towards low pitch	6° w/ slippage -17° w/o slippage	High – Flight idle blade angle, consistent with blade damage Low – Below reverse stop
L2	84° on face side of trailing edge	89° from the trailing edge clamp split line	Indeterminate	-28° w/o slippage	Low – Below reverse stop
L3	94° on face side of trailing edge	11° above the trailing edge split line	Indeterminate	82° w/o slippage	Low – Near feather, not consistent with blade damage

Blades Properties: See Photos #16 through #20

Blade # L1 – Blade fractured from hub/clamp

Camber side	Chordwise/rotational scoring and abrasion
Face side	Chordwise/rotational abrasion
Bend	Aft and opposite rotation
Twist	Towards low pitch
Lead edge damage	Wave-type bends consistent with tree strike. Fracture/tear 10" from tip, material deformation to low pitch (Photo #16).
Trail edge damage	Localized, random bending
Blade bearings	Not recovered
Butt/shank impact marks	Pilot tube fractured, fragment jammed in bore. Pilot tube shoulder impression and impact crescent in aft/trailing edge quadrant. (Photo #17)
De-Ice boot	Torn

Blade # L2 – Blade fractured from hub/clamp, portion of blade retention radius remained in clamp

Camber side	Chordwise/rotational scoring and abrasion
Face side	Chordwise/rotational scoring in mid-blade and tip leading edge areas, random spanwise scoring along span
Bend	Aft and opposite rotation
Twist	Towards low pitch
Lead edge damage	Gouging and chunking, material deformation appears neutral
Trail edge damage	Localized bends, kinks and nicks
Blade bearings	Corroded, fractured race, ball imprints
Butt/shank impact marks	Blade retention radius sheared on camber side. Pilot tube fractured, fragment jammed in bore. Pilot tube shoulder impression and impact crescent in aft/trailing edge quadrant. (Photo #17)
De-Ice boot	Torn

Blade # L3

Camber side	Chordwise/rotational scoring and abrasion
Face side	Chordwise/rotational scoring and abrasion
Bend	Aft and opposite rotation
Twist	Towards low pitch
Lead edge damage	Nicks and dents
Trail edge damage	Localized bends
Blade bearings	Intact, grease in good condition
Butt/shank impact marks	Pilot tube fractured, fragment jammed in bore. Pilot tube shoulder impression and impact crescent in trailing edge quadrant. (Photo #17)
De-Ice boot	Torn

Photo #11 - Left propeller as-presented for examination



Photo #12 - Left propeller mounting flange area



Photo #13 - Left propeller clamps recovered



Photo #14 - L3 start lock bracket with plunger extended



Photo #15 - Left propeller hub unit/spider



Photo #16 - L1 blade leading edge fracture/tear



Photo #17 - Left propeller blade butts



Photo #18 - Left propeller blades leading edge view



Photo #19 - Left propeller blades camber side



Photo #20 - Left propeller blades face side

