Date of Accident: February, 3, 2019

Location: Yorba Linda, CA

NTSB File No.: WPR19FA079

Aircraft: Cessna 414A

Registration No.: N414RS

Serial No.: 414A0821 (Year of Manufacture 1982)

Operator: (Per registration certificate found in aircraft, FAA database indicates registration not valid)
AIR 20 CORP
[redacted]
Gardenville, NV 89410-7327

Written by: Les Doud - Air Safety Investigator

Report Date: March 11, 2019

Contents:

PROPELLER EXAMINATION REPORT

Date of Examination: February 6-8, 2019

Location: Air Transport
[redacted]
Phoenix, AZ 85034

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

Representatives:

Les Doud	Hartzell Propeller Inc. ASI
Maja Smith	NTSB Investigator in Charge
Eliott Simpson	NTSB Sr. Air Safety Investigator
Ricardo Asensio	Textron Air Safety Investigator

ACCIDENT SYNOPSIS
The NTSB preliminary report states:

"On February 3, 2019, at 1345 Pacific standard time, a Cessna 414, N414RS, experienced an in-flight breakup over Yorba Linda, California, about 11 miles west of the departure airport Fullerton Municipal Airport (FUL), Fullerton, California. The pilot and four individuals on the ground sustained fatal injuries, two individuals on the ground sustained serious injuries and the airplane was destroyed. The airplane was registered to and operated by the private pilot as a 14 *Code of Federal Regulations* (CFR) Part 91 cross-country personal flight. Visual meteorological conditions (VMC) prevailed over the accident location, and no flight plan was filed. The flight departed at 1339, with a planned destination of Minden-Tahoe Airport (MEV), Minden, Nevada.

Radar and audio communications data provided by the Federal Aviation Administration (FAA) revealed that after departing FUL, the pilot initiated a climbing left turn to the east. Visual meteorological conditions (VMC) existed at the departure airport, however, preliminary information indicated that the weather transitioned to instrument meteorological conditions (IMC) with precipitation, microburst and rain showers over the accident area. During the take-off clearance, the FUL tower air traffic controller cautioned the pilot regarding deteriorating weather, about 4 miles east of FUL. Radar data showed that 5 1/2 minutes after takeoff, the airplane had climbed to an altitude of about 7,800 ft above ground level before it started a rapid descending right turn and subsequently impacted the ground.

Numerous witnesses who were located near the accident site, saw the airplane exit the clouds at a high rate of descent before parts of the airplane started to break off. One witness reported that he, "observed an aircraft emerge from the overcast layer on a northwesterly heading with a nose down pitch of approximately 60 degrees, pointed directly at my location with no discernable movement. It remained in that attitude for approximately 4 to 5 seconds before initiating a high-speed dive recovery. Approaching the bottom of the recovery the aircraft began to roll to its right. As it did, the left horizontal stabilizer departed the aircraft, immediately followed by the remainder of the empennage. The left wing then appeared to shear off just outside of the number one (left) engine igniting the left wing. After which, the aircraft disappeared behind the hill to the northeast of the observed location, trailing flames behind it. The sound of an explosion and large plume of black smoke immediately followed."

Examination of the accident site revealed that the wreckage debris was scattered throughout a neighborhood area about 1,000 ft long and 800 ft wide on a south-to-north orientation. At the far south parameter of the debris field were tail sections. The far north area contained the left engine, and left propeller and the fuselage. About 700 ft north-east from the first recovered piece of debris, the right engine and the right propeller impacted an asphalt road, and came to rest in a nearby front yard. The left wing was found about 716 ft north of the first recovered piece of debris, about 140 ft south-west of a burned house. Within the house, fragments of the outboard right wing (which also contained the fuel tank) were located. The fuselage with the attached right inboard wing, along with the left propeller and left engine were located about 310 ft downhill from the burned house on a heading of 310°."

SUMMARY AND ANALYSIS OF FINDINGS

Both left and right propellers fracture-separated from their respective engines during the impact sequence. The propellers were recovered and examined at Air Transport in Phoenix, AZ on February 6-8, 2019. The propellers were disassembled to document impact damage and gather information that indicated state of operation prior to impact.

The aircraft experienced an in-flight breakup and both engines separated from their respective nacelle/engine mounts prior to impact with terrain. Based on photos provided by on-scene investigators, the right engine and propeller impacted on a residential street and the propeller came to rest in the driveway of 19761 Crestknoll Drive. The left engine and propeller impacted trees and fell into the residential backyard of 19912 Canyon Drive. A *Nest* security camera located at 6111 Amberdale Drive that was pointed south recorded the impact sequence of the left engine/propeller and fuselage.

The left propeller exhibited chordwise/rotational abrasion on blade L1 camber side and a wave-bend that is characteristic of a tree strike. The other two blades did not exhibit damage consistent with high rotational speed under power, such as significant leading edge gouging and/or chordwise/rotational scoring. Preload plate marks suggested a blade angle of approximately 46° at some point during the breakup and impact sequence. A counterweight puncture mark in the spinner dome suggested a blade angle near the low pitch stop position.

The right propeller exhibited minimal chordwise/rotational scoring or twisting damage on the blades that would indicate rotation under power at time of impact with terrain. Blade R3 had no remarkable scoring or gouging damage suggesting it never contacted the asphalt during the initial impact. There were also no remarkable rotational marks on the spinner indicating rotation. Ground impact marks, location and direction of deformation damage, as well as blade damage all indicate the propeller impacted with little to no rotational speed. Pitch change knob marks in preload plates R1 and R3 indicated the blade angle was in the normal range operation and higher than the low pitch stop at time of initial impact with terrain. Damage suggested that impact forces caused forcible movement toward low pitch as recorded by the counterweight scrape marks on the interior spinner dome surface near R2 and R3 blade apertures.

It could not be determined if the propellers made contact with any part of the airframe during the breakup sequence and prior to impact with terrain.

Audio analysis of several security cameras was completed to discern propeller noise signatures that may provide aircraft airspeed estimates. As mentioned previously, the *Nest* camera video at 6111 Amberdale Drive recorded the impact sequence of the left engine/propeller and fuselage. This camera location appeared to be closely in line with the aircraft flight path (see Figure 1). The audio spectrums from that video are provided in Figure 2 and Figure 3. The 414A engines are rated for 2700 RPM. For a 3-blade propeller without Doppler shift, 2700 RPM equates to a blade passage frequency of 135 Hz. Frequencies above or below that may indicate Doppler shift due to aircraft velocity, either approaching (higher frequency) or moving away (lower frequency) from the camera. The propeller blade passage frequency at the start of the Amberdale video is approximately 137 Hz, with distinct harmonics at 2x, 3x, 4x, etc. blade passage frequencies as shown in Figure 2. Figure 3 shows the audio spectrum just before the inflight breakup occurred. Due to Doppler shift the propeller blade passage frequency increased to approximately 257 Hz as the aircraft accelerated toward the camera microphone. The spectrogram in Figure 4 shows this increasing frequency over time. Assuming the pilot had 2700 RPM set, the velocity necessary to generate that Doppler shift is approximately 310-315 knots. All the security camera videos that were reviewed indicated that after the inflight breakup, engine and propeller noise diminished quickly and was no longer detectable before impact with terrain.

Propeller performance analysis at approximately 310 KTAS, 2000 ft, and with full power of 325 HP/2700 RPM results in blade angles of approximately 34.5°.

CONCLUSIONS

There were no discrepancies noted during the examination that would prevent or degrade normal propeller operation prior to impact. Both propellers appear to have slowed in rotation with blade angles above the start lock position prior to impact with terrain. All damage was consistent with high impact forces.

Figure #1 –6111 Amberdale Security Camera Location

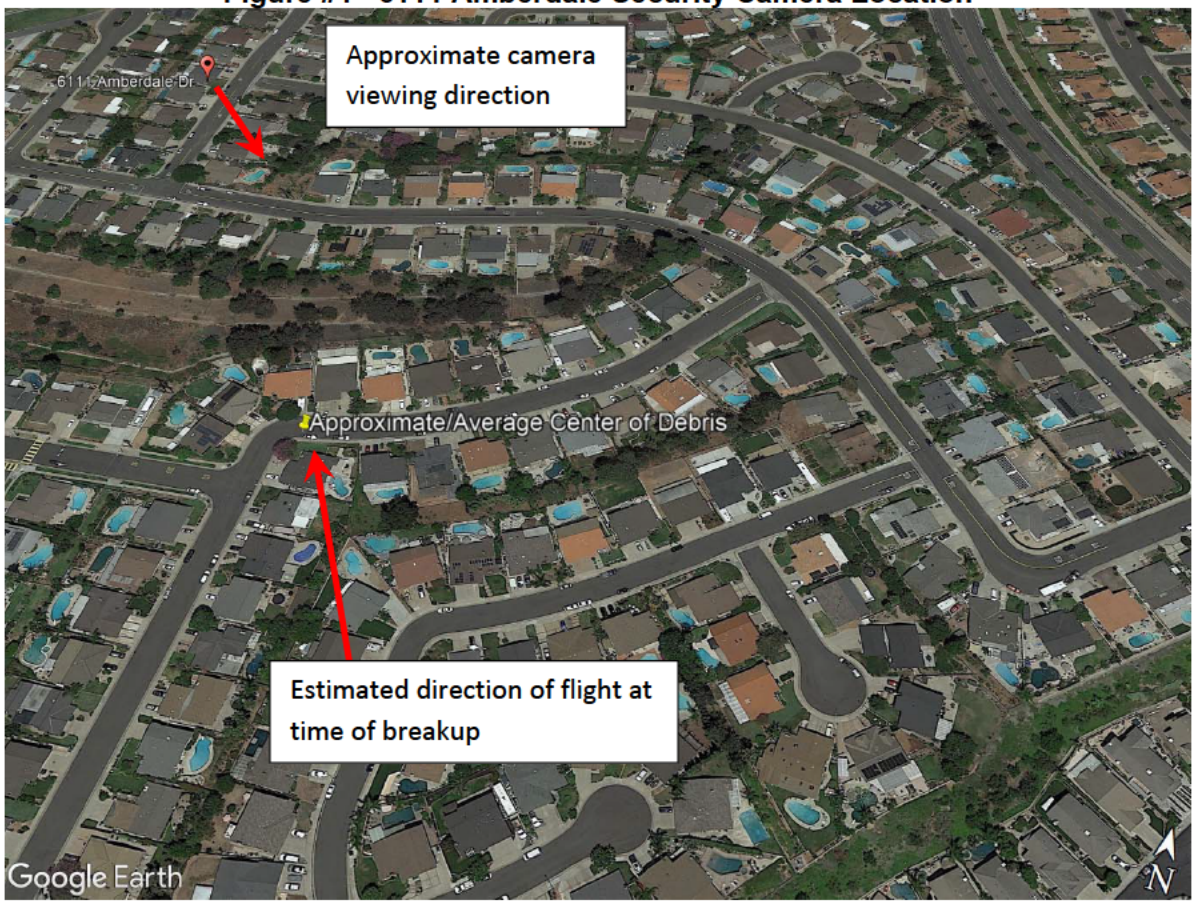


Figure #2 – Audio spectrum from security camera at 6111 Amberdale Dr. (beginning of video)

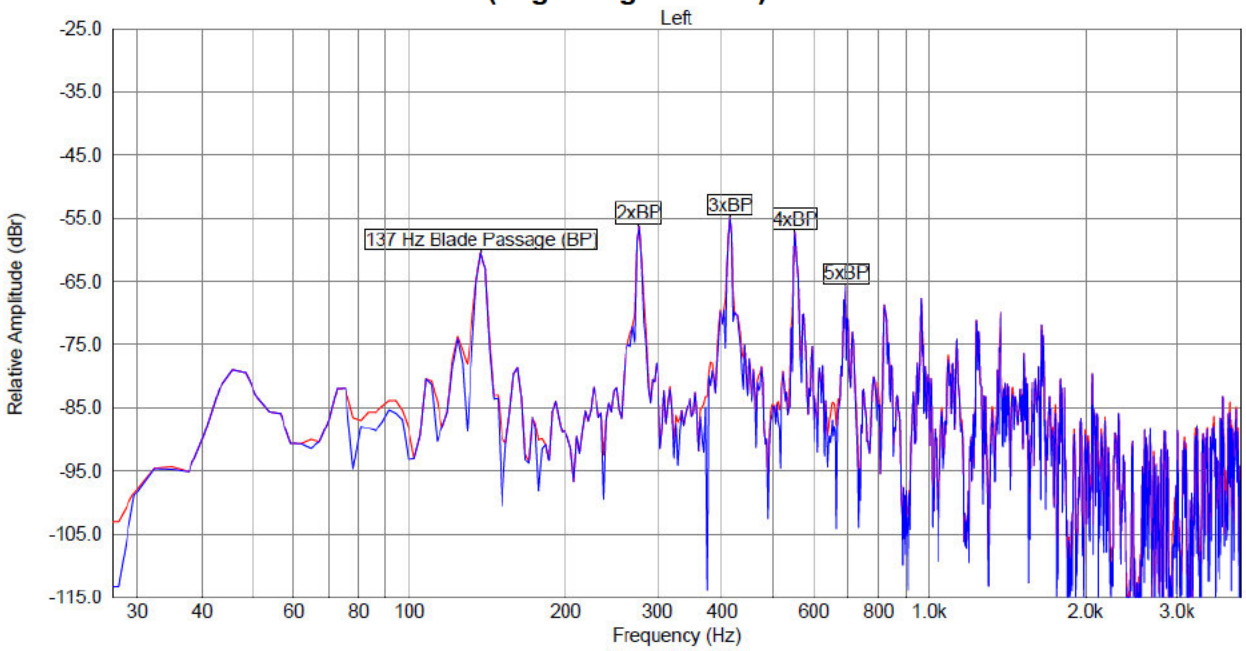


Figure #3 – Audio spectrum from security camera at 6111 Amberdale Dr. (just before inflight breakup)

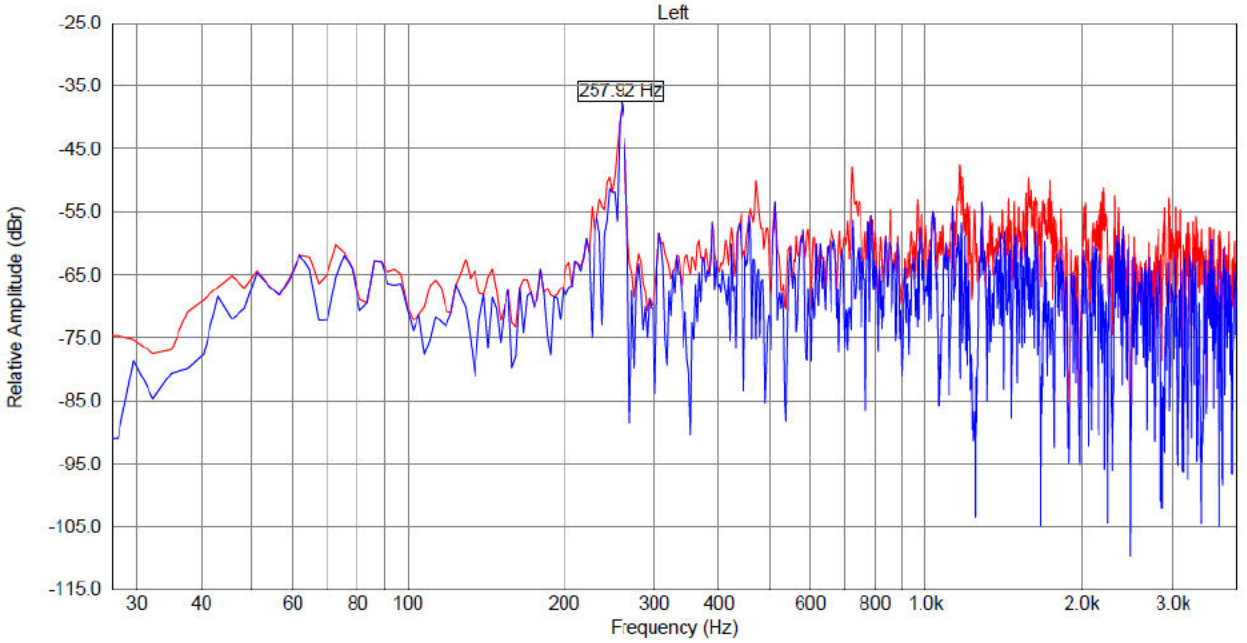
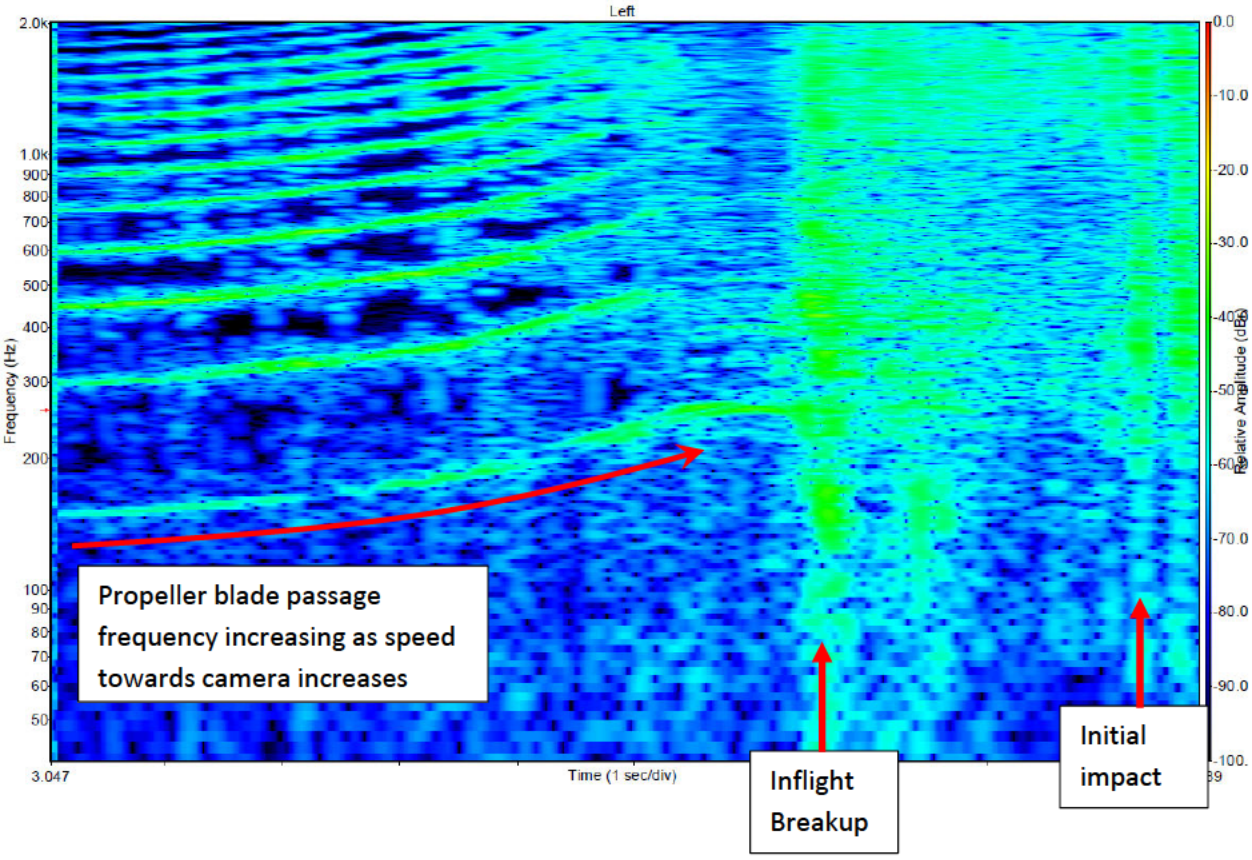


Figure #3 – Audio spectrogram from security camera at 6111 Amberdale Dr.



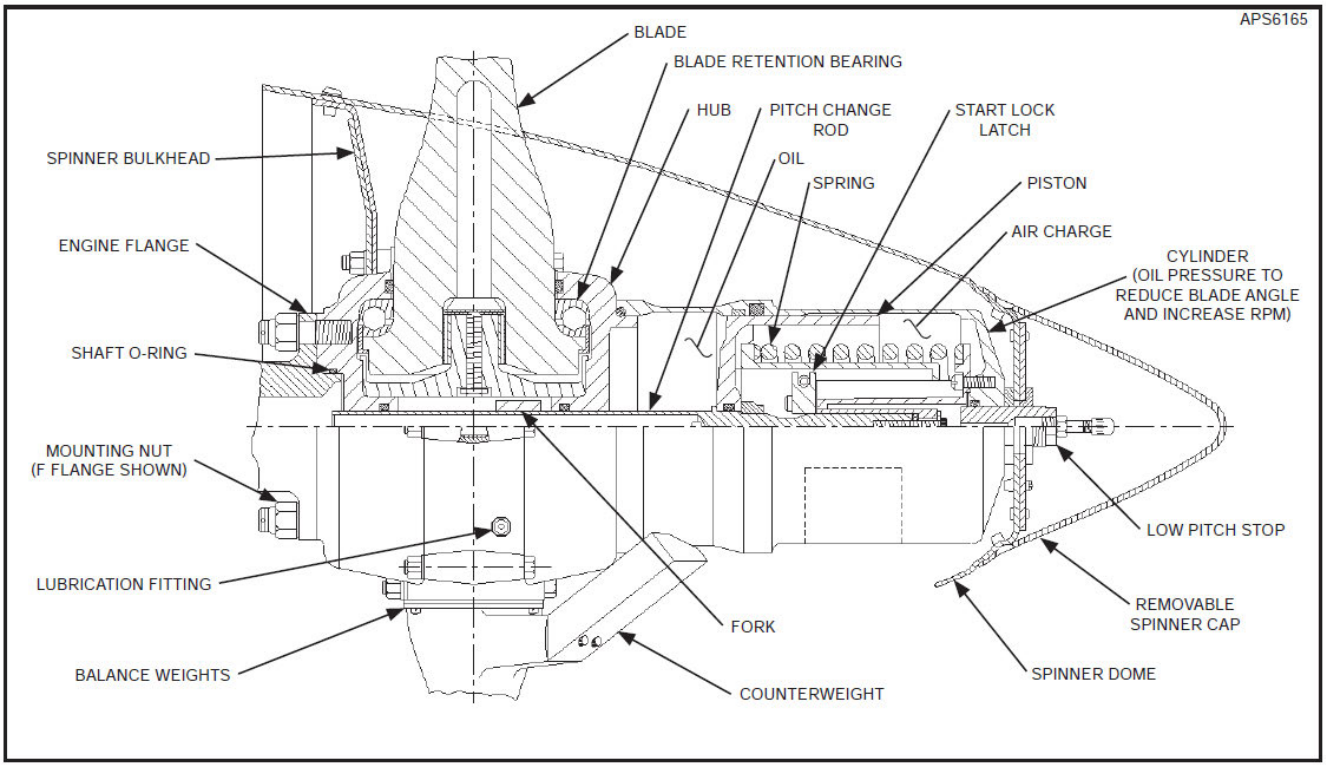
GENERAL INFORMATION

Propeller Description: The Cessna 414A 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: **LEFT**

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

Propeller Assembly Serial Number: EB6296B

Service History: The propeller logbook indicates the last propeller service was a 100 hour/annual inspection conducted by Carson Valley Aircraft Services on 4/3/18 at a TSN of 1252.9 hours. There was no propeller logbook entry indicating the propeller had been overhauled.

	S/N	Date of Manufacture	TTSN	TSO
Hub/Factory	A78638B	11/21/05	1396.3	NA
Blade 1	K30650	1/17/05	1396.3	NA
Blade 2	K30645	1/17/05	1396.3	NA
Blade 3	K30653	1/17/05	1396.3	NA

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 left propeller fractured-separated from the engine during the impact sequence and was found lodged into the soil behind the residence at 19912 Canyon Dr. (near where fuselage came to rest) as shown in Photo #1. The propeller was presented for examination as shown in Photo #2. The spinner dome was crushed and torn but remained attached to the propeller assembly. The engine crankshaft fractured behind the flange which remained attached to the propeller; one of the six studs fracture-separated and was missing. All three blades remained attached to the propeller assembly. Blade L1 had a large wave-bend in the mid-blade area and was at a high pitch, almost feathered position. Blade L2 was bent aft and rotated in the high pitch direction approximately 180° from a normal operating position; it was beyond the feather stop and the counterweight was on the aft side the propeller assembly. Blades L3 was bent forward and in a normal operating blade angle range. Blades L2 and L3 rotated by hand force suggesting fractured pitch change knobs. There was distinguishable chordwise/rotational scoring on the camber side of blade L1. Blades L2 and L3 exhibited some chordwise/rotational scrapes on the face side. There were varying degrees of dents, gouges and tears in the trailing edges of all three blades. The propeller had various amounts of dirt and vegetation in and around the hub including pine needles. leaves, grass and wood pulp. Photo #3 shows the propeller with the spinner dome removed prior to disassembly.

Propeller Cycling: Propeller cycling was not attempted due to suspected damage to two pitch change knobs.

Spinner Dome: The spinner dome was crushed and torn with no remarkable spiral deformation. There was a counterweight cut/puncture/impression at the L3 blade position with an angle of approximately 25-27° (Photo #4). This equates to a blade angle of approximately of 13° which corresponds to the low pitch stop position. The forward bulkhead debonded and was found loose inside the dome.

Spinner Bulkhead: The spinner bulkhead was bent and torn. The de-ice slip ring remained intact but bent and gouged adjacent to the L1 blade arm (Photo #5).

Engine/Propeller Mounting: The crankshaft flange remained attached to the propeller flange and one of the six mounting studs was fracture-separated; the remaining five studs/nuts were tight. The mounting flange appeared intact and there were no indications of fretting/galling on the mating surfaces (Photo #6). The crankshaft flange fracture is shown in Photo #7.

Hydraulic Unit: The hydraulic unit consisting of the cylinder, piston, pitch change rod, pitch stops (low, feather and start lock), feathering spring and guides remained attached to the propeller assembly during the impact sequence. The air valve stem fractured from the low pitch stop assembly and was found loose inside the spinner dome; the air valve cap was not found.

The cylinder was intact with a dent on one side with no apparent oil leaks at the attachment or into the hub. When the cylinder was removed, oil was present on the pressure side of the piston with no evidence of leakage past the piston or into the hub. The feathering spring retainer cup was shattered with many small fragments in the air chamber of the cylinder (Photo #8).

The piston was intact with a dent adjacent to the location of the dent in the cylinder. The pitch change rod was intact but bent in the area that threads into the fork (Photo #9). The fork had one forward tank fractured due to forceful rotation of the blade in the low pitch direction (Photo #12).

The start lock assembly appeared intact and undamaged (Photo #10). When removing the low pitch stop it appeared the pitch change rod was at a position higher/past than the start lock. The low pitch stop had normal contact wear with no apparent forceful impact with the pitch change rod (Photo #11). The start lock sleeve and feathering stop appeared intact and undamaged. The feathering spring and forward spring guide appeared intact and undamaged.

Hub Assembly: The hub assembly appeared intact with no visually obvious fractures or cracks. The cylinder mounting boss and threads appeared intact and undamaged. There were burrs/impact deformation on all three preload plate shoulders (Photos #13 and #14). When the hub was initially opened the quantity of grease indicated it was overserviced.

Preload Plates: All three preload plate lips were sheared, fractured and/or smashed. L1 had an impact mark from contact with the aft hub half pocket web (Photo #15). L2 and L3 had impact marks from contact marks with the forward hub half pocket web. All three preload plates had fork contact marks near the hub parting line position which is equivalent to a blade angle of approximately 46°. There were normal fork bumper scuff marks on all three preload plates

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).

Propeller Blade Properties: (Photos #16 through #20)

Blade # L1

Camber side	Chordwise/rotational scoring
Face side	Random scoring near tip
Bend	Mid-blade was bent aft in what appears to be a tree-strike wave-type bend
Twist	Not remarkable
Lead edge damage	Tree strike wave bend, nicks and gouges near tip
Trail edge damage	Gouges and dents
Knob condition	Intact, not shot peened
Counterweight	Intact
Blade bearings	Intact
Butt/shank impact marks	Preload plat slot mark on the low pitch side of knob
De-Ice boot	Delaminated outboard end of face side

Blade # L2

Camber side	Spanwise scoring mid-blade and tip
Face side	Chordwise scrapes in the mid-blade area
Bend	Aft
Twist	Leading edge up at tip, toward high pitch
Lead edge damage	Nicks and gouges
Trail edge damage	Torn and gouged
Knob condition	Fractured, appears to be a shear/overload fracture
Counterweight	Intact
Blade bearings	Intact
Butt/shank impact marks	Preload place crescent-shaped contact mark in the aft/trailing edge quadrant
De-Ice boot	Torn and peeled along the leading edge camber side

Blade # L3

Camber side	Not remarkable
Face side	Spanwise scoring along leading edge, chordwise scrapes near tip
Bend	Forward, thrust direction
Twist	Leading edge up at tip, toward high pitch
Lead edge damage	Not remarkable
Trail edge damage	Wave bend and nicks in mid-blade
Knob condition	Fractured, appears to be a shear/overload fracture
Counterweight	Intact
Blade bearings	Intact
Butt/shank impact marks	Preload plate slot mark on both low and high pitch side of knob
De-Ice boot	Torn and peeled along leading edge

Photo #1 – Left propeller in-situ
(Photo provided by on-scene investigators)

Photo #2 – Left propeller as-presented for examination

Photo #3 – Left propeller with spinner dome removed

Photo #4 – Left propeller spinner dome counterweight mark/puncture

Photo #5 – Left spinner bulkhead

Photo #6 – Left propeller/hub mounting flange

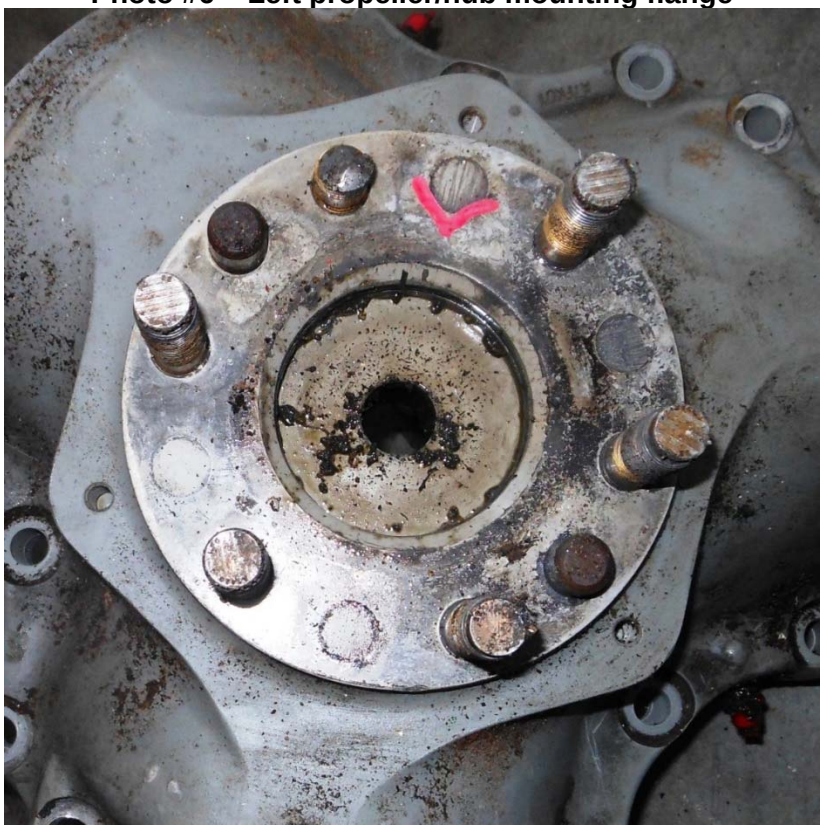


Photo #7 – Left crankshaft fracture surface

Photo #8 – Left propeller fragmented spring retainer cup

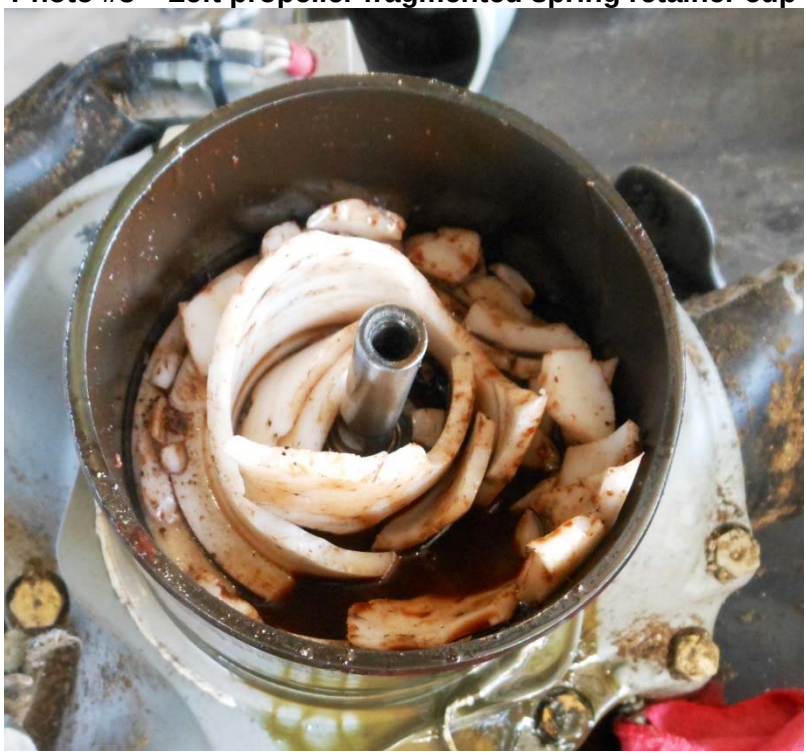


Photo #9 – Left propeller piston and pitch change rod

Photo #10 – Left propeller cylinder internal surface and start lock weights

Photo #11 – Left propeller low pitch stop

Photo #12 – Left fork fracture

Photo #13 – Left aft hub half

Photo #14 – Left forward hub half

Photo #15 – Left preload plates

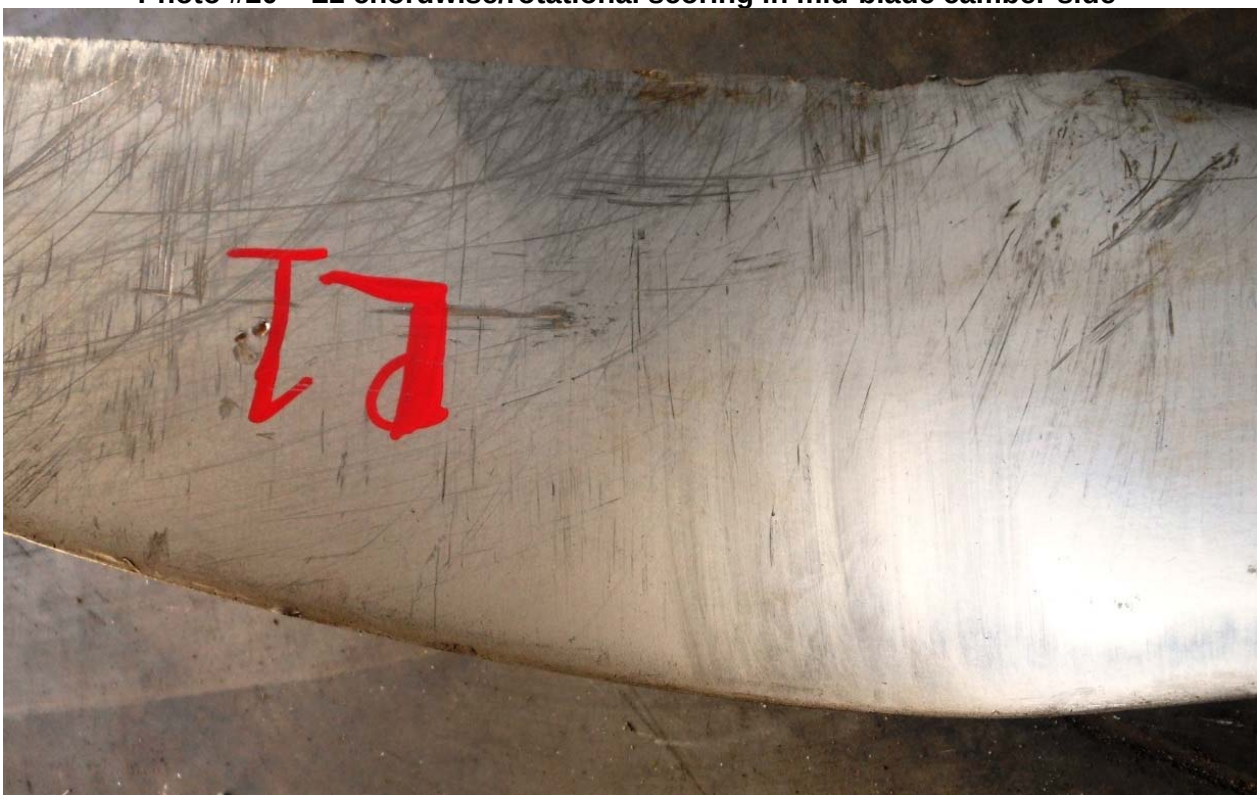
Photo #16 – Left blades camber side view

Photo #17 – Left blades face side view

Photo #18 – L2 and L3 pitch change knob fractures

Photo #19 – L1 leading edge view (tree strike wave bend in mid-blade)

Photo #20 – L1 chordwise/rotational scoring in mid-blade camber-side



Position: **RIGHT**

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

Propeller Assembly Serial Number: EB6297B

Service History: The propeller logbook indicates the last propeller service was a 100 hour/annual inspection conducted by Carson Valley Aircraft Services on 4/3/18 at a TSN of 1252.9 hours. There was no propeller logbook entry indicating the propeller had been overhauled. There is a logbook entry for a propeller flush and reseal by Stockton Propeller Inc. on 7/13/18 that was coincident with an engine overhaul/exchange.

	S/N	Date of Manufacture	TTSN	TSO
Hub/Factory	A78639B	11/21/05	1396.3	NA
Blade R1	K30655	1/17/05	1396.3	NA
Blade R2	K30641	1/17/05	1396.3	NA
Blade R3	K30643	1/17/05	1396.3	NA

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 right propeller fractured-separated from the engine during the impact sequence and was found in the residential driveway of 19761 Crestknoll Drive as shown in Photo #22. The propeller and engine initially impacted the asphalt street in front of this address and left impact marks corresponding to one blade edge and spinner/cylinder dome shape (Photo #21). The propeller was presented for examination as shown in Photos #23 and #24. The propeller mounting studs were pulled from the hub and all six studs/nuts remained in the crankshaft flange. The spinner dome was flattened on one side only, consistent with the impact marks in the asphalt. R1 and R3 blades rotated in the hub by hand force indicating fractured pitch change knobs. Blade R1 was bent aft, the tip was fractured and the aft hub pocket wall was fractured and the blade bearings were missing. Blade R2 had little remarkable bending and twisting; only leading edge damage. Blade R3 was bent forward. There was a distinct counterweight puncture in the spinner dome at blade R1 (Photo #25).

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

Spinner Dome: The spinner dome crushed on one side only with no remarkable rotational scoring or deformation (Photo #26). There was a distinct counterweight puncture mark at the R1 blade position at approximately 32° (Photo #27). This equates to a blade angle of approximately of 19°. There were also counterweight scuff marks on the internal surface at blade R2 and R3 positions between a low pitch position and a feather position (Photo #28).

Spinner Bulkhead: The spinner bulkhead was bent and torn as shown in Photo #29. The de-ice ring separated from the propeller assembly during the impact sequence and not found during this inspection.

Engine/Propeller Mounting: All six propeller mounting studs were pulled from the hub/mounting flange during the impact sequence. One of the drive dowel pins was also pulled from the hub and is missing. Several stud holes had deformation in the same direction indicating impact forces towards R1 and aft. There were no indications of fretting/galling on the mating surfaces (Photo #30). The crankshaft fractured inside the engine case and the fracture surface as shown in Photo #32.

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 found loose inside the spinner dome. The cylinder was crushed on one side and buckled in the same direction, consistent with the ground impact mark spinner dome deformation (Photo #33). The pitch change rod fractured just aft of the piston attachment. The piston, feathering springs, start lock and feather stop could not be removed due to damage and safety considerations and therefore the were not examined. The air valve fractured from the low pitch stop assembly. The low pitch stop was removed and appeared to have normal contact wear with no apparent forceful impact with the pitch change rod (Photo #35).

Pitch Change Rod: The pitch change rod aft of the piston was fractured and bent as shown in Photo #38 and could not be rotated for removal. The pitch change rod aft of the fork was also bent and gouged by blade R1 shank and blade retention hardware (Photo #34).

Fork: The was not removed due to the bent pitch change rod. A section of one aft tang fractured and there were knob/block impact marks in the slots. The plastic fork bumpers were also smashed.

Hub Assembly: The R1 blade retention pocket was fractured around both the aft and forward hub half (Photos #36 and #37) indicating impact forces in the aft direction. The aft hub R1 retention pocket fragmented and one fragment on the lead/face side of the aft hub half remained attached to the assembly. There was a counterweight impression mark on the external surface of the forward hub half at the R1 position; the impression mark was in the normal range of counterweight angles (Photo #25). The cylinder mounting boss threads were fracture-separated around approximately 50% of the circumference (Photo #38). The internal preload plate pockets of all three blades on both the forward and aft hub halves were damaged (Photos #36 and #37). Blade R1 pocket “scooped” hub material from the preload plate shoulder and pitch change rod boss (Photo #37).

Preload Plates: (Photo #39) The R1 preload blade was substantially damaged due to blade R1 movement in the retention pocket during the impact sequence. The R2 and R3 preload plate lips were sheared, fractured and/or smashed. R1 and R3 also had impact marks from contact with the pitch change knob.

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	Preload plate fractured/gouged with a pitch change knob impact mark at the 17° blade angle position (equivalent to a blade angle of approximately 30-31°). The plate had a thru-puncture from the fork leg on the leading edge side at a location consistent with the knob impact mark at 17°.
R2	Contact marks from fork in the mid-to-low pitch range of normal operation, at approximately the same position as the thru-puncture on R1.
R3	Preload plate had a pitch change knob impact mark at the 27° blade angle position (equivalent to a blade angle of approximately 20-21°).

Propeller Blade Properties: Photos #40 through #44

Blade # R1 – Approximately 6" of tip fractured and not recovered from accident site

Camber side	Chordwise/rotational scoring to approximately 0.3c. Deep, spanwise scoring consistent with impact into asphalt
Face side	Random spanwise scoring, gouging near shank
Bend	Aft
Twist	Not remarkable
Lead edge damage	Nicks
Trail edge damage	Bends and gouges
Knob condition	Fractured with block intact; bending overload
Counterweight	Fracture-separated from blade and recovered at crash scene. Attachment holes deformed inboard toward hub.
Blade bearings	Fractured bearing race retention ring, bearings missing and not presented
Butt/shank impact marks	Gouged, bearing retention shelf gouged on face side
De-Ice boot	Cut/torn

Blade # R2

Camber side	Random scratches
Face side	Not remarkable
Bend	Not remarkable
Twist	Not remarkable
Lead edge damage	Gouges and nicks consistent with asphalt strike
Trail edge damage	Not remarkable
Knob condition	Fracture-separated from blade, loose in hub cavity. Block fractured. Fracture appears shear/overload.
Counterweight	Intact and removed to facilitate disassembly
Blade bearings	Intact
Butt/shank impact marks	Not remarkable
De-Ice boot	Cut along leading edge

Blade # R3

Camber side	Random scratches
Face side	Scratches and scoring near shank
Bend	Forward. Trailing edge corner bent forward
Twist	Not remarkable
Lead edge damage	Not remarkable
Trail edge damage	Abrasion mid-blade on face side
Knob condition	Fracture-separated. Fracture appears shear/overload
Counterweight	Intact and removed to facilitate disassembly
Blade bearings	Intact
Butt/shank impact marks	Preload plate slot contact mark on high pitch side of knob
De-Ice boot	Not remarkable

Photo #21 – Right propeller impact mark
(photo provided by on-scene investigators)

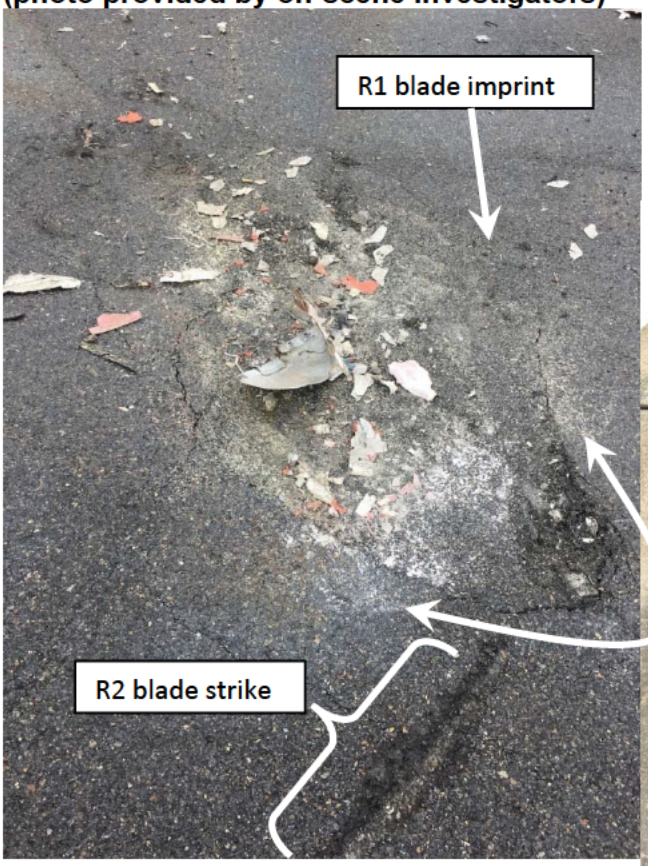


Photo #22 – Right propeller in-situ
(photo provided by on-scene investigators)

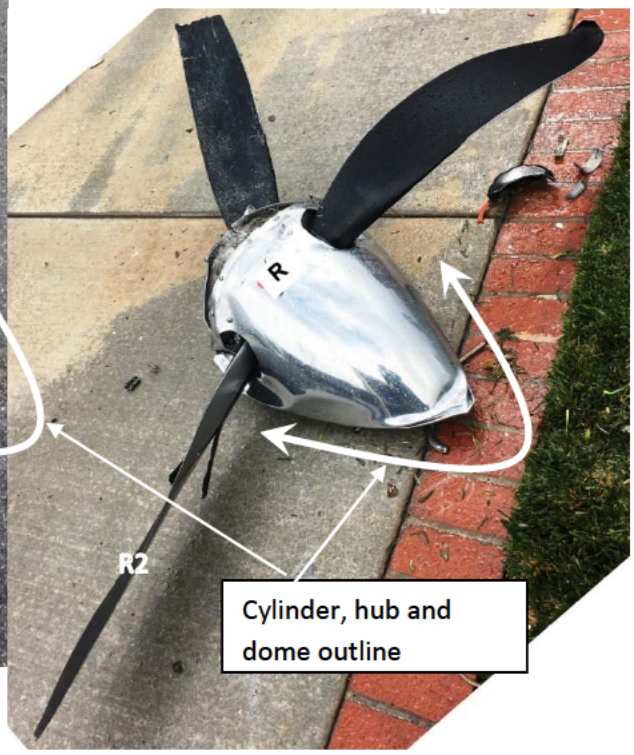


Photo #23 – Right propeller as-presented for examination

Photo #24 – Right propeller as-presented for examination

Photo #25 – Right propeller spinner dome removed, counterweight impression at R1

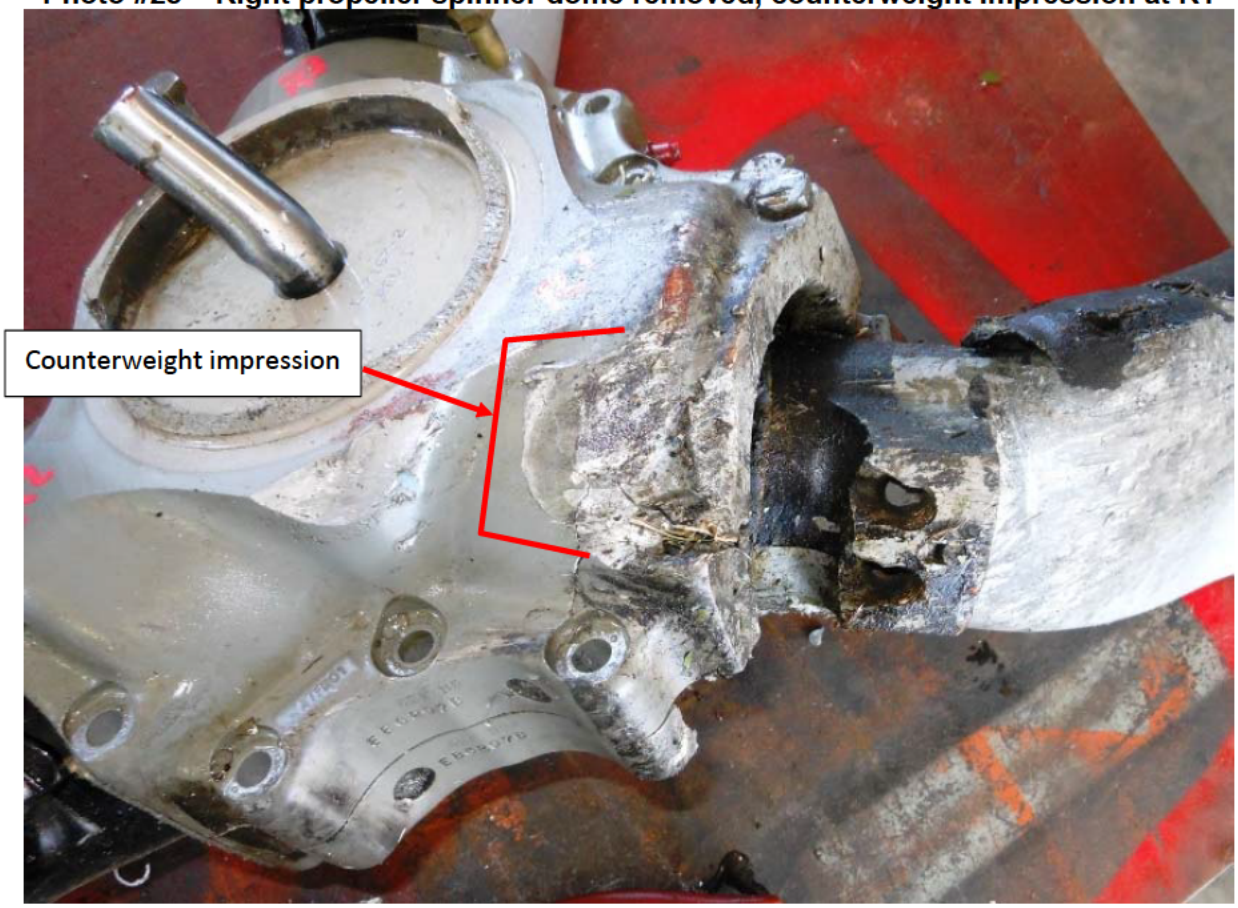


Photo #26 – Right spinner dome

Photo #27 – Right spinner dome, counterweight puncture at R1

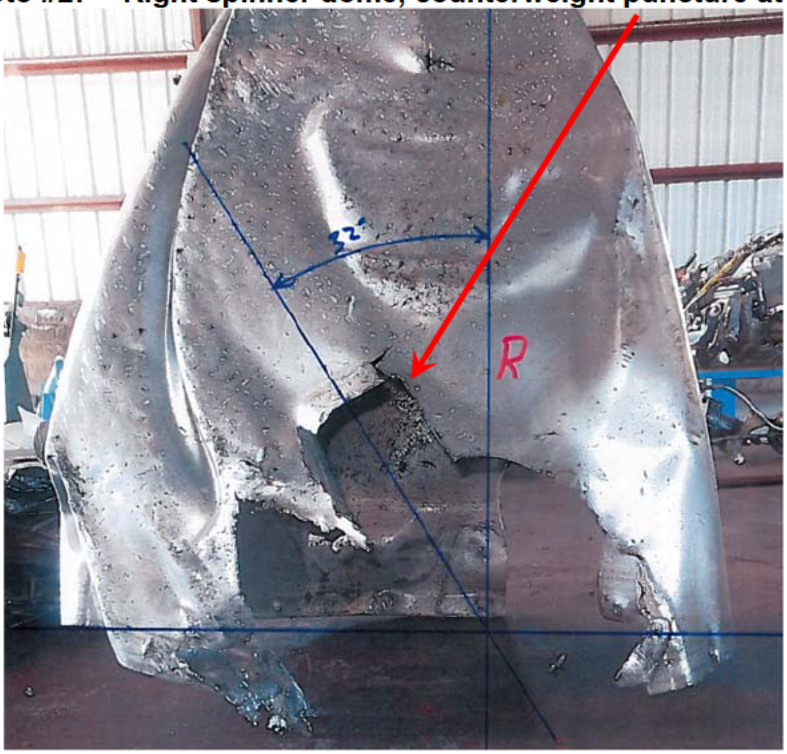


Photo #28 – R2 and R3 counterweight scrape marks on inside of spinner dome

Photo #29 – Right spinner bulkhead

Photo #30 – Right propeller mounting flange

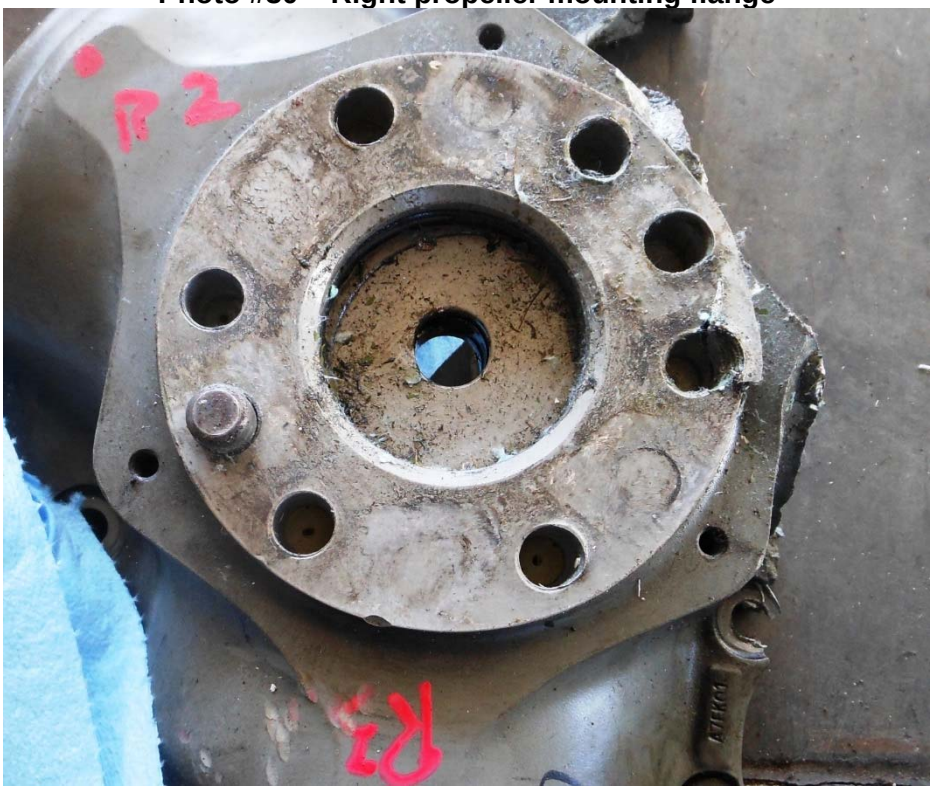


Photo #31 – Right crankshaft flange

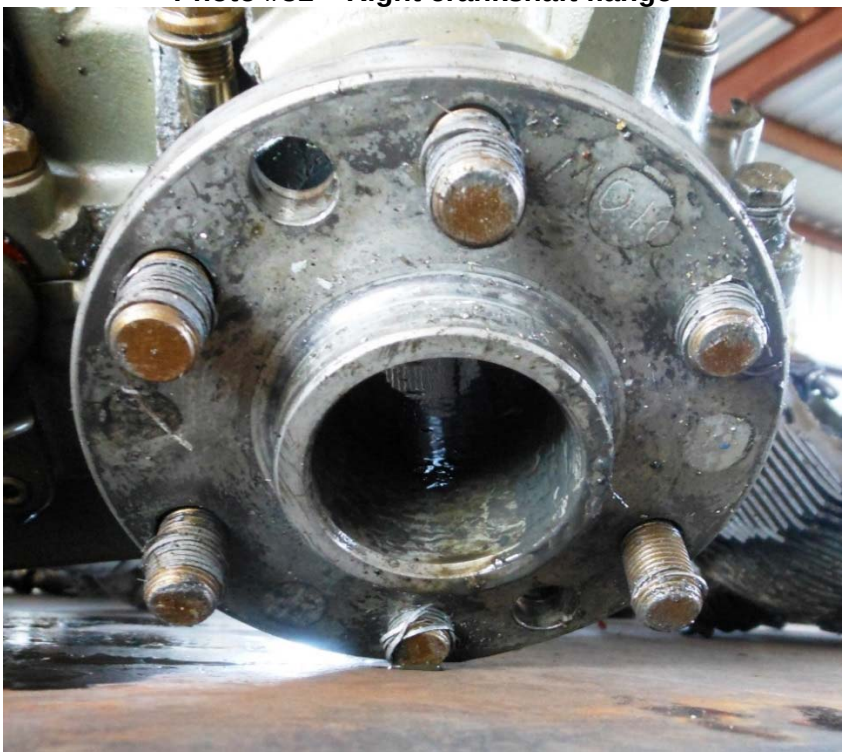


Photo #32 – Right crankshaft fracture surface

Photo #33 – Right cylinder/hydraulic unit

Photo #34 – Right pitch change rod aft of fork

Photo #35 – Right low pitch stop

Photo #36 – Right forward hub half

Photo #37 – Right aft hub half and R1 retention pocket fracture

Photo #38 – Right cylinder mounting boss and pitch change rod bend

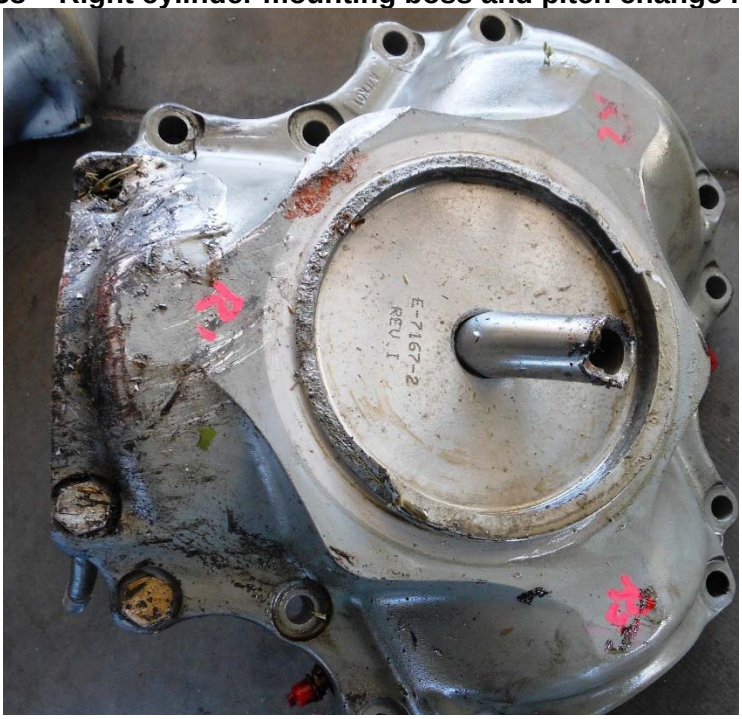


Photo #39 – Right preload plates

Photo #40 – Right blades camber side view

Photo #41 – Right blades face side view

Photo #42 – R2 leading edge

Photo #43 – R1 tip fracture

Photo #44 – Pitch change knob fractures

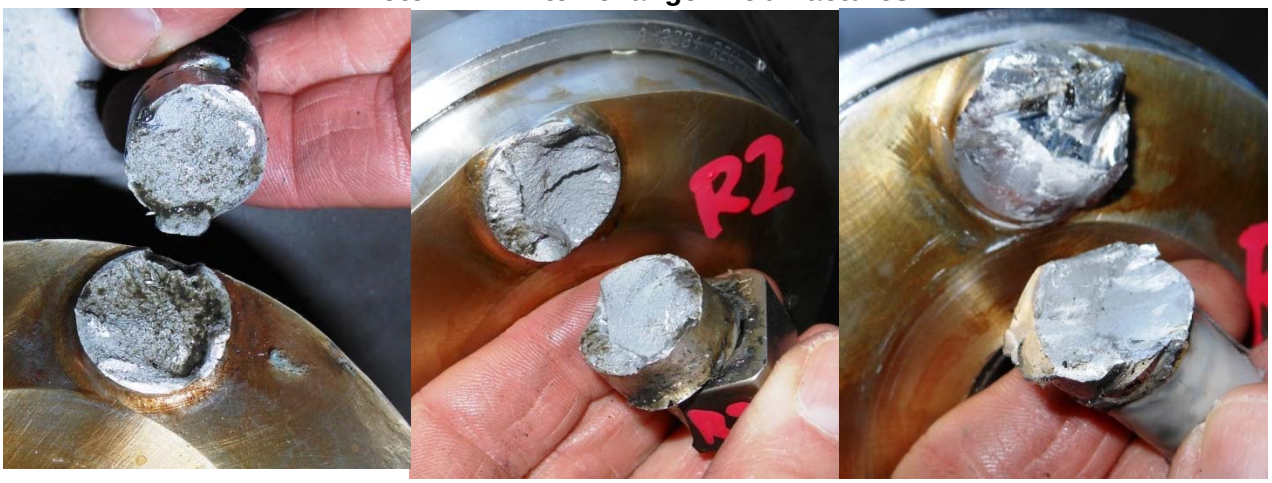


PHOTO LIST

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
DSCN8869.JPG	Right propeller as presented A
DSCN8870.JPG	Right propeller as presented B
DSCN8871.JPG	Right propeller as presented C
DSCN8872.JPG	Right propeller as presented D
DSCN8873.JPG	Right propeller as presented E
DSCN8874.JPG	Right propeller as presented F
DSCN8875.JPG	Right propeller as presented G
DSCN8876.JPG	Right propeller as presented H
DSCN8877.JPG	Right propeller as presented I
DSCN8878.JPG	Right mounting flange as-presented
DSCN8879.JPG	R1 blade tip as-presented
DSCN8880.JPG	R1 tip fracture surface
DSCN8881.JPG	R1 blade retention pocket fractured & counterweight impact impression
DSCN8882.JPG	Right cylinder mounting boss and pitch change rod prior to opening hub A
DSCN8883.JPG	Right cylinder mounting boss and pitch change rod prior to opening hub B
DSCN8884.JPG	Right assembly prior to opening hub
DSCN8885.JPG	Right hub internal damage at R1 blade retention pocket prior to opening hub A
DSCN8886.JPG	Right hub internal damage at R1 blade retention pocket prior to opening hub B
DSCN8887.JPG	Right hub internal damage at R1 blade retention pocket prior to opening hub C
DSCN8888.JPG	Right hub internal damage at R1 blade retention pocket prior to opening hub D
DSCN8889.JPG	Right hub internal damage at R1 blade retention pocket prior to opening hub E
DSCN8890.JPG	R3 pitch change knob fracture prior to opening hub
DSCN8891.JPG	Left propeller as-presented A
DSCN8892.JPG	Left propeller as-presented B
DSCN8893.JPG	Left propeller as-presented C
DSCN8894.JPG	Left spinner dome counterweight puncture
DSCN8895.JPG	Left propeller blade L2 position as-presented
DSCN8896.JPG	Left propeller with dome removed A
DSCN8897.JPG	Left propeller with dome removed B
DSCN8898.JPG	Left propeller with dome removed C
DSCN8899.JPG	Left propeller with dome removed D
DSCN8900.JPG	Left propeller hydraulic unit with debris on surface
DSCN8901.JPG	Left mounting flange
DSCN8905.JPG	Left propeller pitch change rod position prior to disassembly A
DSCN8906.JPG	Left propeller pitch change rod position prior to disassembly B
DSCN8907.JPG	Left propeller oil draining from proper position

DSCN8908.JPG	Left Feathering spring and fragmented retention cup A
DSCN8909.JPG	Left Feathering spring and fragmented retention cup B
DSCN8910.JPG	Left cylinder internal/start lock A
DSCN8911.JPG	Left cylinder internal/start lock B
DSCN8912.JPG	Left fractured spring retention cup
DSCN8913.JPG	Left mounting flange and de-ice slip ring A
DSCN8914.JPG	Left mounting flange and de-ice slip ring B
DSCN8915.JPG	Left de-ice slip ring A
DSCN8916.JPG	Left de-ice slip ring B
DSCN8917.JPG	Left de-ice slip ring C
DSCN8918.JPG	Left after opening hub A
DSCN8919.JPG	Left after opening hub B
DSCN8920.JPG	Left spinner bulkhead
DSCN8921.JPG	Left spinner dome A
DSCN8922.JPG	Left spinner dome counterweight puncture from interior
DSCN8923.JPG	Left spinner dome B
DSCN8924.JPG	Left cylinder internal/start lock C
DSCN8925.JPG	Left piston and pitch change rod
DSCN8926.JPG	Left fork A
DSCN8927.JPG	Left fork B
DSCN8928.JPG	Left fork C
DSCN8929.JPG	Left fork D
DSCN8930.JPG	Left fork E
DSCN8931.JPG	Left spring cup fragments bagged
DSCN8932.JPG	Left low pitch stop
DSCN8933.JPG	Left start lock sleeve and feathering stop
DSCN8934.JPG	Left hub internal A
DSCN8935.JPG	Left hub internal B
DSCN8936.JPG	Left hub internal C
DSCN8937.JPG	Left mounting flange
DSCN8938.JPG	Left cylinder mounting boss
DSCN8939.JPG	Left preload plates A
DSCN8940.JPG	Left preload plates B
DSCN8941.JPG	Left feathering spring
DSCN8942.JPG	Left blades camber side A
DSCN8943.JPG	Left blades camber side B
DSCN8944.JPG	Left assembly S/N
DSCN8945.JPG	L1 blade butt
DSCN8946.JPG	L2 blade butt
DSCN8947.JPG	L3 blade butt
DSCN8948.JPG	L1 tree strike wave bend
DSCN8949.JPG	L1 chordwise/rotational scoring
DSCN8950.JPG	L3 pitch change knob fracture
DSCN8951.JPG	L3 pitch change knob and block
DSCN8952.JPG	L2 pitch change knob fracture
DSCN8953.JPG	Left hardware bags
DSCN8954.JPG	L3 face side tip
DSCN8955.JPG	L2 face side tip
DSCN8956.JPG	L1 face side tip

DSCN8957.JPG	Left blades face side A
DSCN8958.JPG	Left blades face side B
DSCN8959.JPG	Right spinner dome crushed A
DSCN8960.JPG	Right spinner dome crushed A
DSCN8961.JPG	Right spinner dome non-impact side A
DSCN8962.JPG	Right spinner dome non-impact side B
DSCN8963.JPG	Right spinner dome internal at R2 aperture
DSCN8964.JPG	Right spinner dome internal at R3 aperture
DSCN8965.JPG	Right spinner dome internal at R1 aperture
DSCN8966.JPG	Right spinner dome counterweight puncture at R1
DSCN8967.JPG	Right spinner bulkhead A
DSCN8968.JPG	Right spinner bulkhead B
DSCN8969.JPG	Right hydraulic unit A
DSCN8970.JPG	Right hydraulic unit B
DSCN8971.JPG	Right hydraulic unit C
DSCN8972.JPG	Right pitch change rod position in hydraulic unit
DSCN8973.JPG	Right piston bottom and pitch change fracture A
DSCN8974.JPG	Right piston bottom and pitch change fracture B
DSCN8975.JPG	Right low pitch stop A
DSCN8976.JPG	Right low pitch stop B
DSCN8977.JPG	Right air valve port
DSCN8978.JPG	Right mounting flange and hardware A
DSCN8979.JPG	Right mounting flange and hardware B
DSCN8980.JPG	Right crankshaft mounting flange face
DSCN8981.JPG	Right crankshaft fracture surface A
DSCN8982.JPG	Right crankshaft fracture surface B
DSCN8983.JPG	Right crankshaft fracture surface C
DSCN8984.JPG	Right crankshaft fracture surface D
DSCN8985.JPG	Left crankshaft fracture surface
DSCN8986.JPG	Right propeller hub mounting flange face A
DSCN8987.JPG	Right propeller hub mounting flange face B
DSCN8988.JPG	Right cylinder mounting boss and pitch change rod
DSCN8989.JPG	R1 blade retention arm forward hub, counterweight impact mark
DSCN8990.JPG	Right hub forward internal A
DSCN8991.JPG	Right hub forward internal B
DSCN8992.JPG	Right hub R1 forward retention pocket damage
DSCN8993.JPG	R2 blade retention pocket, forward hub
DSCN8994.JPG	R3 blade retention pocket, forward hub
DSCN8995.JPG	Right fork A
DSCN8996.JPG	Right fork B
DSCN8997.JPG	Right pitch change rod damage A
DSCN8998.JPG	Right pitch change rod damage B
DSCN8999.JPG	Right pitch change rod damage C
DSCN9000.JPG	R1 blade retention pocket damage aft hub A
DSCN9001.JPG	R1 blade retention pocket damage aft hub B
DSCN9002.JPG	R1 preload plate A
DSCN9003.JPG	R1 preload plate B
DSCN9004.JPG	R2 preload plate
DSCN9005.JPG	R3 preload plate

DSCN9006.JPG	R1 preload plate internal
DSCN9007.JPG	R1 pitch change knob and block
DSCN9008.JPG	R2 pitch change knob and block
DSCN9009.JPG	R3 pitch change knob and block
DSCN9010.JPG	R1 pitch change knob fracture A
DSCN9011.JPG	R1 pitch change knob fracture B
DSCN9012.JPG	R2 pitch change knob fracture
DSCN9013.JPG	R3 pitch change knob fracture
DSCN9014.JPG	R3 blade butt A
DSCN9015.JPG	R3 blade butt B
DSCN9016.JPG	R2 blade butt
DSCN9017.JPG	R1 blade butt
DSCN9018.JPG	Right blades camber side A
DSCN9019.JPG	Right blades camber side B
DSCN9020.JPG	R2 blade leading edge
DSCN9021.JPG	Right blades face side A
DSCN9022.JPG	R1 tip fracture
DSCN9023.JPG	Right blades face side B
DSCN9024.JPG	R1 blade counterweight boss
DSCN9025.JPG	R1 blade shank
DSCN9026.JPG	Right hardware bags