

Aircraft Accident/Incident report No.: 200128

Date of Accident: January 28, 2020

Location: Springfield, IL (Approximately 7.3 miles southeast of Abraham Lincoln Capital Airport (KSPI) Runway 31 threshold)

NTSB File No.: CEN20FA070

Aircraft: Aerostar PA-60-601P (Modified to the "Samurai 350" configuration by Merlyn Products Inc. STC SA4156NM and SE4157NM)

Registration No.: N6071R

Serial No.: 61P-0686-7963324 (Year of manufacture 1979)

Owner/Operator: (per FAA Registration Database)
LKJ Properties LLC
[REDACTED]
Springfield, IL 62701-1201

Written by: Les Doud - Air Safety Investigator

Report Date: February 19, 2020

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PROPELLER EXAMINATION REPORT

Date of Investigation: January 30-31, 2020

Location: Illinois Department of Transportation – Aeronautics Division
1 Langhorne Bond Dr.
Springfield, IL 62707

Propeller Model(s): HC-C3YR-2UF with FC8468B-8R blades

Representatives: Les Doud – Hartzell Propeller Air Safety Investigator
Todd Fox – NTSB Investigator in Charge
Clive Adams – FAA PMI Springfield, IL FSDO
Mark Platt – Lycoming Air Safety Investigator

ACCIDENT SYNOPSIS

The following excerpts in quotations are from the NTSB Preliminary Report:

“On January 28, 2020, about 1503 central standard time, a Piper PA-60-601P airplane, N6071R, collided with terrain while on an instrument approach to Abraham Lincoln Capital Airport (SPI), Springfield, Illinois. The airline transport pilot, 2 passengers, and a dog were fatally injured. The airplane was destroyed during a postimpact fire. The airplane was owned by LKJ Properties, LLC, and operated under Title 14 *Code of Federal Regulations* Part 91 on an instrument flight rules (IFR) flight plan. Day instrument meteorological conditions (IMC) prevailed at the accident site.”

“According to automatic dependent surveillance-broadcast (ADS-B) data that was transmitted by the airplane to Federal Aviation Administration (FAA) air traffic control (ATC), the flight departed runway 18L at HSV and turned north-northwest toward SPI. The airplane subsequently climbed to 10,000 ft mean sea level (msl) and continued direct toward SPI. At 1440:34, the pilot established radio contact with Springfield approach and reported being level at 10,000 ft msl. The approach controller replied that the pilot should expect radar vectors to join the localizer for the instrument landing system (ILS) runway 31 at SPI. At 1441:20, the approach controller told the pilot that there were a couple of pilot reports (PIREPS) for light to moderate mixed icing in the clouds at 3,000 ft msl. The approach controller also cleared the pilot to descend to maintain 3,000 ft msl. At 1441:32, the pilot reported leaving 10,000 ft msl for 3,000 ft msl.”

After one unsuccessful attempt to fly the ILS Runway 31 approach, the pilot was on his second attempt when “the airplane impacted a harvested cornfield about 7.3 miles southeast of the runway 31 threshold. The wreckage debris path measured about 200 ft and was oriented on a 248° compass heading.”

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Both the left and right propellers remained attached to their engine propeller shaft flange.

“At 1452, about 11 minutes before the accident, the SPI automated surface observing system reported a calm wind, 5 miles surface visibility with mist, 700 ft above ground level (agl) overcast ceiling, temperature -1°C, dew point -3°C, and an altimeter setting of 30.10 inches of mercury. There was an active weather advisory (AIRMET) for moderate icing while operating in clouds between the freezing level and 8,000 ft msl. The pilot reported to the approach controller that the cloud tops were about 3,000 ft msl.”

“A doorbell security camera located about 300 ft north of the accident site captured video and audio of the final seconds of the flight. A review of the camera footage revealed that the airplane descended toward the ground in a left wing down, slightly nose-down attitude. All three landing gear were observed to be extended before impact. There was no evidence of an inflight fire before impact. The initial impact with the ground was obscured by a door post and trees; however, when the airplane reemerged it was observed sliding on its lower fuselage. Smoke from a postimpact fire was observed a couple seconds after the accident.”

“A second doorbell security camera, located about 0.6 miles south of the accident site, captured audio of the final seconds of the flight. The sound spectrums of both doorbell cameras were analyzed to identify any propeller sound signatures that were consistent with the propellers rotating under engine power. Both sound spectrums exhibited a relatively constant propeller noise signature until about two seconds before impact. The results of an acoustic analysis were consistent with the airplane's propellers rotating at 2,500 rpm before a sudden reduction in propeller speed to about 1,200 rpm about two seconds before impact.”

SUMMARY AND ANALYSIS OF FINDINGS

The on-scene propeller investigation was conducted on the morning of January 30, 2020. The engines and propellers had already been recovered to the Illinois Department of Transportation hangar. The on-scene investigation mostly included documentation of the propeller strike marks in the soil near the initial impact point. Both propellers impacted/sliced through wet, and what appeared to be relatively soft, rock-free harvested corn crop soil.

The right instrument panel containing the tachometer was recovered and photographed at the crash scene. The tachometer pointers for the left and right RPM were frozen at approximately 1200 RPM as shown in Photo #1.

As stated in the NTSB Preliminary Report, the investigation party was given two doorbell camera videos; one captured the aircraft impact sequence and another captured flyover audio only. The audio tracks of both videos were analyzed for propeller noise signatures. The video that captured the impact sequence was at the front door of [REDACTED] Garry Drive, Springfield, IL. Its viewpoint was looking in the direction of approximately due south. An image from that video showing the aircraft just before impact is shown in Figure 1. The camera that captured audio only was at [REDACTED] Woodhaven Dr. Springfield, IL; its viewpoint direction is unknown. A spectrogram for each video are presented in Figures 2 and 3.

Photo #1 – Engine instrument panel with both RPM indicators at approximately 1200



Figure 1. Image capture from doorbell video at [REDACTED] Garry Drive



Both spectrums indicate a relatively constant propeller noise signature until approximately two seconds prior to impact. At that time a noticeable “burst” of noise and drop in RPM occurred just before impact.

The fundamental blade passage frequency of a 3-blade propeller at the rated RPM of 2500 is 125 Hz without Doppler shift due to velocity.

Figure 2 – Audio spectrogram at [REDACTED] Garry Drive

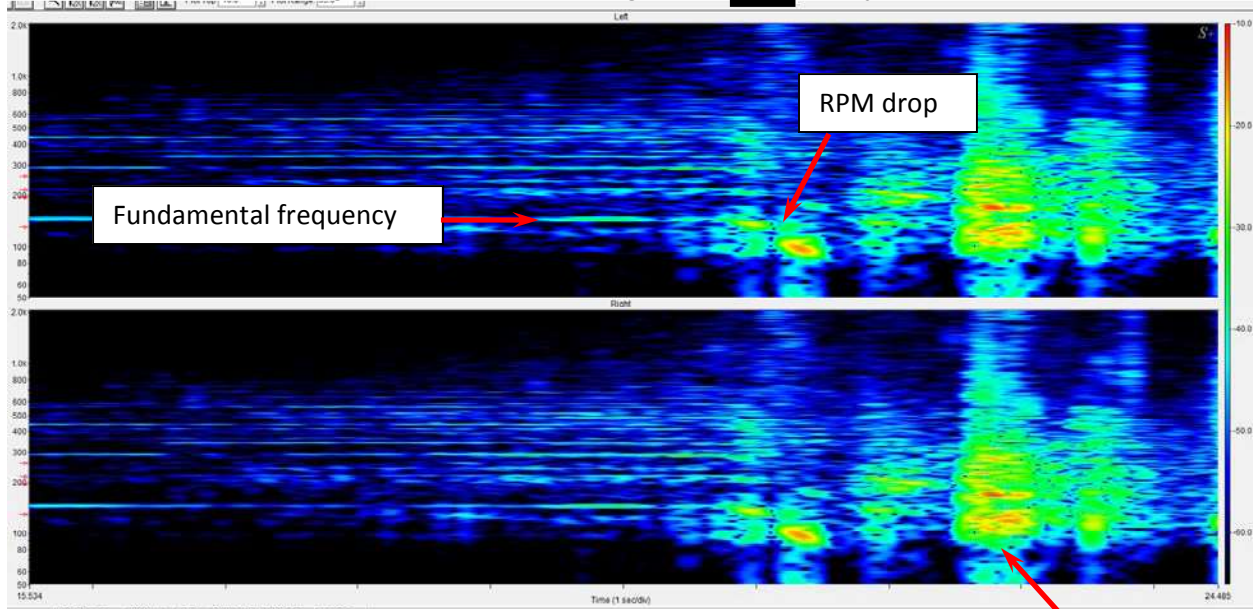
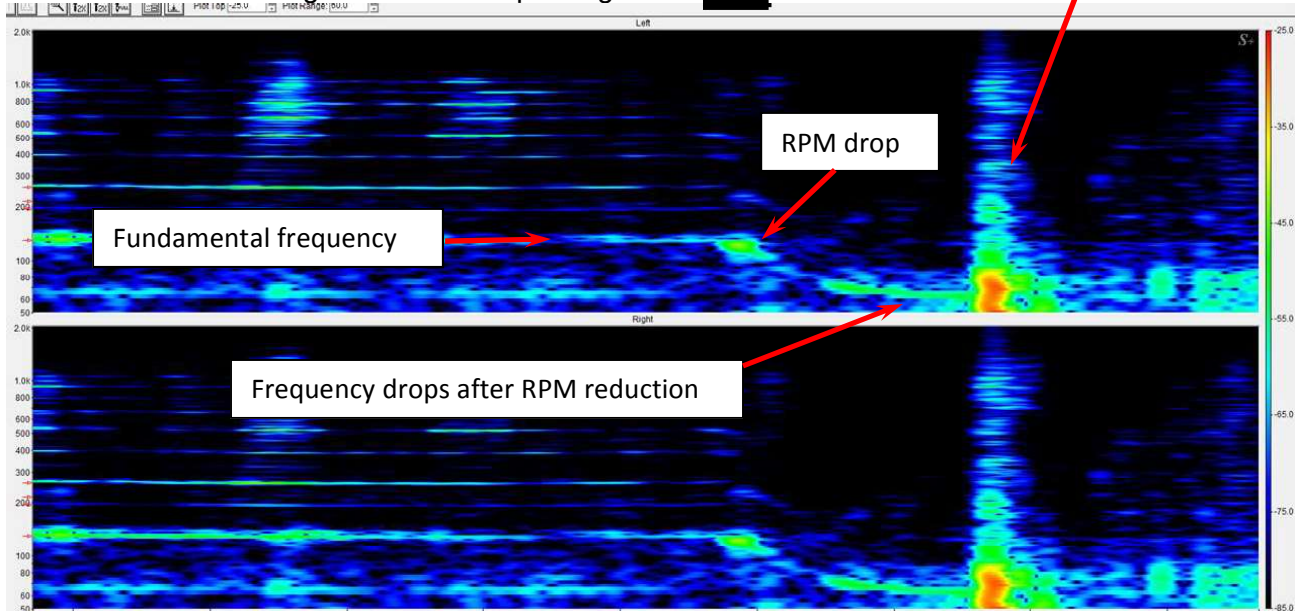


Figure 3 – Audio spectrogram at [REDACTED] Woodhaven Dr.



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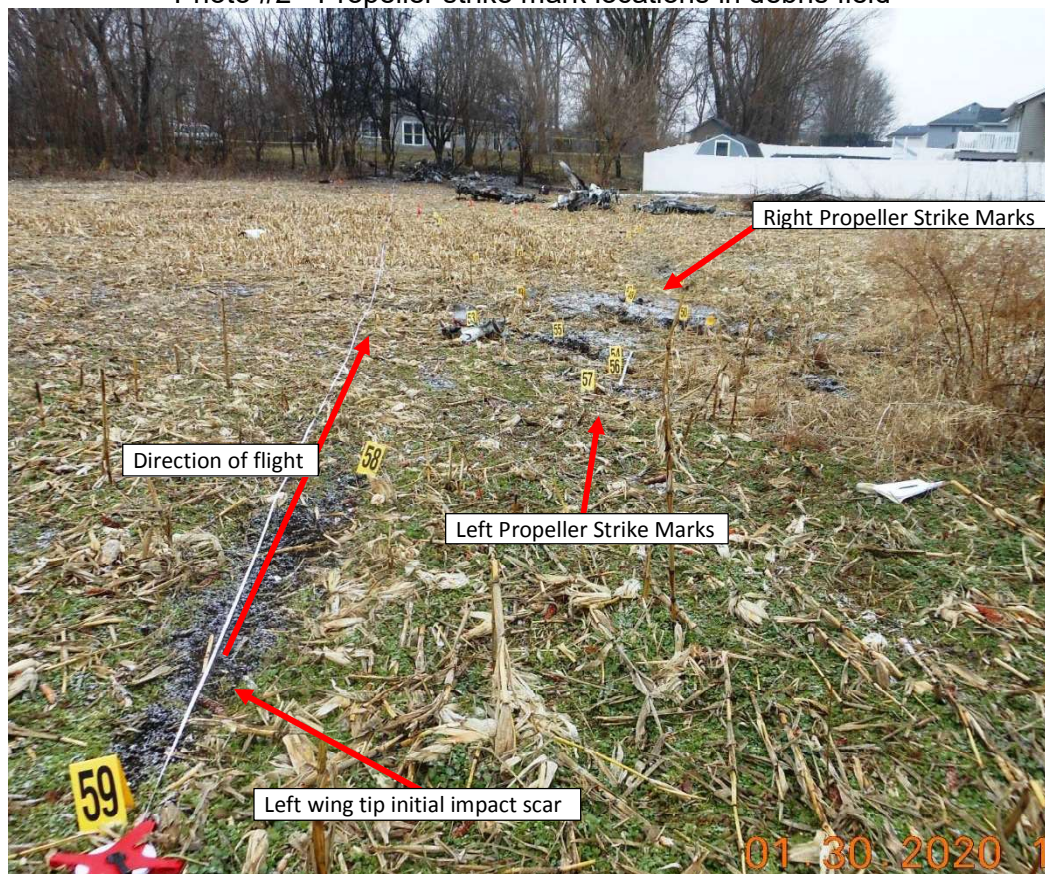
The spectrogram from the [REDACTED] Garry Drive video captured the visual and audio of the final seconds of flight and the impact sequence. The aircraft flight path was mostly toward, but not directly at the camera during the final few seconds of flight. The initial blade passage frequency recorded in this video was approximately 143 Hz. A Doppler shift in frequency from 125 Hz to 143 Hz represents an aircraft velocity component of approximately 80 knots toward the camera. This spectrogram shows an abrupt drop in propeller noise frequency approximately two seconds prior to impact.

The spectrogram at [REDACTED] Woodhaven shows a fundamental frequency of approximately 128 Hz until two seconds prior to impact. The difference between 125 and 128 Hz is likely from Doppler shift due to aircraft velocity relative to the camera position. The fundamental frequency drops to approximately 62 Hz just prior to impact which equates to approximately 1240 RPM, or 1180 RPM if adjusted for a 3 Hz Doppler shift.

Both videos indicate the RPM (and thus power) was reduced prior to impact and is consistent with what the cockpit tachometer was indicating after the crash.

As stated in the NTSB Preliminary Report, the aircraft impacted a harvested cornfield. A flight path angle of approximately -22° was estimated from the doorbell video image at [REDACTED] Garry Drive. Both propellers impacted/cut into cornfield soil that was wet, soft and relatively rock-free. The propellers left slice/strike marks in the locations shown in Photo #2.

Photo #2 - Propeller strike mark locations in debris field



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There were three distinguishable propeller strike marks made by the left propeller as shown in Photo #3. The distances between the three marks were as follows:

Between the first and second strikes = 2.54 ft.

Average between the second and third strikes = 2.73 ft. (third strike was curved in shape)

The average distance between the left propeller strike marks was therefore 2.64 ft. The following equation can be used to estimate either aircraft speed or propeller RPM given the other quantity. If using an RPM of approximately 1200 indicated by two sources; the engine tachometers and the audio spectrums, the estimated ground speed at impact was 94 knots.

$$V_{kts} = \frac{RPM \cdot D \cdot N}{101.3}$$

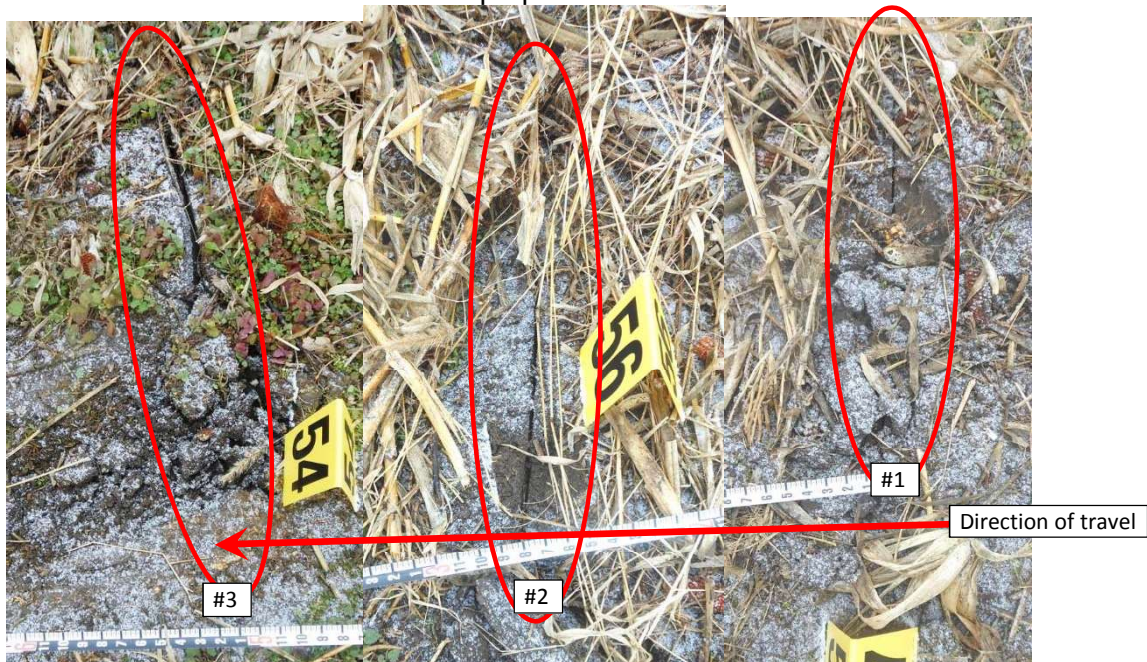
Where:

V_{kts} = Estimated true airspeed

D = Distance between marks (ft.)

N = Number of blades

Photo #3 - Left propeller strike marks



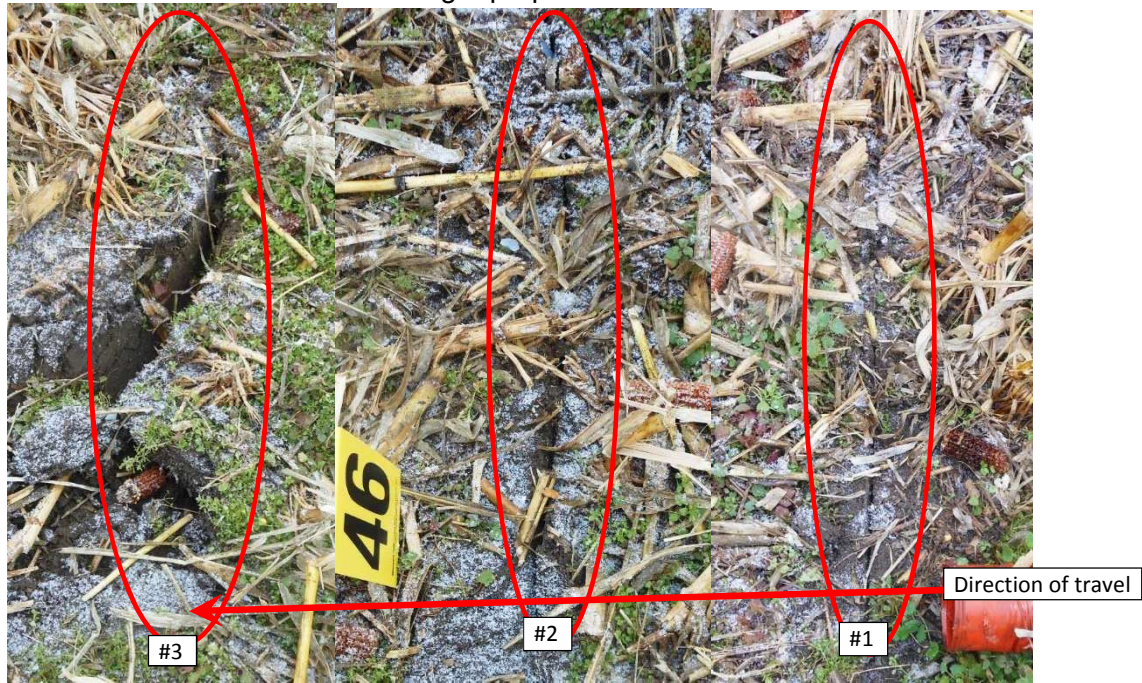
There were three distinguishable propeller strike marks made by the right propeller as shown in Photo #4. The distances between the three marks were as follows:

Between the first and second strikes = 2.42 ft.

Between the second and third strikes = 2.58 ft.

The average distance between the right propeller strike marks was therefore 2.5 ft. If using the RPM of approximately 1200, the estimated ground speed at impact was 88 knots.

Photo #4 - Right propeller strike marks



All propeller components were accounted for at the crash scene. Both propellers were recovered from the crash scene and transported to the hangar of Illinois Department of Transportation – Aeronautics Division located on the Abraham Lincoln Capital Airport for examination.

Both propellers remained attached to their engines and were removed prior to examination. Both propellers were disassembled on January 30-31, 2020 to assess condition prior to impact and evaluate impact damage.

Blade damage such as aft bending, bending opposite rotation and twisting toward low pitch indicated both propellers were rotating at a low power condition. An impact mark on the low pitch stop and fork contact marks on the preload plates suggested the propellers was rotating on or near the low pitch stop angle of approximately 14°.

CONCLUSIONS

All propeller components remained attached to the engine throughout the impact sequence. There were no visible discrepancies noted that would prevent or degrade normal propeller or governor operation prior to impact. All visible damage was consistent with high impact forces.

Overall, the degree of damage between the right and left propellers and the propeller strike marks were similar, suggesting a power symmetry. A comparison of blade L3 and R3 damage is shown in Photos #5 and #6. All visual evidence and propeller strike marks indicated that neither propeller was feathered at time of impact.

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Measurements of strike marks made by both propellers suggested the aircraft ground speed at impact was approximately 85-95 knots. Acoustic analysis of the propeller noise from two audio sources suggested both engines were operating at approximately the rated RPM of 2500 as the aircraft approached the impact point. The power/RPM appears to have been reduced to approximately 1200 RPM about two seconds prior to impact. An underspeeding RPM suggests the propellers were operating at or near the low pitch stop at low power when the aircraft impacted terrain. Propeller damage documented during the examination was consistent with impact at low power in an underspeeding condition.

Photo #5 – L3 and R3 blade damage comparison – camber side



Photo #6 – L3 and R3 blade damage comparison – edge view

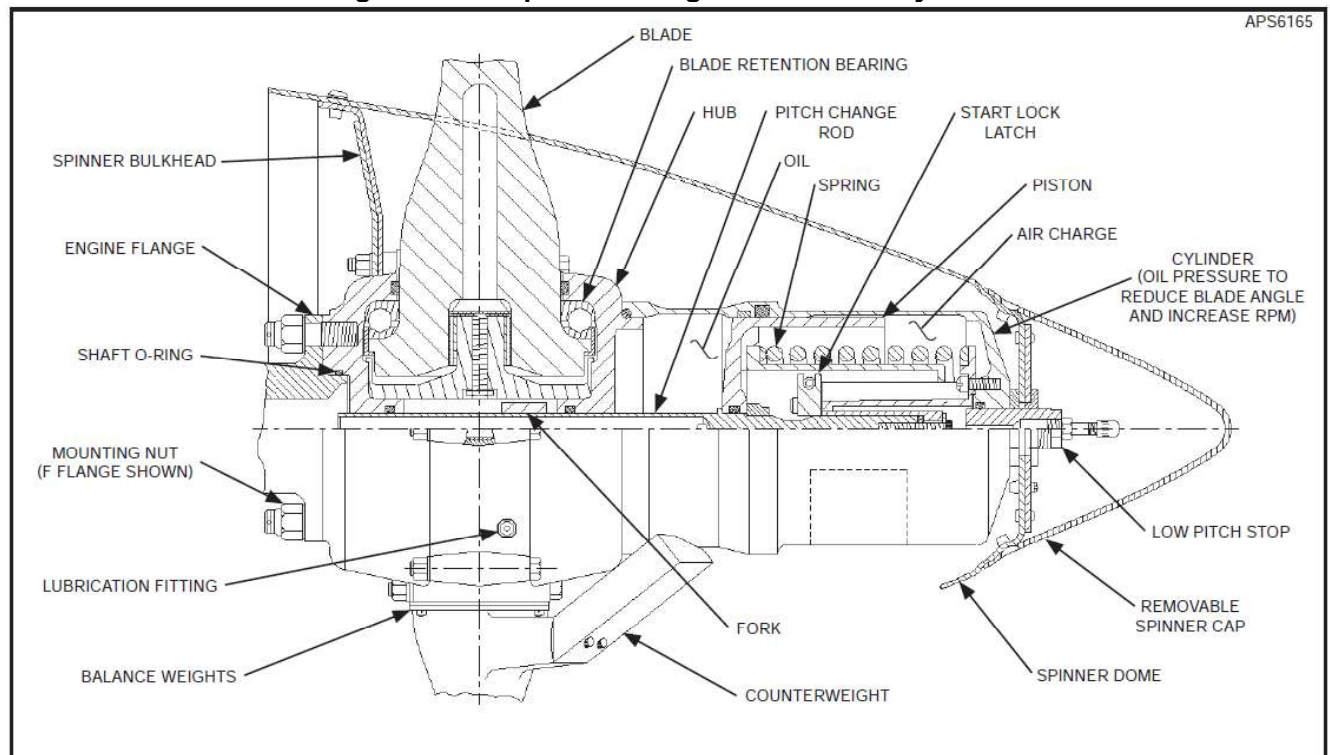


GENERAL INFORMATION

Propeller Description: The propellers installed on the accident airplane 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. A propeller cutaway sketch showing major components and terminology is shown in Figure 4.

Installation Data: Refer to Hartzell Propeller Installation Data Sheet No. 1870, Type Certificate Data Sheet A17WE, and Merlyn STCs SA1456NM and SE1457NM. For new/overhauled propellers blade angles are set to the specifications below, referenced at the 30-inch radius.

Low Pitch:	14.0 ± 0.1 degrees
Start lock:	19.5 ± 1.5 degrees
Feather:	82.5 ± 1.0 degrees

Figure 4 – Propeller Configuration Cutaway

PROPELLER FACTUAL FINDINGS**Position:** LEFT**Propeller Model:** HC-C3YR-2UF with FC8468B-8R blades**Propeller Assembly Serial Number:** CK3849A

Service History: On November 26, 2019, the airplane's previous left propeller suffered a birdstrike while on approach to Sarasota/Bradenton International Airport (SRQ), Sarasota, Florida. The left propeller (S/N CK5097B according to the propeller logbook) was removed and sent to an overhaul facility to be inspected and possibly repaired. The damaged propeller exceeded repair limits and another overhauled propeller (S/N CK3849A) was installed on the airplane on January 27, 2020. The 8130-3 provided with the overhauled propeller (C/N CK3849A) stated TTSN on January 20, 2020 was 3640.0 hours and TSO 0.0.

	<u>S/N</u>	<u>Date of Manufacture</u>	<u>TTSN</u>	<u>TSO</u>
Hub/Factory	A25413A	8/25/1994	~3640.0	Est. < 5 hours
Blade L1	F04574	6/15/1981	~3640.0	Est. < 5 hours
Blade L2	F02297	6/15/1981	~3640.0	Est. < 5 hours
Blade L3	F04830	6/30/1981	~3640.0	Est. < 5 hours

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

As Received Condition: The left propeller remained attached to the engine propeller shaft flange and was presented for examination as shown in Photo #7. One propeller blade appeared to be in the feathered position, two blades appeared to be in the normal range of operation. Two blades were noticeably bent in the aft direction and one blade appeared to be slightly bent aft. Two blades had indications of heat exposure such as charring, sooting and paint blistering. One blade could be partially rotated by hand force. The spinner dome was dented with one counterweight mark on the internal surface in the normal blade angle range of operation. The hydraulic unit remained intact and undamaged and the piston/pitch change mechanism appeared to be on the start locks. Blade L1 was bent aft, bent opposite rotation and twisted towards low pitch. Blade L2 was bent slightly aft and no remarkable twisting. Blade L3 was bent aft, opposite rotation and twisted towards low pitch. All three blades exhibited chordwise/rotational scoring isolated to the leading edges, primarily on the camber side with some on the face side.

Spinner Dome: The spinner dome and dome cap were dented as shown in Photos #7 and #8. There was a counterweight contact mark adjacent to one blade located in the normal range of operation.

Spinner Bulkhead: The spinner bulkhead was ring gear mounted and was intact but the dome attach flange was bent slightly adjacent to the areas of the dome denting.

Propeller Cycling: Propeller cycling was not attempted due to lack of equipment to pressurize the hydraulic unit.

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Cylinder/Hydraulic Unit: The cylinder/hydraulic unit appeared intact, undamaged and securely attached to the hub as shown in Photo #9. The air valve remained intact and an aircharge of 20 psig was measured before disassembly. Photo #12 shows the hydraulic unit components.

Piston: The piston appeared intact and undamaged (Photo #11).

Pitch Change Rod: The pitch change rod was intact but bent slightly in the area of the fork threads. The pitch change rod was removed from the fork/assembly without difficulty.

Fork: The fork appeared intact and undamaged (Photo #11). The anti-rotation bumpers appeared intact and not smashed.

Spring/Spring Guides: The feathering spring, spring retaining cup and spring seat appeared intact and undamaged (Photo #12).

Pitch Stops:

Low Pitch Stop: The low pitch stop had an impact impression from the cap screw in the top of the pitch change rod as shown in Photo #10.

Feather Stop: The feather stop washer was removed and appeared intact and undamaged.

Start Lock: The start lock components were intact and undamaged.

Engine/Propeller Mounting: The propeller remained attached to the engine crankshaft flange with no apparent damage to the mounting area (Photo #13). All mounting hardware was present and lock-wired.

Hub Assembly: See Photos #14 and #15. Upon opening the hub, it appeared to have been recently overhauled; all components appeared clean with little wear. The bearing grease was clean and the amount suggested it had not been serviced since assembly. There were no visibly obvious cracks or fractures in the blade retention system, with all through bolts present and secure. There was damage to the preload plate shelf and blade retention pocket of L3 in the face/trailing edge quadrant. There was also an impact mark on the aft hub from the blade seal rub strip in the L3 blade aperture, in the aft direction.

Preload Plates: See Photo #16. There were no remarkable fork or pitch change knob impact marks on any preload plate that would indicate a blade angle at impact.

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 48° (knob 12° + 36° = 48°).

Preload Plate	Condition
L1	Appeared intact and undamaged
L2	Hub/web impact marks on the aft quadrant
L3	Retention lip sheared in aft quadrant, hub/web impact marks on the forward and aft quadrants. There was a pitch change knob dent in the slot at 26° and 31° representative of blade angles of approximately 17-22°.

Propeller Blade Properties: See Photos #17 through #22.

Blade # L1

Camber side	Charred, sooted and paint blistered in mid-blade area
Face side	Charred, sooted and paint blistered in mid-blade area
Bend	Aft and opposite rotation along outboard 12"
Twist	Leading edge down/toward lower pitch at tip
Lead edge damage	Paint abraded, chordwise/rotational scoring along Lead Edge area
Trail edge damage	Dents, nicks 10-12" from tip
Knob condition	Bent opposite low pitch
Counterweight	Intact
Blade bearings	Intact
Butt/shank impact marks	Not remarkable
De-Ice boot	Charred, blistered/bubbled

Blade # L2

Camber side	Charred and sooted 24" from/to tip
Face side	Charred and sooted, paint blistered last 8" from/to tip
Bend	Aft
Twist	Not remarkable
Lead edge damage	Paint abrasion, chordwise/rotational scoring
Trail edge damage	Scoring abrasion 21" from/to tip
Knob condition	Bent opposite low pitch
Counterweight	Intact
Blade bearings	Intact
Butt/shank impact marks	Crescent/smile impact mark in aft/trailing edge quadrant with corresponding mark on inside surface of preload plate
De-Ice boot	Charred, blistered/bubbled

Blade # L3

Camber side	Chordwise/rotational scoring, paint abraded off at mid-blade bend
Face side	Spanwise/45° score marks on outboard area
Bend	Aft
Twist	Leading edge down/toward low pitch at tip
Lead edge damage	Chordwise/rotational abrasion, nicks/dents 14-15" from tip
Trail edge damage	Not remarkable
Knob condition	Fractured, fracture surface indicates overload
Counterweight	Intact
Blade bearings	Intact
Butt/shank impact marks	Impact crescent in aft quadrant
De-Ice boot	Peeled along aft/camber edge

Photo #7 – Left propeller as-presented



Photo #8 – Spinner dome and dome cap



Photo #9 – Left propeller after removal from engine



Photo #10 – Left low pitch stop impression



Photo #11 – Left piston and pitch change rod



Photo #12 – Left feathering spring, guides and start lock components



Photo #13 – Left propeller mounting flange



Photo #14 – Left aft hub half



Photo #15 – Left forward hub half



Photo #16 – Left preload plates



Photo #17 – L3 pitch change knob fracture



Photo #18 – L3 impact crescent in aft/face quadrant



Photo #19 – Left blades camber side



Photo #20 – Left blades face side



Photo #21 – Left blades leading edge view



Photo #22 – L3 camber side tip area



Aircraft Accident/Incident report No.: 200128**Position:** RIGHT**Propeller Model:** HC-C3YR-2UF with FC8468B-8R blades**Propeller Assembly Serial Number:** CK5427B

Service History: According to the right propeller logbook, the last service on the propeller was during an annual inspection on 8/1/2019 by Mullens Aviation of Labelle, FL. The times in the table below are at the last annual inspection. It could not be determined what individual component (hub and blades) total times were on the day of the accident. The propeller was last overhauled on 3/24/15 by Aircraft Accessories of OK Inc. The hub was replaced during that overhaul. The previous assembly S/N was CK1508B according to the logbook.

	<u>S/N</u>	<u>Date of Manufacture</u>	<u>TTSN</u>	<u>TSO</u>
Hub/Factory	B18818B	3/6/2015	Unknown	772.0
Blade R1	E29528	4/3/1979	3542.7	772.0
Blade R2	E26403	3/5/1979	3542.7	772.0
Blade R3	C79647	2/5/1975	3542.7	772.0

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

As Received Condition: The right propeller remained attached to the engine propeller shaft flange and was presented for examination as shown in Photo #23. The spinner dome was dented with counterweight impressions at blade aperture R1 with angles of 38 and 55 degrees which equate to a blade angle of approximately 25 and 42 degrees respectively. All three blades appeared to be in the normal blade angle range. All three blades were bent aft, opposite rotation in varying degrees and twisted towards low pitch. One blade had indications of heat exposure such as charring, sooting and paint blistering. The hydraulic unit remained intact and undamaged and the piston/pitch change mechanism appeared to be in the feathered position. All three blades exhibited chordwise/rotational scoring isolated to the leading edges on both the camber and face side. All three blades could be partially rotated by hand force indicating a fractured pitch change knob.

Spinner Dome: The spinner dome was dented with counterweight impressions at blade aperture R1 with angles of 38 and 55 degrees which equate to a blade angle of approximately 25 and 42 degrees respectively. The spinner dome and cap are shown in Photos #23 and #24. The measurement of the counterweight impression is shown in Photo #25.

Spinner Bulkhead: The spinner bulkhead was ring gear mounted and was intact but the dome attach flange was bent slightly adjacent to the areas of the dome denting.

Propeller Cycling: Propeller cycling was not attempted due to lack of equipment to pressurize the hydraulic unit.

Cylinder/Hydraulic Unit: The cylinder/hydraulic unit appeared intact, undamaged and securely attached to the hub as shown in Photo #26. The air valve remained intact and an aircharge of 38 psig was measured before disassembly.

Piston: The piston appeared intact and undamaged (Photo #27).

Pitch Change Rod: The pitch change rod was fractured forward and aft of the fork attachment threads. The threaded portion of the rod remained in the fork.

Fork: The fork appeared intact (Photo #28). There were knob/block impact marks in the slots as shown in Photo #29. The anti-rotation bumpers appeared intact and not smashed.

Spring/Spring Guides: The feathering spring, spring retaining cup and spring seat appeared intact and undamaged (Photo #27).

Pitch Stops:

Low Pitch Stop: The low pitch stop had an impact impression from the cap screw in the top of the pitch change rod as shown in Photo #30. This suggested the pitch change mechanisms was forced towards the low pitch direction during the impact sequence.

Feather Stop: The feather stop washer was removed and appeared intact and undamaged.

Start Lock: The start lock components were intact and undamaged.

Engine/Propeller Mounting: The propeller mounting flange and hardware appeared intact and undamaged as shown in Photo #31. All six mounting studs were present, secure and lock-wired.

Hub Assembly: See Photos #32 and #33. There were no visibly obvious cracks or fractures in the blade retention system, with all through bolts present and secure. There was varying degree of damage to the preload plate shelf/web in all three blade retention pockets. The aft hub web in retention pocket R3 was visibly displaced indicating impact forces in the aft direction. There was an impact mark on the aft hub aperture from the blade R2 shank/rub strip in the aft direction. The cylinder mounting boss appeared intact and undamaged. The aft pitch change rod segment remained in the aft hub bore. There were fork contact marks on the forward hub half between the R1 and R2 blade retention pockets.

Preload Plates: See Photo #34. All three preload plates had varying degrees of retention lip smashing/shearing.

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 48° (knob 12° + 36° = 48°).

Preload Plate	Condition
R1	Gouge mark from fork near the hub parting line. Blade butt contact marks in aft/face quadrant.
R2	Knob impact mark in the slot at approximately 45 degrees which equates to a blade angle of 3 degrees. Gouge mark from fork corresponding to the knob impact mark in the slot at low pitch.
R3	Knob impact mark in the slot at approximately 21 degrees which equates to a blade angle of 27 degrees. Gouge marks from fork at corresponding location to the knob mark in the slot.

Propeller Blade Properties: See Photos #35 through #38**Blade # R1**

Camber side	Paint abrasion along leading edge and trailing edge
Face side	Chordwise/rotational scoring/abrasion primarily near leading edge
Bend	Aft and opposite rotation
Twist	Leading edge down/towards low pitch
Lead edge damage	Chordwise/rotational scoring along leading edge
Trail edge damage	Not remarkable
Knob condition	Fractured, fracture surface indicates overload
Counterweight	Intact, removed to facilitate disassembly
Blade bearings	Intact
Butt/shank impact marks	Not remarkable
De-Ice boot	Camber/trailing edge area of boot flashing abraded away

Blade # R2

Camber side	Sooted, charred, paint blistered
Face side	Sooted, charred
Bend	Aft and opposite rotation
Twist	Leading edge down/toward low pitch
Lead edge damage	Chordwise/rotational scoring along leading edge
Trail edge damage	Dent approximately 2" from tip
Knob condition	Fractured, fracture surface indicates overload
Counterweight	Intact, removed to facilitate disassembly
Blade bearings	Intact
Butt/shank impact marks	Impact crescent in the aft/trailing edge quadrant
De-Ice boot	Charred, blistered on face side, camber side edge seal abraded

Blade # R3

Camber side	Spanwise/sliding scoring along trailing edge
Face side	Chordwise/rotational scoring
Bend	Aft and opposite rotation
Twist	Leading edge down/toward low pitch near tip
Lead edge damage	Chordwise/rotational scoring
Trail edge damage	Nicks and dents along mid-blade area
Knob condition	Fractured, fracture surface indicates overload
Counterweight	Intact, removed to facilitate disassembly
Blade bearings	Intact
Butt/shank impact marks	Impact crescent in the aft quadrant
De-Ice boot	Charred, blistered, edge seal on camber side abraded

Photo #23 – Right propeller as-presented for examination



Photo #24 – Right spinner dome and dome cap



Photo #25 – Right spinner dome counterweight impression angles



Photo #26 – Right hydraulic unit condition after spinner removal



Photo #27 – Right hydraulic unit components



Photo #28 – Right fork with pitch change rod segment in threads



Photo #29 – Right fork impact marks in slot



Photo #30 – Right low pitch stop impact mark



Photo #31 – Right mounting flange



Photo #32 – Right aft hub half internal surface



Photo #33 – Right forward hub half



Photo #34 – Right preload plates and knob/blocks



Photo #35 – Right blades camber side



Photo #36 – Right blades face side



Photo #37 – Right blades leading edge view



Photo #38 – R3 chordwise/rotational scoring camber side tip area along leading edge



Propeller Governors

The propellers governors were removed from their respective engines for an external, visual examination. See Photos #38 and #39.

Right Propeller Governor Model: F-8-45Z

Right Governor S/N: D411T

Manufacturing records indicate this S/N was original built as a Model F-6 on February 18, 1979.

Left Propeller Governor Model: F-6-35Z

Left Governor S/N: 792X

Manufacturing records indicate this S/N was original built as a Model F-3-2 on November 17, 1976.

Both left and right governor gasket/screens were clear. Both governor pump shafts rotated freely and smoothly by finger force and “gurgled” indicating pumping action. The control arm also rotated freely and smoothly by hand force. There were no external discrepancies noted that would preclude normal operation.

Photo #38 – Right propeller governor



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Photo #39 – Left propeller governor



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.

<u>Picture File Name</u>	<u>Description</u>
DSCN0669.JPG	Crash scene looking at incoming flight path
DSCN0670.JPG	Propeller blade strike mark Right #1
DSCN0671.JPG	Propeller blade strike mark Right #2
DSCN0672.JPG	Propeller blade strike mark Right #3
DSCN0673.JPG	Crash scene looking in direction of travel near propeller strike marks A
DSCN0674.JPG	Crash scene looking in direction of travel near initial impact point
DSCN0675.JPG	Propeller blade strike marks - Right #1 to #2 measurement
DSCN0676.JPG	Propeller blade strike marks - Right #2 to #3 measurement
DSCN0677.JPG	Propeller blade strike marks - Right #1 and #2
DSCN0678.JPG	Propeller blade strike marks - Right #3
DSCN0679.JPG	Propeller blade strike marks - Left #1 to #2 measurement A
DSCN0680.JPG	Propeller blade strike marks - Left #1 close up A
DSCN0681.JPG	Propeller blade strike marks - Left #1 close up B
DSCN0682.JPG	Propeller blade strike marks - Left #2 close up
DSCN0683.JPG	Propeller blade strike marks - Left #3 close up
DSCN0684.JPG	Propeller blade strike marks - Left #1 to #2 measurement B
DSCN0685.JPG	Propeller blade strike marks - Left #2 to #3 measurement A
DSCN0686.JPG	Propeller blade strike marks - Left #2 to #3 measurement B
DSCN0687.JPG	Left engine nacelle impact scar and fragmentation of lower nacelle/inlet
DSCN0688.JPG	Crash scene looking in direction of travel near propeller strike marks B
DSCN0689.JPG	Crash scene cabin heater A
DSCN0690.JPG	Crash scene cabin heater B
DSCN0691.JPG	Crash scene cabin heater C
DSCN0692.JPG	Crash scene cabin heater data plate A
DSCN0693.JPG	Crash scene cabin heater data plate B
DSCN0694.JPG	Crash scene cabin heater D
DSCN0695.JPG	Crash scene right engine fuel control panel A
DSCN0696.JPG	Crash scene right engine fuel control panel B
DSCN0697.JPG	 Garry Drive front porch/doorbell camera location
DSCN0698.JPG	 Garry Drive view from doorbell camera A
DSCN0699.JPG	 Garry Drive view from doorbell camera B
DSCN0700.JPG	 Garry Drive view from doorbell camera C
DSCN0701.JPG	Crash scene - engine instrument panel
DSCN0702.JPG	Crash scene - recovered instruments and radios
DSCN0703.JPG	Left engine and prop as-recovered/presented A

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DSCN0704.JPG	Left engine and prop as-recovered/presented B
DSCN0705.JPG	Right engine and prop as-recovered/presented A
DSCN0706.JPG	Right engine and prop as-recovered/presented B
DSCN0707.JPG	Left engine and prop as-recovered/presented C
DSCN0708.JPG	Left engine aircharge valve A
DSCN0709.JPG	Left engine aircharge valve B
DSCN0710.JPG	Left propeller after removal from engine
DSCN0711.JPG	L1 blade in assembly
DSCN0712.JPG	L2 blade in assembly
DSCN0713.JPG	L3 blade in assembly
DSCN0714.JPG	Left prop piston after cylinder removal
DSCN0715.JPG	Left prop after hub opening A
DSCN0716.JPG	Left prop after hub opening B
DSCN0717.JPG	Left forward hub half after opening
DSCN0718.JPG	Left hydraulic unit components A
DSCN0719.JPG	Left cylinder internal surface A
DSCN0720.JPG	Right prop after spinner dome removal A
DSCN0721.JPG	Right prop after spinner dome removal B
DSCN0722.JPG	Right prop after spinner dome removal C
DSCN0723.JPG	Right prop after removal from engine
DSCN0724.JPG	R2 in assembly
DSCN0725.JPG	R1 in assembly
DSCN0726.JPG	R3 in assembly
DSCN0727.JPG	Left spinner dome and dome cap
DSCN0728.JPG	Left low pitch stop
DSCN0729.JPG	Left low pitch stop impact mark A
DSCN0730.JPG	Left low pitch stop impact mark B
DSCN0731.JPG	Left cylinder external surface
DSCN0732.JPG	Left cylinder internal surface B
DSCN0733.JPG	Left piston and pitch change rod
DSCN0734.JPG	Left hydraulic unit components B
DSCN0735.JPG	Unuseable- underexposed
DSCN0736.JPG	Left fork
DSCN0737.JPG	Left forward hub half internal surfaces
DSCN0738.JPG	Left aft hub half internal surfaces A
DSCN0739.JPG	Left aft hub half internal surfaces B
DSCN0740.JPG	Left mounting flange
DSCN0741.JPG	Left preload plates and pitch change blocks
DSCN0742.JPG	L3 preload plate A
DSCN0743.JPG	L3 preload plate B
DSCN0744.JPG	L3 preload plate aft sidewall/lip damage
DSCN0745.JPG	L1 blade butt
DSCN0746.JPG	L2 blade butt
DSCN0747.JPG	L3 blade butt A
DSCN0748.JPG	L3 knob fracture
DSCN0749.JPG	L3 impact crescent
DSCN0750.JPG	L3 blade butt B

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DSCN0751.JPG	Left blades camber side A
DSCN0752.JPG	Left blades camber side B
DSCN0753.JPG	L3 camber side near tip
DSCN0754.JPG	L2 camber side near tip
DSCN0755.JPG	L1 camber side near tip A
DSCN0756.JPG	L1 camber side near tip B
DSCN0757.JPG	Left blades face side A
DSCN0758.JPG	Left blades face side B
DSCN0759.JPG	Left blades face side C
DSCN0760.JPG	L3 blade face side near tip
DSCN0761.JPG	Left prop hardware bags
DSCN0762.JPG	Right spinner dome and dome cap
DSCN0763.JPG	Right low pitch stop assembly A
DSCN0764.JPG	Right low pitch stop assembly B
DSCN0765.JPG	Right low pitch stop impact mark
DSCN0766.JPG	Right cylinder external surface
DSCN0767.JPG	Right cylinder internal surface
DSCN0768.JPG	Right piston and pitch change rod
DSCN0769.JPG	Right hydraulic unit components
DSCN0770.JPG	Right fork A
DSCN0771.JPG	Right fork B
DSCN0772.JPG	Right fork slot impact marks
DSCN0773.JPG	Right forward hub half internal surface
DSCN0774.JPG	Right aft hub half internal surface
DSCN0775.JPG	Right preload plates and knob blocks A
DSCN0776.JPG	Right preload plates and knob blocks B
DSCN0777.JPG	R2 preload plate
DSCN0778.JPG	R3 preload plate
DSCN0779.JPG	R3 preload plate sidewall and lip damage
DSCN0780.JPG	Right mounting flange
DSCN0781.JPG	Right blades camber side A
DSCN0782.JPG	Right blades camber side B
DSCN0783.JPG	R1 camber side tip area A
DSCN0784.JPG	R1 camber side tip area B
DSCN0785.JPG	R2 camber side tip area
DSCN0786.JPG	R3 camber side tip area A
DSCN0787.JPG	R3 camber side tip area B
DSCN0788.JPG	Right blades face side
DSCN0789.JPG	R1 face side tip area A
DSCN0790.JPG	R1 face side tip area B
DSCN0791.JPG	R1 face side tip area C
DSCN0792.JPG	R1 face side tip area D
DSCN0793.JPG	R2 face side tip area
DSCN0794.JPG	R3 face side tip area
DSCN0795.JPG	Right blades face side from tip view
DSCN0796.JPG	Right blades lead edge view
DSCN0797.JPG	Right blades camber side lead edge view

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DSCN0798.JPG	Left blades lead edge view
DSCN0799.JPG	Left blades camber side lead edge view
DSCN0800.JPG	L3 vs. R3 lead edge view comparison
DSCN0801.JPG	L3 vs. R3 camber side lead edge view comparison
DSCN0802.JPG	Left governor A
DSCN0803.JPG	Left governor B
DSCN0804.JPG	Right governor
DSCN0805.JPG	Right hub and hardware bags as given for storage
DSCN0806.JPG	Left hub and hardware bags as given for storage
TH0000029.JPG	Theodolite photo looking at incoming flight path/direction
TH0000030.JPG	Theodolite pitch angle measurement to tree top
TH0000031.JPG	Theodolite photo of crash scene in impact direction
TH0000032.JPG	Theodolite photo in approx. direction of airport/approach course A
TH0000033.JPG	Theodolite photo in approx. direction of airport/approach course B
TH0000034.JPG	Theodolite photo right spinner counterweight impression angle A
TH0000035.JPG	Theodolite photo right spinner counterweight impression angle B
TH0000036.JPG	Theodolite photo right spinner counterweight impression angle C