Date of Accident: August 5, 2018

Location: Santa Ana, CA

NTSB File No.: WPR18FA211

Aircraft: Cessna 414

Registration No.: N727RP

Serial No.: 414-0385 (Year of Manufacture 1973)

Operator: (per FAA Registration Database)
Category III Aviation Corp.
350 Sansome St.
[redacted]
San Francisco, CA 94104-1308

Written by: Les Doud - Air Safety Investigator

Report Date: September 4, 2018

Contents:

PROPELLER EXAMINATION REPORT

Date of Investigation: August 28-29, 2018

Location: Southwest Aircraft Transportation & Recovery
Chino Airport (KCNO)
[redacted]
Chino, CA 91710

Propeller Model(s): PHC-C3YF-2UF with FC7693DFB blades

Representatives:

Les Doud	Hartzell Propeller Inc. ASI
Albert Nixon	NTSB Investigator in Charge

ACCIDENT SYNOPSIS

The NTSB preliminary report states:

"On August 5, 2018, about 1229 Pacific daylight time, a Cessna 414 airplane, N727RP, sustained substantial damage when it impacted the ground in a shopping mall parking lot in Santa Ana, California. The private pilot and four passengers were fatally injured. The airplane was registered to and operated by Category III Aviation Corporation under the provisions of Title 14 *Code of Federal Regulations* Part 91, as a business flight. Visual meteorological conditions prevailed, and no flight plan was filed for the cross-country flight. The flight departed Buchanan Field Airport (CCA), Concord, California, about 1022 and was destined for John Wayne-Orange County Airport (SNA), Santa Ana, California.

A review of the SNA Air Traffic Control Tower (ATCT) audio tape revealed that the pilot established contact with the control tower controller when he was west of the airport descending to 1,700 ft. mean sea level (msl). The pilot was told to expect right traffic to runway 20R. The controller then queried the pilot to determine if he could accept runway 20L, and the pilot responded that he was unable to land on runway 20L. The controller then instructed the pilot to hold over the South Coast Plaza, a local holding point for aircraft operating under visual flight rules (VFR), and to conduct left 360°turns for sequencing. When the accident airplane arrived at the holding point, the pilot responded that he could accept runway 20L for landing. The pilot was then instructed to continue his turn to accomplish a left 270° turn and to cross mid-field at or above 1,300 ft. msl, for left traffic to runway 20L. The pilot acknowledged that instruction. The controller then instructed the pilot to climb to 1,300 ft. msl.

A review of the preliminary radar data showed that at 1228, the airplane was about 1-mile northwest of SNA, traveling eastbound at an altitude of about 1,000 ft. msl. The airplane began a left turn and the last radar return was recorded at 1229. At this time, the airplane was descending through an altitude of about 494 ft. msl.

Multiple witnesses near the accident site observed the airplane enter the left bank turn and shortly thereafter, they observed the bank angle increase and the airplane descend towards the ground at a steep angle. During the descent, the pilot transmitted "emergency" three times. The airplane did not recover from the descent and collided with several vehicles in a shopping mall parking lot before coming to rest upright about 35 ft. from the entrance of a major store.

Examination of the accident site by the National Transportation Safety Board investigators revealed that that all major components of the airplane were located throughout the 150 ft. long debris path.

The airplane wreckage was recovered to a secure storage facility for further examination."

SUMMARY AND ANALYSIS OF FINDINGS

Both left and right propellers fracture-separated from the aircraft during the impact sequence. The propellers were recovered to a hangar at the Chino Airport and examined on August 28-29, 2018. The propellers were disassembled to inspect damage and look for indications of power state at time of impact.

Damage to both left and right propellers was similar. Leading edge gouging and chordwise/rotational scoring indicated rotation. Blade bending and twisting characteristics also suggested rotation at impact. Photo #1 shows the relative bend and twist damage between left and right propeller blades suggesting power symmetry. One blade retention pocket on each propeller (L2 and R2) fractured in a helical direction; aft and opposite rotation (Photo #2).

L3 blade bending in the forward/thrust direction, deep chordwise/rotational scoring and blade strike marks in the asphalt from the left propeller suggest it was rotating under moderate-to-high power.

Fork impact marks on the preload plates of both propellers indicated the propeller blade angle was in the lower range of normal operation during the impact sequence.

There were no indications that either propeller was at or near the feathered position.

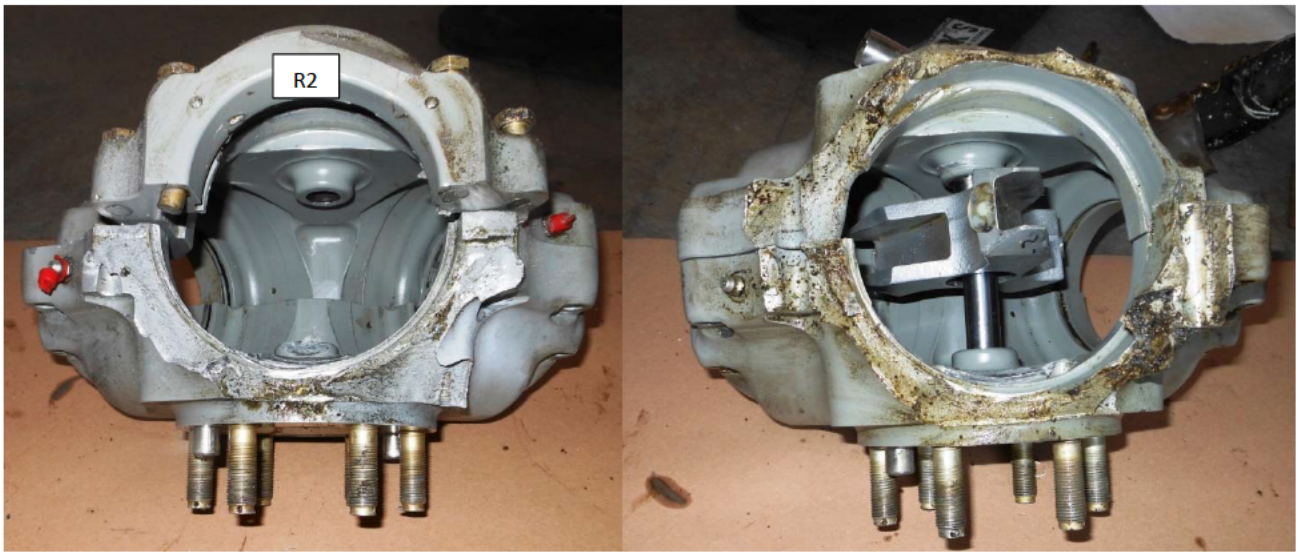
CONCLUSIONS

According to on-scene personnel and review of crash scene photos, all propeller components were accounted for at the crash scene. There were no discrepancies noted that would prevent or degrade normal propeller operation prior to impact. All damage was consistent with high impact forces.

Overall, the degree of blade bending and twisting was similar between left and right propellers suggesting power symmetry at time impact. Chordwise/rotational scoring, leading edge gouging and blade retention pocket fractures indicated rotation at time of impact. Internal impact marks indicated the propeller blade angle was in the low range of normal operation during the impact sequence. In total, the damage suggested a power ON condition on both propellers at time of impact.

Photo #1 – Relative bend/twist comparison L2 vs. R1 (left) and R2 vs. L2 (right)

Photo #2 – Blade retention pocket fracture comparisons (R2 pocket on left vs. L2 on right)



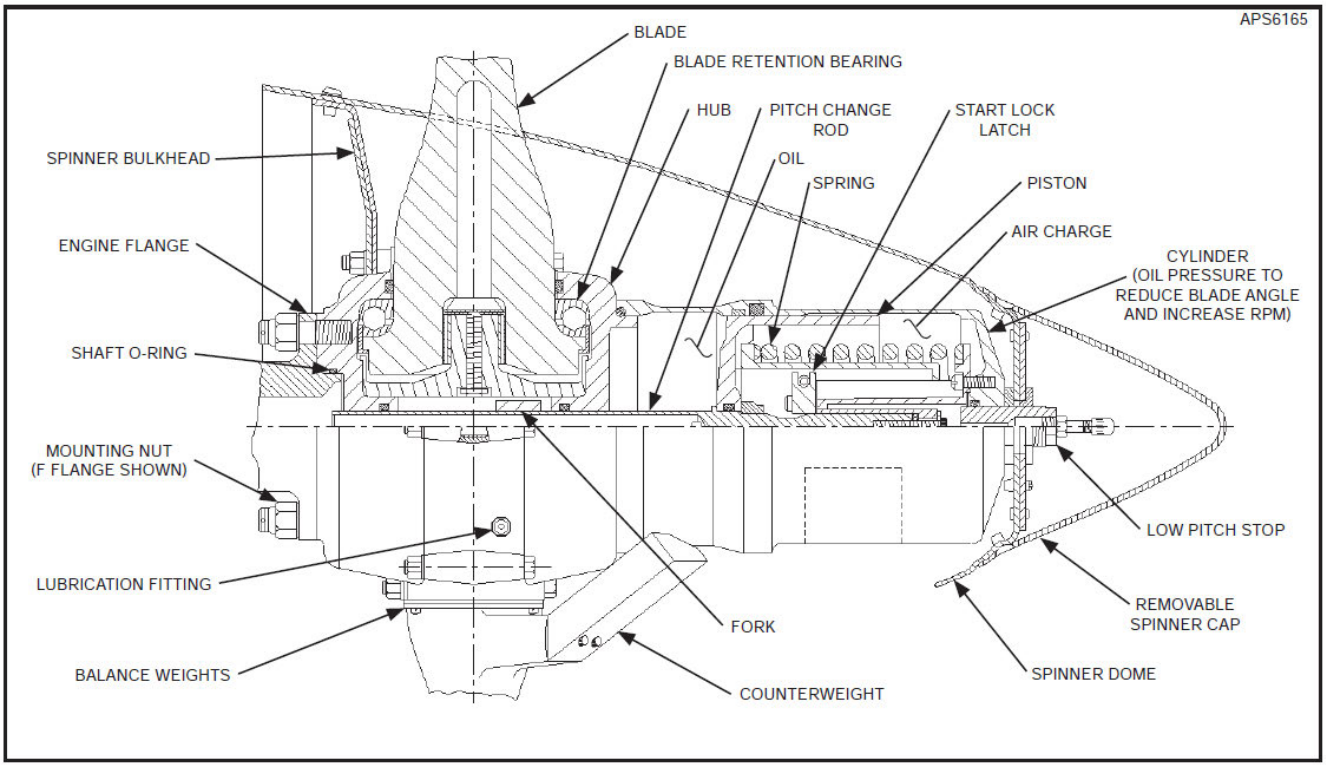
GENERAL INFORMATION

Propeller Description: The Cessna 414 propellers examined are 78" diameter, 3-blade single-acting, hydraulically operated, constant speed model with feathering capability. Oil pressure from the propeller governor is used to move the blades to the low pitch (blade angle) direction. A spring, counterweights, and an air charge move the blades to the high pitch/feather direction in the absence of governor oil pressure. The propeller incorporates start locks to keep propeller blade angle low to minimize the starting torque. The blades and hub are of aluminum construction. Propeller rotation is clockwise as viewed from the rear.

Installation Data: Refer to Hartzell Propeller Installation Data Sheet No. 1945, STC SA09971SC-D, and Type Certificate Data Sheet A7CE for additional information. (Blade angles below reference the 30-inch radius).

Low Pitch:	13.0 ± 0.1 degrees
Start lock:	18.0 ± 1.5 degrees
Feather:	81.1 ± 1.0 degrees

Figure 1 – Propeller Configuration Cutaway



PROPELLER EXAMINATION FACTUAL FINDINGS

Position: **RIGHT**

Propeller Model: PHC-C3YF-2UF with FC7693DFB blades

Propeller Assembly Serial Number: EB7242B

Service History: The propeller logbooks were not available at this examination so the service history is unknown.

	S/N	Date of Manufacture	TTSN	TSO
Hub/Factory	B1584B	1/26/2010	UNK	UNK
Blade R1	K95964	1/10/2010	UNK	UNK
Blade R2	K95967	1/10/2010	UNK	UNK
Blade R3	K95965	1/10/2010	UNK	UNK

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

As Received Condition: The propeller impacted a red, 2013 Chevy Malibu Eco and fractured from the engine crankshaft during the impact sequence. It lodged in the trunk area of the car at the crash scene as shown in Photo #3. The propeller blades appeared to make multiple cuts through the car sheet metal during the impact sequence. The propeller was recovered to a hangar at Chino Airport for examination as shown in Photo #4. R1 and R2 blades were bent aft, opposite rotation and twisted towards low pitch. Blade R1 had approximately 4-5" of the tip fracture-separated. Blade R2 had a large leading edge gouge. The hydraulic unit fractured from the hub unit (seen in Photo #6) and was not presented for examination. The R2 blade retention pocket was fractured in a helical path direction (aft/opposite rotation direction) as shown in Photos #5 and #6. The R2 counterweight fracture-separated and was not presented for examination. There was distinguishable chordwise/rotational scoring on the camber side of all three blades. Blade R3 also exhibited chordwise/rotational scoring on the face side. There was also leading edge gouging with material deformation towards low and high pitch. One of the three pitch change knobs was fractured.

Propeller Cycling: Propeller cycling was not possible due to damage.

Spinner Dome: The spinner dome was not presented for examination at Southwest Aircraft. However, review of on-scene photos show the spinner dome was torn and dented. The spinner dome also appeared to have a chrome finish which was is not approved by Hartzell Propeller.

Spinner Bulkhead: The spinner bulkhead was bent and torn as shown in Photo #7.

Engine/Propeller Mounting: There appeared to be small, hard, cube-like fragments in the propeller hub mounting bore. The fragments were covered in oil/sludge, collected, bagged and left with the other mounting hardware. The crankshaft flange remained attached to the propeller flange and the fasteners were tight. The mounting flange appeared intact and undamaged

(Photo #8). The crankshaft flange fracture appeared to have some ratchet-like fracture patterns suggesting applied torque at the time of fracture (Photo #9).

Hydraulic Unit: The hydraulic unit consisting of the cylinder, piston, forward pitch change rod, pitch stops (low, feather and start lock), air valve, feathering spring and guides fracture-separated from the propeller assembly during the impact sequence. The hydraulic unit was not presented for examination. Review of the on-scene photos showed the separated hydraulic unit on a sidewalk adjacent to a building in the wreckage path as shown in Photo #10. The cylinder was mostly intact with what appears to be some residual servo oil leaking from it.

Pitch Change Rod: The pitch change rod forward of the hub was fractured and bent as shown in Photo #11. The remaining portion of the rod unthreaded from the fork and was removed without difficulty.

Fork: The fork appeared intact with only knob/block impact marks in the slots, otherwise it appeared undamaged (Photo #11).

Hub Assembly: The hub appeared over-serviced with grease after initially opened. The R2 blade retention pocket was fractured on the aft hub half in the aft/trailing edge direction (Photo #12). The pocket fragmented into three pieces and all remained attached to the assembly. Five hub thru-bolts were bent and had to be cut to separate the hub halves and fragments. The cylinder mounting boss threads were fracture-separated around approximately 30% of the circumference (Photo #13). The internal preload plate pockets of all three blades on both the forward and aft hub halves were damaged (Photos #12 and #14).

Preload Plates: All three preload plate lips were sheared, fractured and/or smashed. R1 and R2 also had impact marks from contact with the aft hub half pocket web.

NOTE: For this propeller model, when the blade knob is aligned with the hub parting line, the blade angle at the reference station is approximately 46.4° (knob 11° + 36° - 0.64° difference between blade Station 30 and the 30” reference radius).

Preload Plate	Condition
R1	Fork contact marks in the low blade angle range.
R2	Fork contact marks in the low blade angle range. Knob impact marks in slot averaging 11° and 37° forward of the parting line (Photo #). The aft wall of the plate was fractured and marred by contact with the hub web.
R3	Fork contact mark in the low blade angle range.

Propeller Blade Properties: (Photos #17 through #21)

Blade # R1 – Approximately 4-5" of tip fracture-separated, fragment not recovered (Photo #20)

Camber side	Chordwise/rotational scoring
Face side	Chordwise/rotational scoring in mid-blade region, otherwise not remarkable
Bend	Aft and opposite rotation
Twist	Leading edge down, toward low pitch
Lead edge damage	Gouged
Trail edge damage	Wave-type buckling bends, gouged
Knob condition	Intact, bent opposite low pitch.
Counterweight	Intact, removed to facilitate propeller disassembly
Blade bearings	Intact
Butt/shank impact marks	Impact mark from hub aperture in trailing edge quadrant. Impact crescent on butt in the aft/trailing edge quadrant.
De-Ice boot	Torn

Blade # R2

Camber side	Chordwise/rotational scorning with red paint transfer from car
Face side	Chordwise/rotational scoring in mid-blade area
Bend	Aft and opposite rotation with some S-bend characteristics at tip
Twist	Leading edge down, toward low pitch
Lead edge damage	Large, 4" gouge/tear near tip (Photo #20)
Trail edge damage	Random scrapes
Knob condition	Fractured/sheared
Counterweight	Fracture-separated, bolts fractured, not presented for examination. Mounting boss gouged and scored.
Blade bearings	Bearing races were fractured. Bearing retention lip sheared off.
Butt/shank impact marks	Gouges and scoring throughout the aft/face side of the shank and bearing retention lip. Impact crescent in aft/face quadrant.
De-Ice boot	Torn

Blade # R3

Camber side	Chordwise/rotational scoring characteristic of cutting through sheet metal (Photo #21)
Face side	Chordwise/rotational scoring (Photo #19)
Bend	Slight forward/thrust direction bending near tip
Twist	Not remarkable
Lead edge damage	Gouged
Trail edge damage	Not remarkable
Knob condition	Intact
Counterweight	Intact, removed to facilitate propeller disassembly
Blade bearings	Intact
Butt/shank impact marks	Not remarkable
De-Ice boot	Torn

Photo #3 – Right propeller in-situ embedded in car
(Photo provided by on-scene investigators)

Photo #4 – Right propeller as-presented for examination

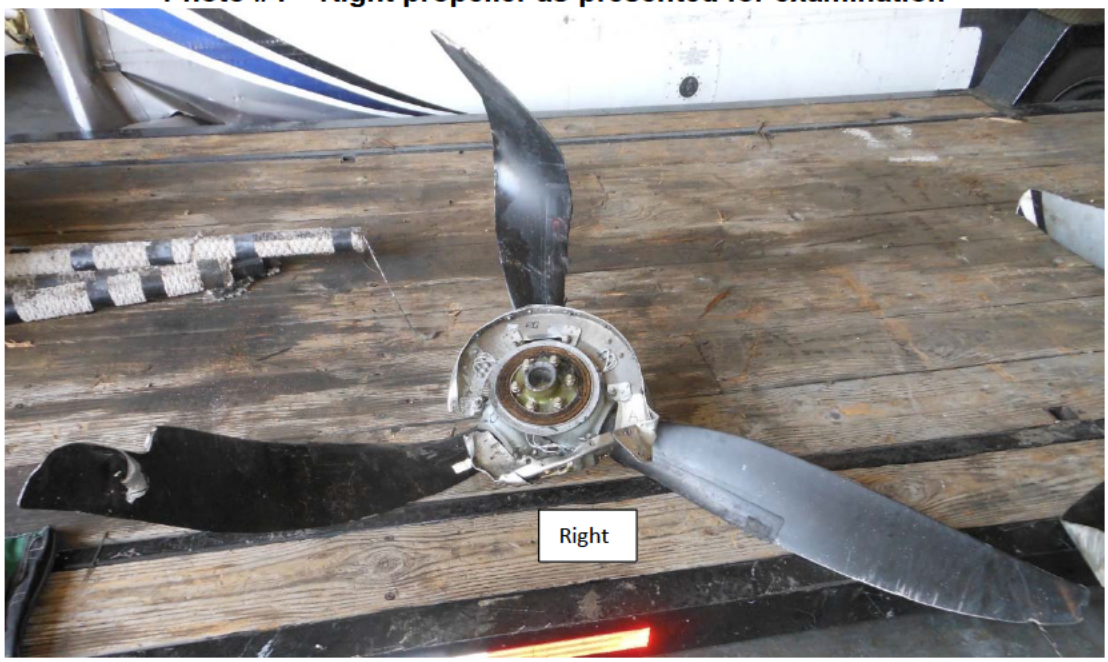


Photo #5 – Right propeller R2 blade retention pocket fracture

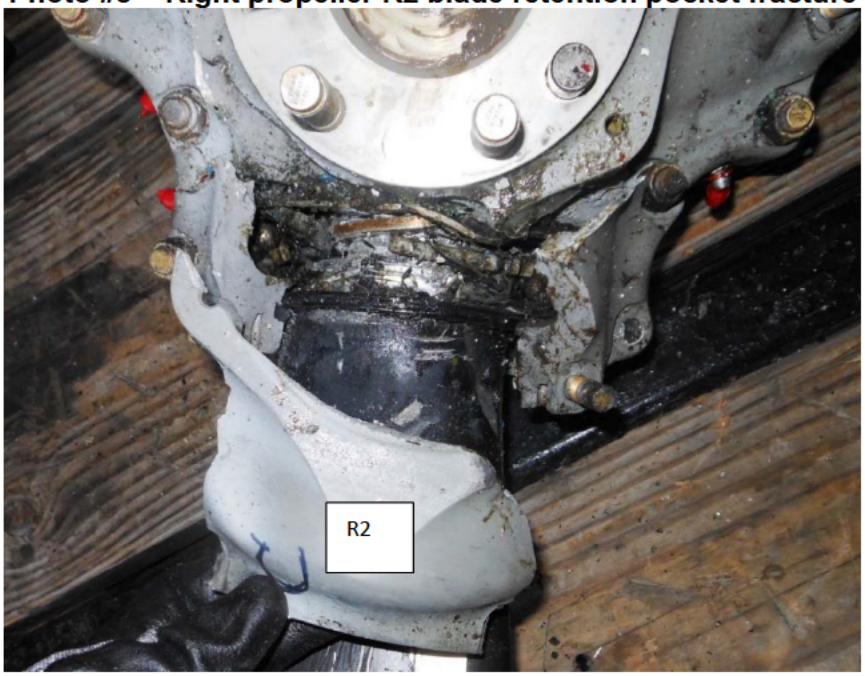


Photo #6 – Right propeller R2 blade retention pocket fracture

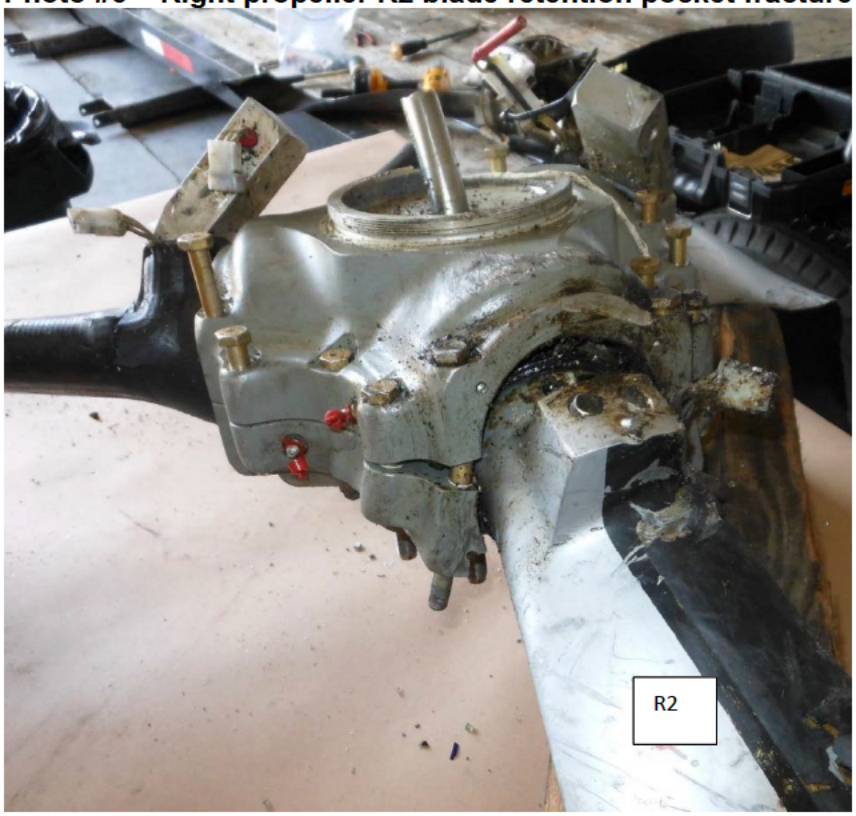


Photo #7 – Right spinner bulkhead

Photo #8 – Right propeller/hub mounting flange

Photo #9 – Right crankshaft fracture surface

Photo #10 – Right hydraulic unit in-situ
(photo provided by on-scene investigators)

Photo #11 – Right fork and pitch chance rod

Photo #12 – Right aft hub half and R2 retention pocket fracture

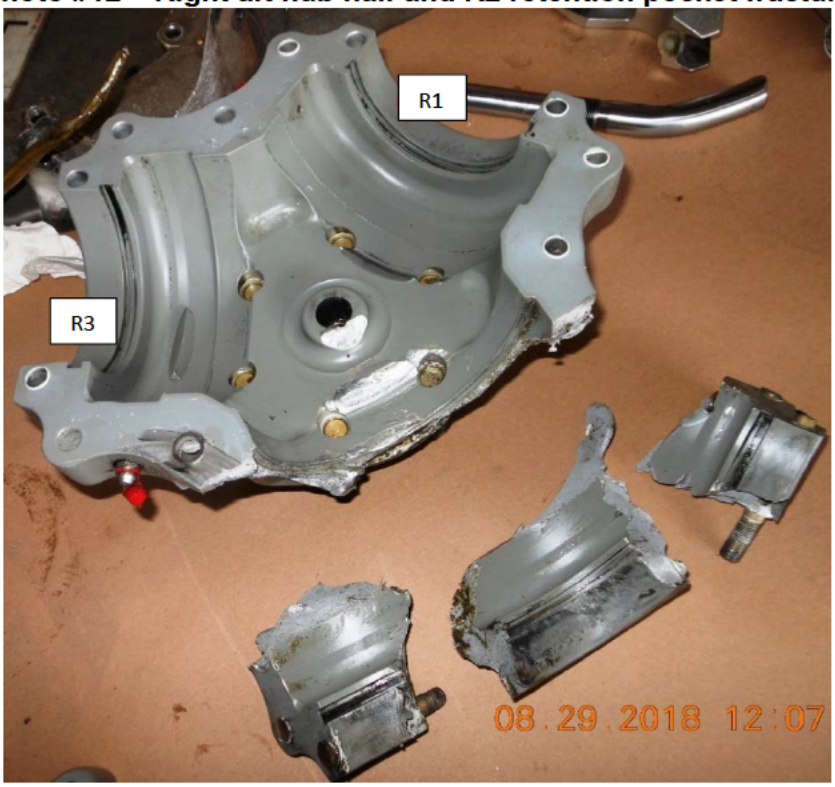


Photo #13 – Right hub cylinder mounting boss

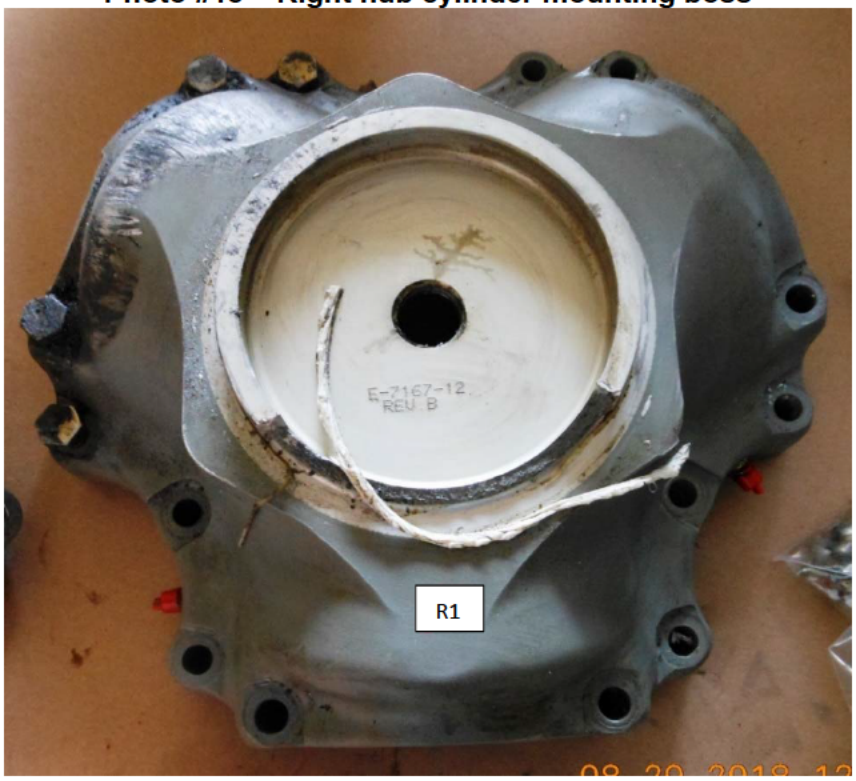


Photo #14 – Right forward hub half

Photo #15 – Right preload plates

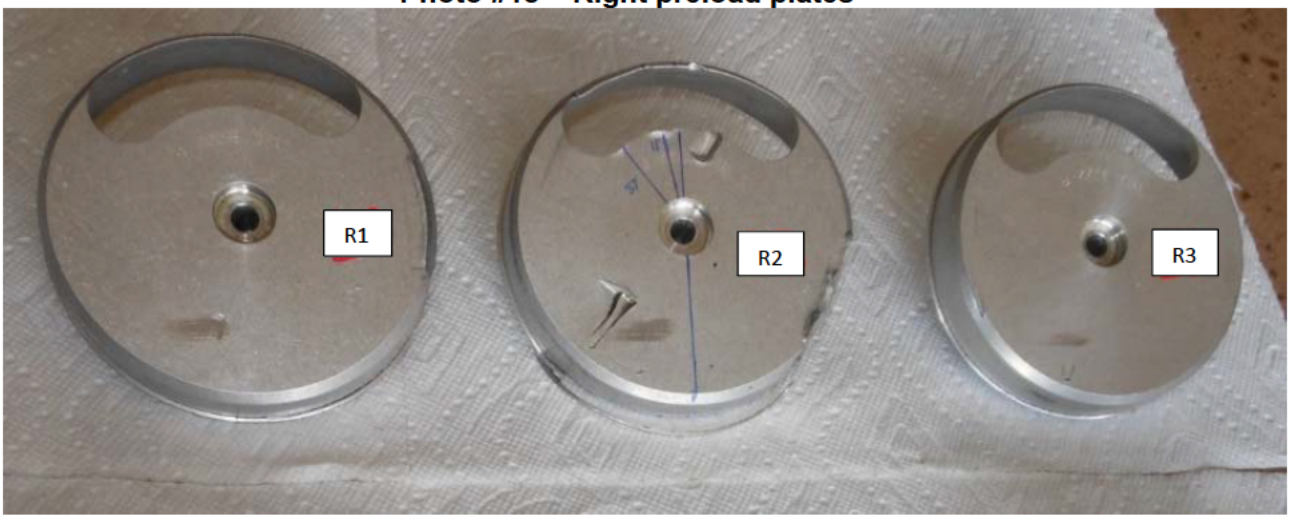


Photo #16 – R2 preload plate with knob impact mark measurements

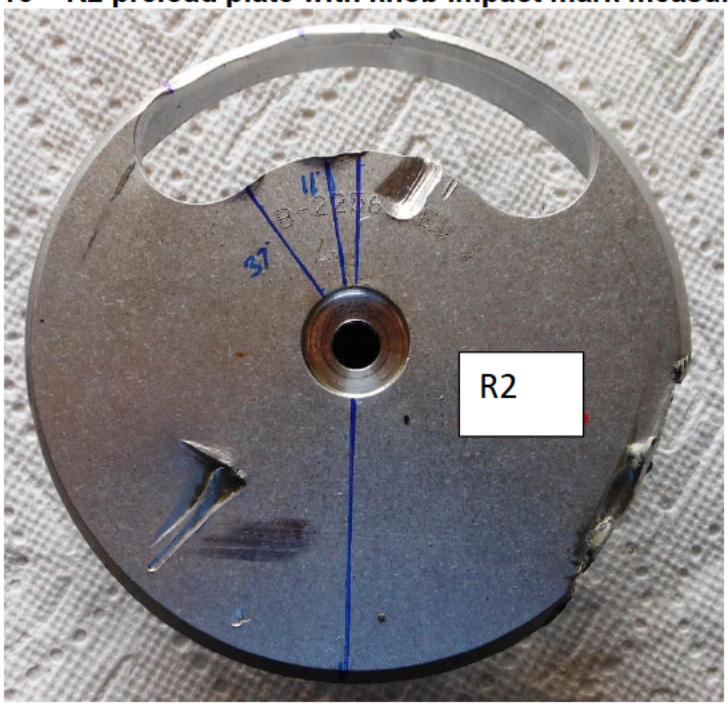


Photo #17 – Right blades camber side view

Photo #18 – Right blades face side view

Photo #19 – R2 and R3 face side tip areas

Photo #20 – R1 and R2 camber side tip areas

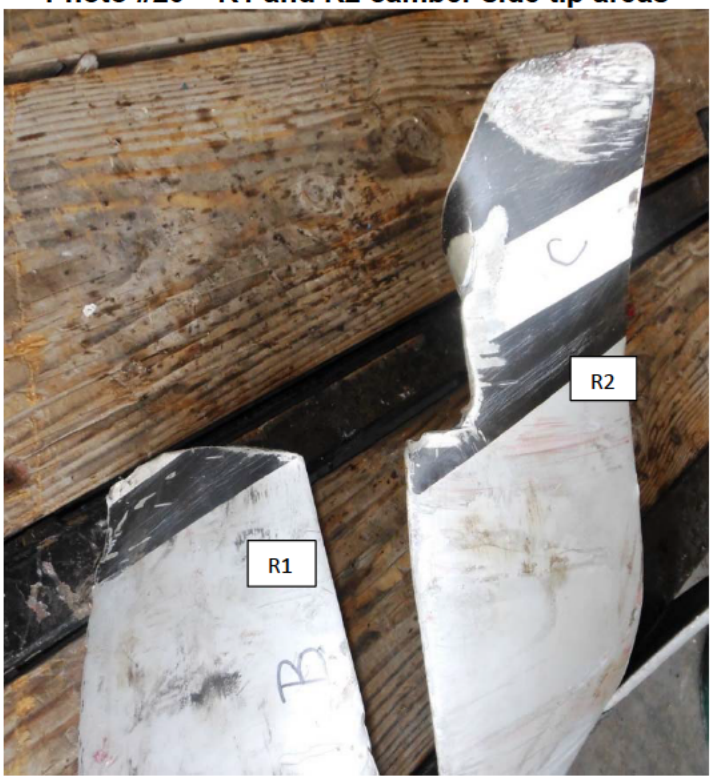


Photo #21 – R2 and R3 leading edge view

Position: **LEFT**

Propeller Model: PHC-C3YF-2UF with FC7693DFB blades

Propeller Assembly Serial Number: EB7243B

Service History: The propeller logbooks were not available at this examination so the service history is unknown.

	S/N	Date of Manufacture	TTSN	TSO
Hub/Factory	B1585B	3/15/2010	UNK	UNK
Blade L1	K98244	3/5/2010	UNK	UNK
Blade L2	K98254	3/5/2010	UNK	UNK
Blade L3	K98253	3/5/2010	UNK	UNK

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

As Received Condition: The propeller impacted the shopping center asphalt parking lot and fractured from the engine crankshaft during the impact sequence as shown in Photos #22 and #23. The L2 blade fracture-separated from the assembly and lodged in the impact crater in Photo #23. The propeller blades appeared to have made two distinguishable slash marks in the asphalt as shown in Photo #23 that were estimated from the photo to be 12-15" apart. The propeller was recovered to a hangar at Chino Airport for examination as shown in Photo #24. L1 and L2 blades were bent aft, opposite rotation and twisted towards low pitch. Blade L3 had approximately 4" of the tip fracture-separated and was bent in the forward/thrust direction near the tip. The hydraulic unit fractured from the hub unit but was found nearby as shown in Photo #22. The L2 blade retention pocket was fractured in a helical path direction suggesting rotation and the L2 blade separated from the assembly. There was distinguishable chordwise/rotational scoring consistent with impact into asphalt on the camber side of blades L1 and L2. There was also leading edge gouging with material deformation towards low pitch. Two of the three pitch change knobs were fractured.

Propeller Cycling: Propeller cycling was not possible due to damage.

Spinner Dome: The spinner dome was not presented for examination at Southwest Aircraft. However, review of on-scene photos show the spinner dome was torn and dented (Photo #22). The spinner dome also appeared to have a chrome finish which was is not approved by Hartzell Propeller.

Spinner Bulkhead: The spinner bulkhead was bent and torn as shown in Photo #25.

Engine/Propeller Mounting: The fractured crankshaft flange remained attached to the propeller mounting flange and the fasteners were tight. The mounting flange appeared intact and undamaged (Photo #26). The crankshaft flange fracture appeared to have some ratchet-like fracture patterns suggesting applied torque at the time of fracture (Photo #27).

Hydraulic Unit: The hydraulic unit consisting of the cylinder, piston, forward pitch change rod, pitch stops (low, feather and start lock), air valve, feathering spring and guides fracture-separated from the propeller assembly during the impact sequence. It was not presented for examination. Review of the on-scene photos showed the separated hydraulic unit next to the propeller assembly as shown in Photo #22. The cylinder appeared partially crushed in the photo. The pitch stops, spring, spring guides and piston were not examined.

Pitch Change Rod: The pitch change rod forward of the hub was fractured and bent as shown in Photo #31 and could not be rotated for removal.

Fork: The fork appeared intact with only knob/block impact marks in the slots, otherwise it appeared undamaged (Photo #30). An attempt was made to remove the fork but the remaining portion of the pitch change rod was bent, prohibiting complete removal from the rod threads.

Hub Assembly: The L2 blade retention pocket was fractured around both the aft and forward hub half (Photos #29 and #30). A fragment on the lead/camber side of the forward hub half remained attached to the assembly. One hub thru-bolt had to be cut to separate the hub halves and fragment. The cylinder mounting boss threads were fracture-separated around approximately 50% of the circumference (Photo #31). The internal preload plate pockets of all three blades on both the forward and aft hub halves were damaged (Photos #29 and #30). There were ball bearing imprints in the forward hub fragment of the L2 blade retention pocket (Photo #29).

Preload Plates: The L2 preload plate was not presented for examination and presumed either destroyed and/or fragmented beyond recognition. The L1 and L3 preload plate lips were sheared, fractured and/or smashed. L1 and L3 also had impact marks from contact with the forward hub half pocket web.

NOTE: For this propeller model, when the blade knob is aligned with the hub parting line, the blade angle at the reference station is approximately 46.4° (knob 11° + 36° - 0.64° difference between blade Station 30 and the 30” reference radius).

Preload Plate	Condition
L1	Fork contact mark in the low blade angle range.
L2	Not presented for examination, presumed missing or destroyed.
L3	Fork contact mark in the low blade angle range.

Propeller Blade Properties: Photos #32 through #37

Blade # L1

Camber side	Chordwise/rotational scoring (Photo #35)
Face side	Diagonal scoring
Bend	Curled aft, opposite rotation
Twist	Curled leading edge down, toward low pitch
Lead edge damage	Gouged
Trail edge damage	Not remarkable
Knob condition	Intact
Counterweight	Fracture-separated, not presented for examination
Blade bearings	Intact
Butt/shank impact marks	Impact crescents in lead and trail quadrants
De-Ice boot	Mostly intact, abrasion on camber side near counterweight boss

Blade # L2

Camber side	Chordwise/rotational scoring (Photo #36)
Face side	Chordwise/rotational scoring near lead edge, diagonal scoring mid-blade
Bend	Curled aft, opposite rotation
Twist	Leading edge down, toward low pitch
Lead edge damage	Nicks and gouges
Trail edge damage	Nicks and gouges
Knob condition	Fracture-separated, not presented for examination
Counterweight	One attach bolt fractured but still attached and displaced from boss. Counterweight boss gouged.
Blade bearings	Not recovered, ball bearing imprints in hub blade retention pocket
Butt/shank impact marks	Gouged, bearing retention lip fracture/sheared. Gouges around aft/face side Teflon rub strip area. Bearing race retention ring missing.
De-Ice boot	Torn

Blade # L3 – Approximately 4” of tip fracture-separated, fragment not presented (Photo #37)

Camber side	Chordwise/rotational scuffing in mid-blade, trailing edge region
Face side	Chordwise/rotational scoring near tip leading edge
Bend	Forward/thrust direction at tip
Twist	Appears twisted leading edge up, towards high pitch at tip
Lead edge damage	Not remarkable except for tear/fracture at tip
Trail edge damage	Bends, dents and nicks
Knob condition	Fracture-separated, fracture direction suggests towards high pitch
Counterweight	Intact, removed to facilitate propeller disassembly
Blade bearings	Intact
Butt/shank impact marks	Impact crescent in lead quadrant
De-Ice boot	Torn

Photo #22 – Left propeller in-situ
(photo provided by on-scene investigators)

Photo #23 – L2 blade in impact crater
(photo provided by on-scene investigators)

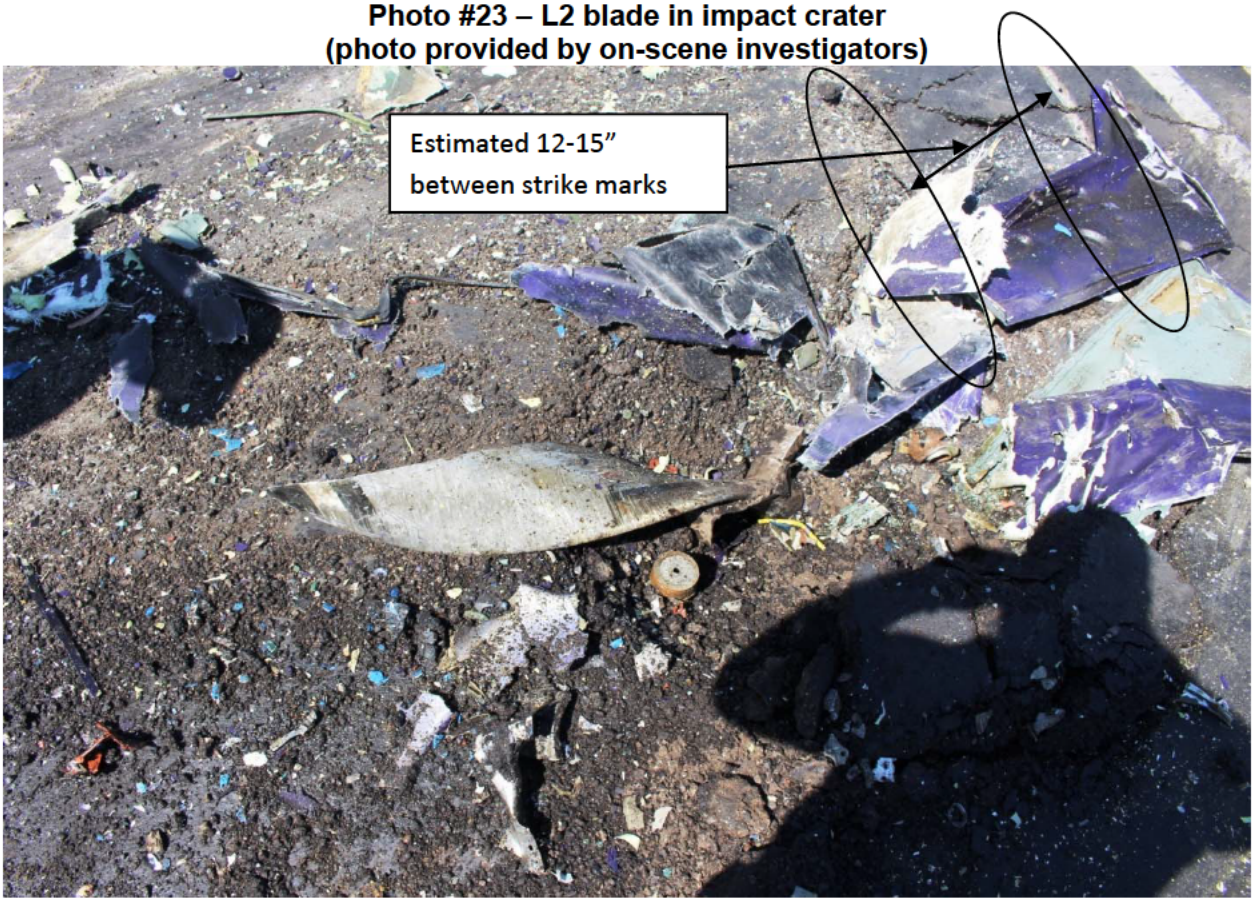


Photo #24 – Left propeller as-presented for examination

Photo #25 – Left spinner bulkhead

Photo #26 – Left propeller mounting flange

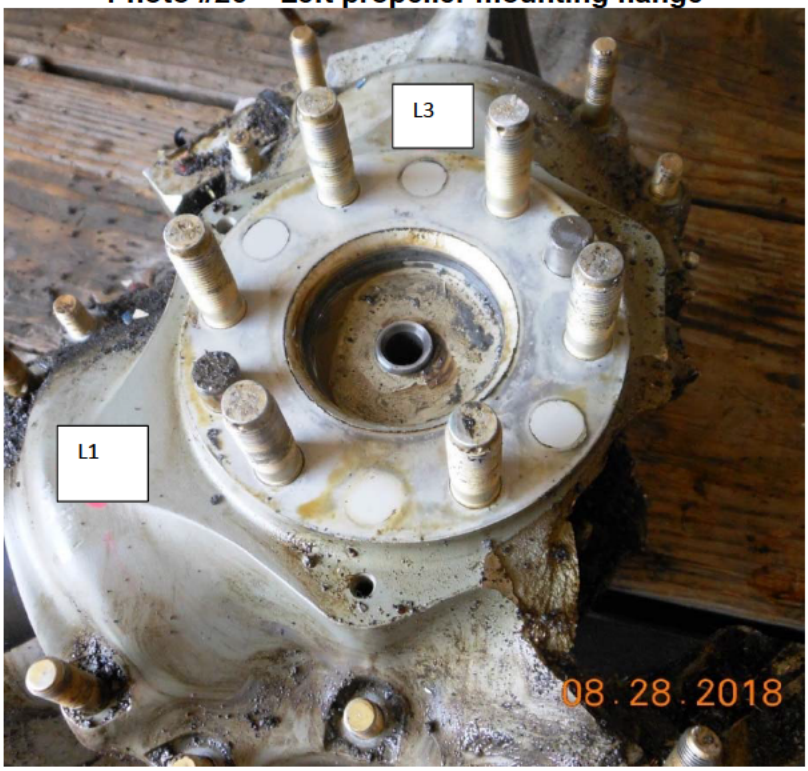


Photo #27 – Left crankshaft fracture surface

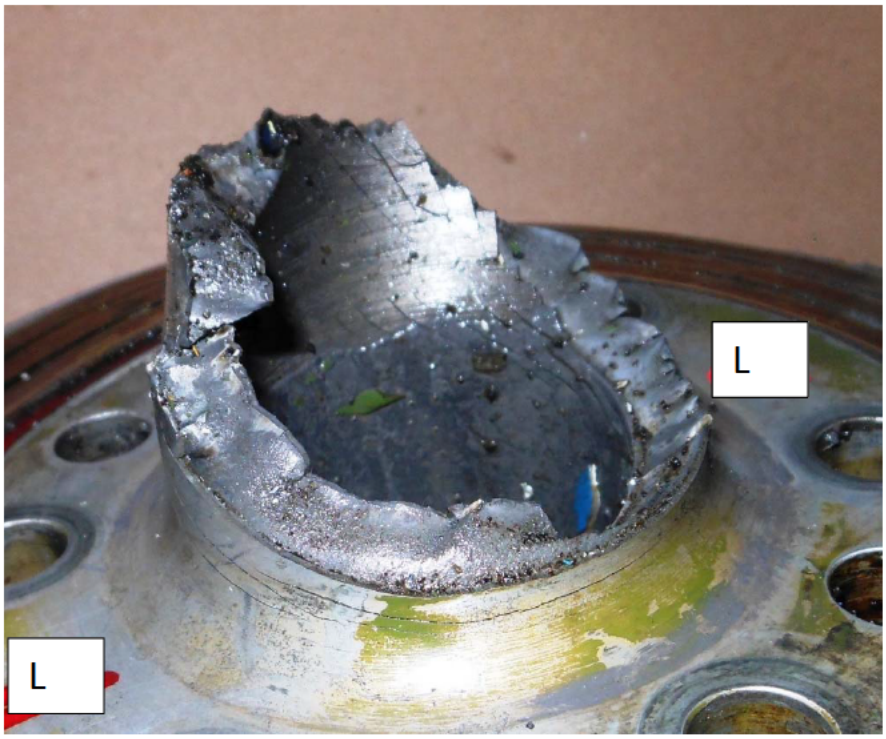


Photo #28 – Left preload plates (L2 not presented)

Photo #29 – Left aft hub half and L2 retention pocket fracture

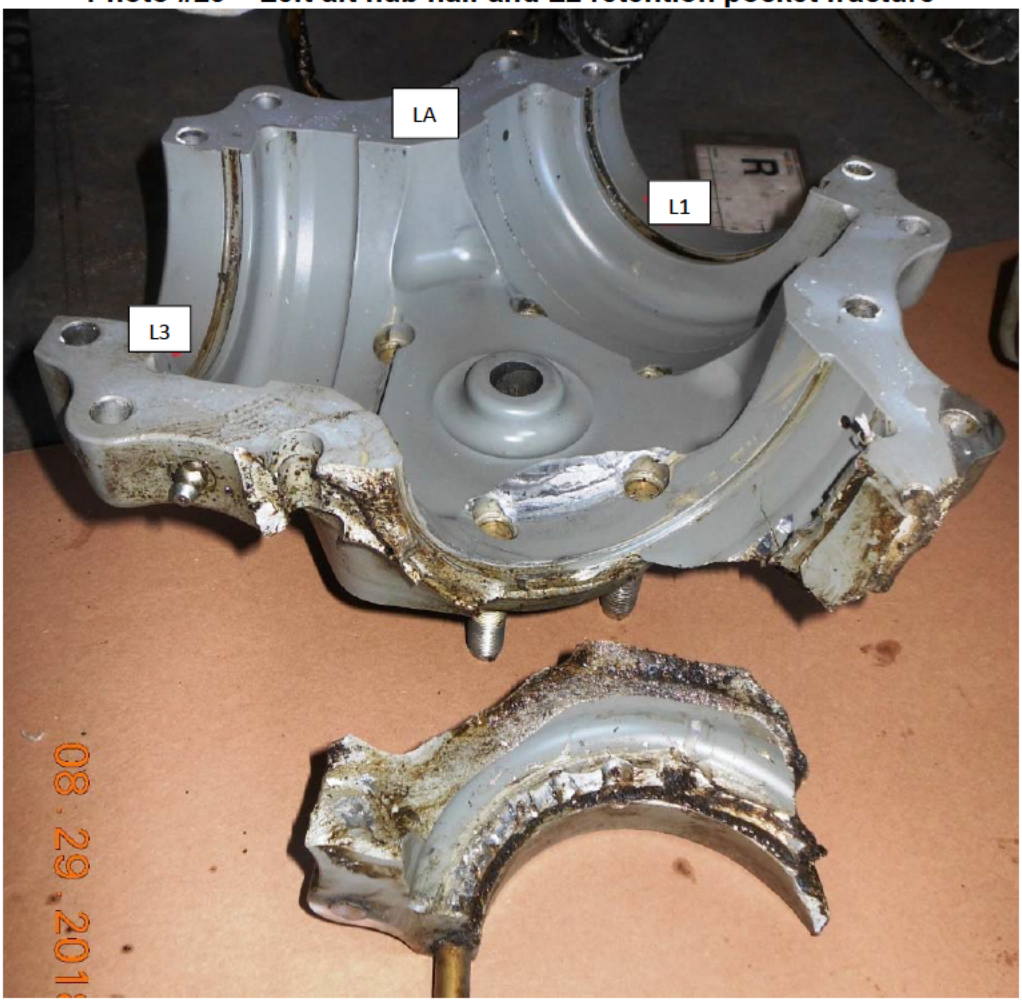


Photo #30 – Left forward hub half

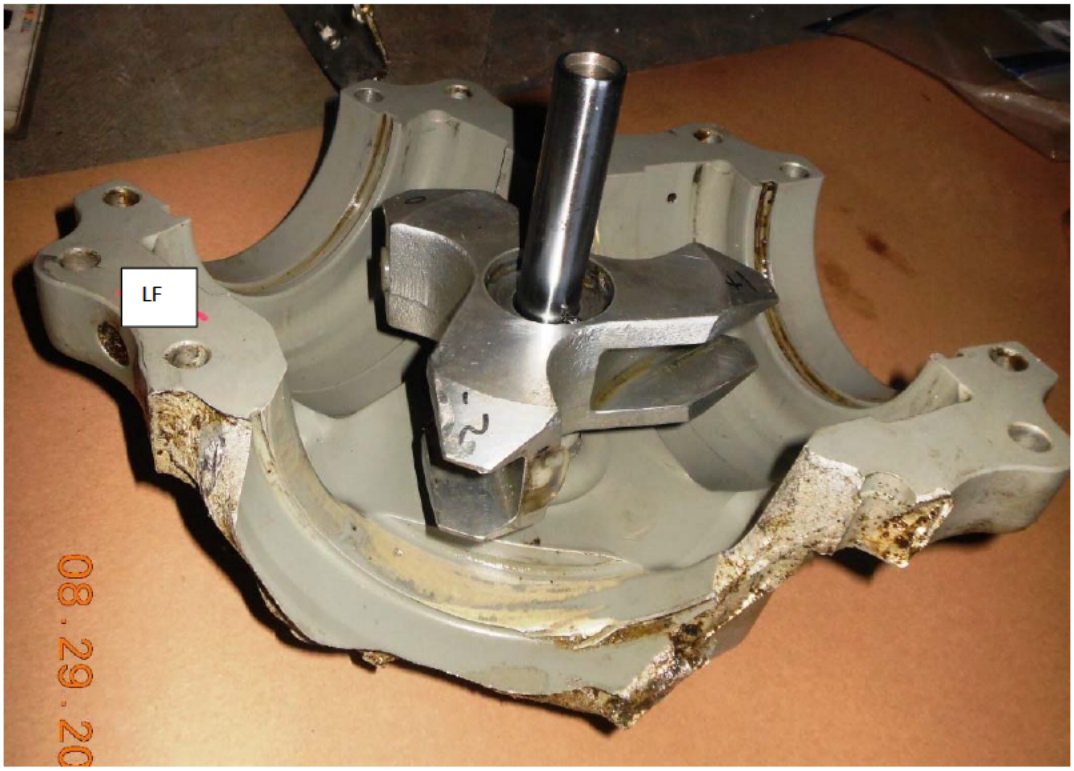


Photo #31 – Left cylinder mounting boss and pitch change rod bend

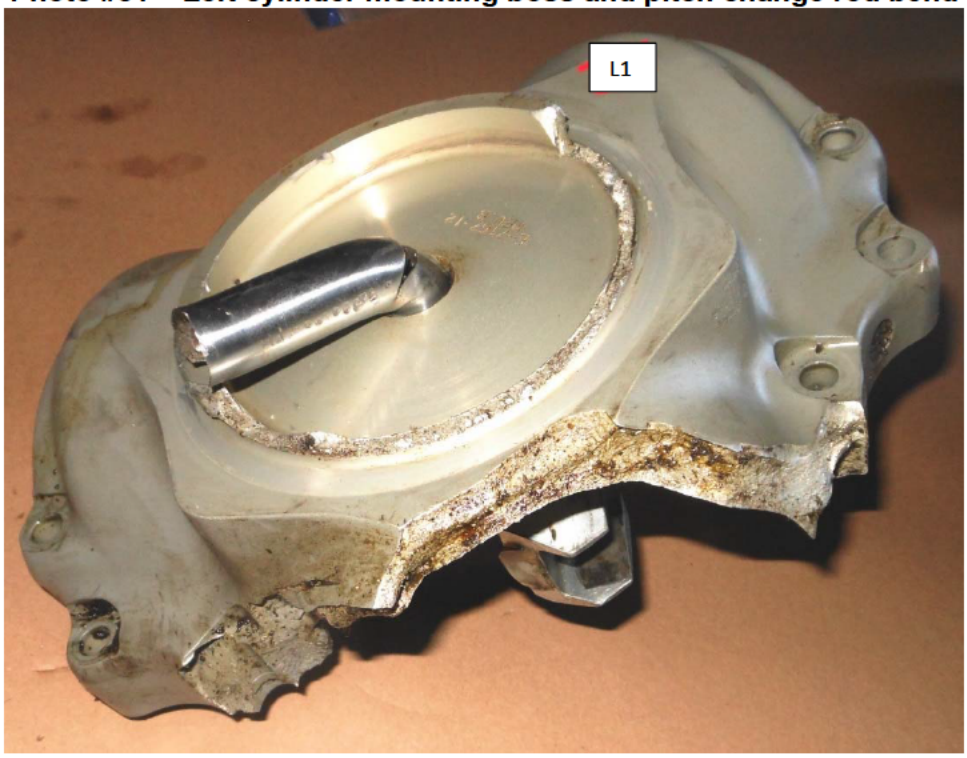


Photo #32 – Left blades camber side view

Photo #33 – Left blades face side view

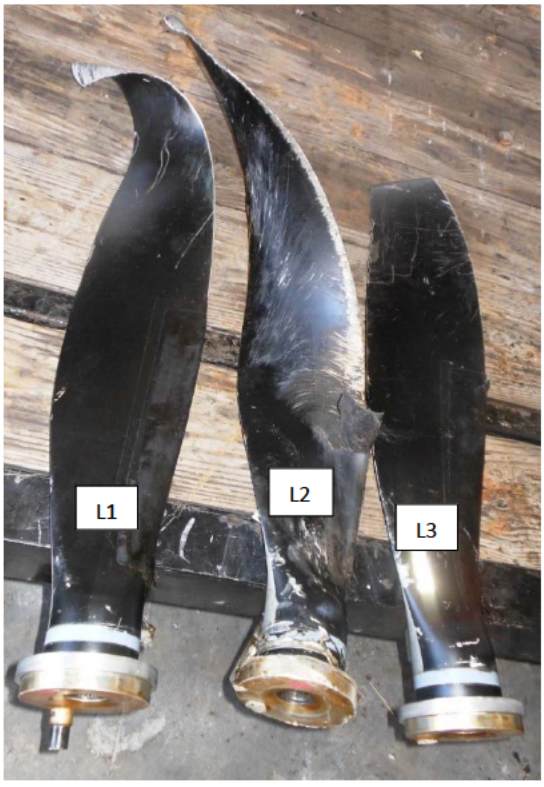


Photo #34 – Left blades leading edge view

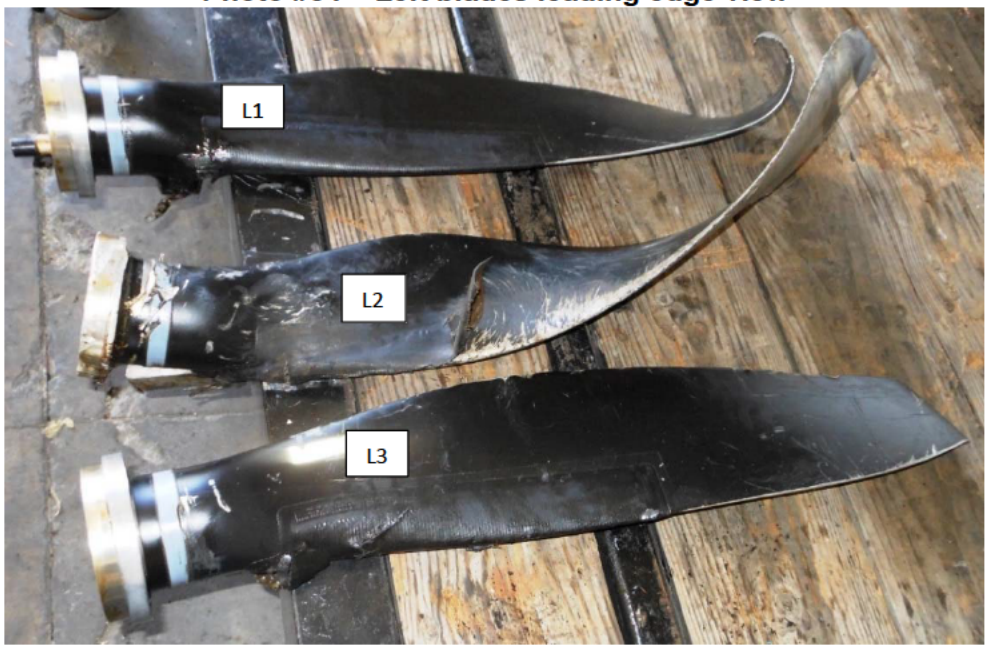


Photo #35 – L1 camber side scoring

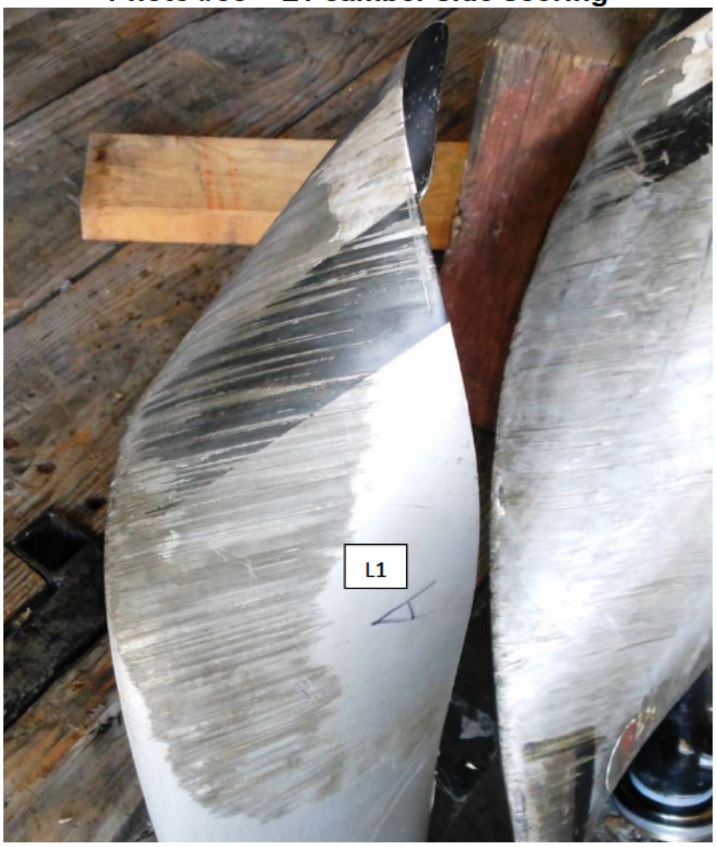


Photo #36 – L2 camber side scoring

Photo #37 – L3 tip fracture

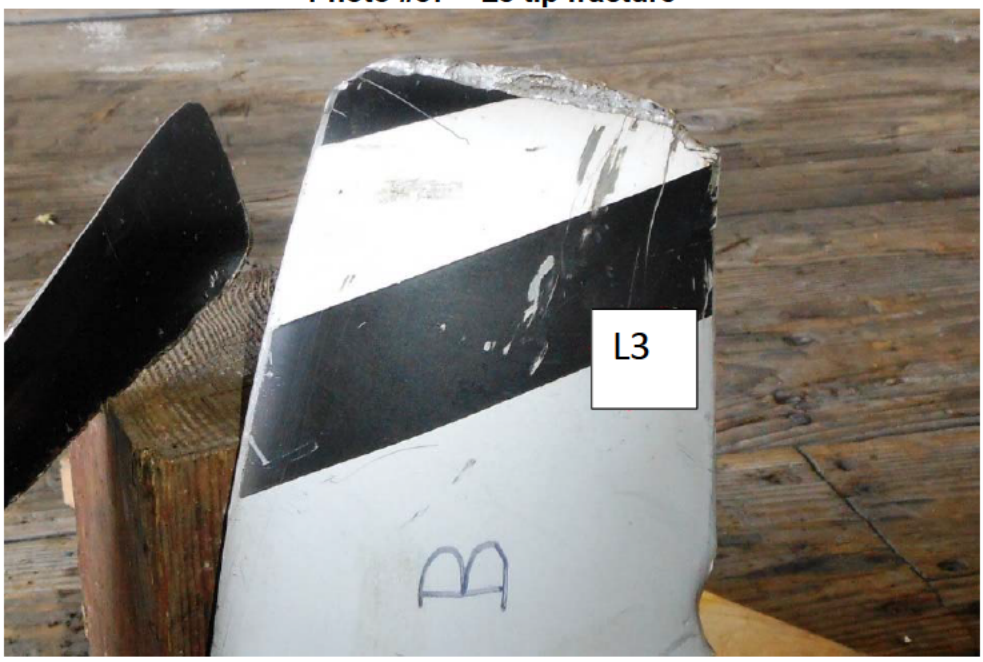


PHOTO LIST

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.

Picture File Name	Description
DSCN8289.JPG	Right propeller as-presented
DSCN8290.JPG	Left propeller as-presented
DSCN8291.JPG	Left propeller bulkhead and mounting flange as-presented
DSCN8292.JPG	Right spinner bulkhead and mounting flange as-presented
DSCN8293.JPG	Right aft hub fracture at R2 A
DSCN8294.JPG	Right aft hub fracture at R2 B
DSCN8295.JPG	Right mounting flange A
DSCN8296.JPG	Right aft hub fracture at R2 C
DSCN8297.JPG	Right aft hub fracture at R2 D
DSCN8298.JPG	Right forward hub/cylinder mounting boss before disassembly A
DSCN8299.JPG	Right blade retention pocket fracture at R2 A
DSCN8300.JPG	Right blade retention pocket fracture at R2 B
DSCN8301.JPG	Right forward hub/cylinder mounting boss before disassembly B
DSCN8302.JPG	Right hub internal after opening
DSCN8303.JPG	Right forward hub internal after opening
DSCN8304.JPG	Left propeller mounting flange after spinner bulkhead removal
DSCN8305.JPG	Left mounting flange
DSCN8306.JPG	Left hub fracture at L2 A
DSCN8307.JPG	Left hub fracture at L2 B
DSCN8308.JPG	Left forward hub half internal after opening
DSCN8309.JPG	Left aft hub half internal after opening
DSCN8310.JPG	Right propeller component lay-out A
DSCN8311.JPG	Right propeller component lay-out B
DSCN8312.JPG	Left propeller component lay-out A
DSCN8313.JPG	Left propeller component lay-out B
DSCN8314.JPG	Left propeller component lay-out C
DSCN8315.JPG	Right propeller component lay-out C
DSCN8316.JPG	Right spinner bulkhead
DSCN8317.JPG	Photo unusable - underexposed
DSCN8318.JPG	Right fork
DSCN8319.JPG	Right fork slot A
DSCN8320.JPG	Right fork slot B
DSCN8321.JPG	Right fork slot C
DSCN8322.JPG	Right fork and pitch change rod
DSCN8323.JPG	Right forward hub internal after cleaning
DSCN8324.JPG	Right cylinder mounting boss A

DSCN8325.JPG	Right cylinder mounting boss B
DSCN8326.JPG	Right aft hub half after cleaning
DSCN8327.JPG	Right aft hub half fracture at R2 with fragments
DSCN8328.JPG	Right hub fracture surface at R2
DSCN8329.JPG	Right model, PC/TC and S/N
DSCN8330.JPG	Right crankshaft fracture surface A
DSCN8331.JPG	Right crankshaft fracture surface B
DSCN8332.JPG	Right mounting flange B
DSCN8333.JPG	Right hardware bags
DSCN8334.JPG	L2 preload plate with knob mark measurements A
DSCN8335.JPG	L2 preload plate with knob mark measurements B
DSCN8336.JPG	L2 preload plate sidewall fracture
DSCN8337.JPG	L2 preload plate with knob mark measurements C
DSCN8338.JPG	Blade R2 vs L2 bend and twist comparison
DSCN8339.JPG	Left and Right preload plates A
DSCN8340.JPG	Left and Right preload plates B
DSCN8341.JPG	Left and Right preload plates C
DSCN8342.JPG	Left and Right preload plates D
DSCN8343.JPG	Left and Right preload plates E
DSCN8344.JPG	Left and Right preload plates F
DSCN8345.JPG	Right blades camber side view A
DSCN8346.JPG	Right blades camber side view B
DSCN8347.JPG	Right blades leading edge view
DSCN8348.JPG	R1 and R2 camber side blade tip
DSCN8349.JPG	R3 camber side blade tip
DSCN8350.JPG	Right blades camber side view B
DSCN8351.JPG	Right blades leading edge view at tip
DSCN8352.JPG	Right blades face side view
DSCN8353.JPG	R3 face side view
DSCN8354.JPG	R2 and R3 face side tip area
DSCN8355.JPG	R1 and R2 face side tip area
DSCN8356.JPG	R1 shank trailing edge hub aperture impact mark
DSCN8357.JPG	R1 blade butt
DSCN8358.JPG	R2 blade butt
DSCN8359.JPG	R3 blade butt
DSCN8360.JPG	R3 pitch change knob
DSCN8361.JPG	R1 blade butt B
DSCN8362.JPG	R2 shank impact damage
DSCN8363.JPG	Left model, PC/TC and S/N
DSCN8364.JPG	Left spinner bulkhead
DSCN8365.JPG	Left crankshaft flange fracture A
DSCN8366.JPG	Left crankshaft flange fracture B
DSCN8367.JPG	Left aft hub half internal after cleaning
DSCN8368.JPG	Left aft hub half internal at L2 fracture
DSCN8369.JPG	Left mounting flange
DSCN8370.JPG	Left aft hub half L2 fracture surface
DSCN8371.JPG	Left forward hub half internal after cleaning A
DSCN8372.JPG	Photo unusable - overexposed
DSCN8373.JPG	Left forward hub half internal after cleaning B (photo dark)

DSCN8374.JPG	Left forward hub half internal after cleaning C (photo dark)
DSCN8375.JPG	Left cylinder mounting boss and pitch change rod A
DSCN8376.JPG	Left cylinder mounting boss and pitch change rod B
DSCN8377.JPG	Left hardware bags
DSCN8378.JPG	Right preload plates with knobs/blocks
DSCN8379.JPG	R2 preload plate with knob fracture surface
DSCN8380.JPG	Left preload plates with knobs/blocks
DSCN8381.JPG	L3 pitch change knob fracture A
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DSCN8383.JPG	R2 knob fracture surface
DSCN8384.JPG	Left blades camber side view A
DSCN8385.JPG	Left blades camber side view B
DSCN8386.JPG	Left blades leading edge view
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DSCN8388.JPG	L1 camber side chordwise scoring
DSCN8389.JPG	L2 camber side chordwise scoring
DSCN8390.JPG	L3 tip fracture
DSCN8391.JPG	Left blades face side from trailing edge
DSCN8392.JPG	Left blades face side from leading edge
DSCN8393.JPG	L1 blade butt
DSCN8394.JPG	L2 blade butt
DSCN8395.JPG	L3 blade butt
DSCN8396.JPG	Left blades face side from shank view A
DSCN8397.JPG	Right blades is suggested impact sequence, face side view
DSCN8398.JPG	Left blades in suggested impact sequence, face side view
DSCN8399.JPG	L2 vs R1 blade twist and bend comparison
DSCN8400.JPG	L2 vs R2 blade twist and bend comparison
DSCN8401.JPG	Right hub halves together at R2 fracture
DSCN8402.JPG	Left hub halves together at L2 fracture