HARTZELL PROPELLER INC.

Aircraft Accident/Incident Report No.: 090821

Date of Accident:	August 21, 2009
Location:	Teterboro, NJ
NTSB File No.:	ERA09FA469
Aircraft:	Beech 58 Baron
Registration No.:	N167TB
Serial No.:	TH-1905
Operator:	per FAA registry: Quest Diagnostics Inc. 159 Air Museum Drive Reading, PA 19605
Written by:	Tom McCreary Air Safety Investigation Manager
Date:	September 8, 2009

Contents:

	Page
Accident Synopsis	2
Conclusion	3
Propeller Teardown Report	4
Governors	14
Photographic Summary	15

ACCIDENT SYNOPSIS

NTSB preliminary report stated that the aircraft was on approach to landing at high speed. It overflew the runway and crashed, struck a sign, tree, and burned.

Aircraft Damage: Destroyed
Injuries: Two persons on board, one fatal, one injured

SUMMARY AND ANALYSIS

The damage to both propellers was remarkably similar. The piston, cylinder, and complete pitch change mechanism were intact on both propellers. Blades from both propellers had very mild bending with no twisting damage, which suggests little or no power at the time of impact. Prior to disassembly, both propellers were in the feathered position. Each spinner dome had impact damage from one blade counterweight while in the feathered position.

Left Propeller:
- Prior to disassembly, the left propeller was in the feathered position.
- One blade counterweight protruded through the spinner dome with the blade in the feathered position, which indicates that the propeller was feathered prior to the spinner being crushed.
- The pitch change mechanism was intact.
- The propeller remained secured to the engine.

Given these facts, the only way for the propeller to be feathered was for it to not have oil in the propeller piston/cylinder which means that it would have had to lose oil pressure to the piston prior to crushing of the spinner dome. This, plus the mild blade damage with no evidence of rotation, indicates that the propeller was feathered prior to impact.

NOTE: The pitch change mechanism can be actuated from feather to low pitch during impact. The forces of impact simply have to overcome the force of the feather spring, air charge, and counterweight forces (if rotating).
With the oil system and propeller pitch change linkage intact, a propeller cannot be actuated from low pitch to feather without loss of oil pressure to the piston/cylinder because oil in the cylinder forms a “hydraulic lock”.

Right Propeller:
The right propeller was similar to the left propeller except:
- The engine shaft was fractured. This would have released oil pressure and allowed the propeller to go to the feather position.
- The spinner dome had two distinct impact marks from a blade counterweight, one at the feather position and one at low pitch. The hole in the spinner dome at the low pitch position was folded such that it appeared to have been created by the counterweight moving from feather toward low pitch (suggesting that the first impact was with the blade at feather).
- Two blades had chordwise scoring. R2 blade had no damage other than chordwise scoring near the leading edge, but because the damage was similar on both the flat and camber sides of the blade, it is not compelling evidence of rotation (could have been feathered). R3 blade had light chordwise scratches on the camber side, which suggests rotation.

The right propeller has less compelling evidence of being feathered than the left propeller. But given the overall similarity of damage of the two propellers, along with the spinner dome damage, it appears that the right propeller was feathered. If it was not feathered, blade damage suggests it was operating at low power or no power at the time of impact.

CONCLUSIONS

The left propeller was feathered at the time of impact.

The right propeller appears to have been feathered at the time of impact.

There were no discrepancies noted that would preclude normal operation. All damage was consistent with impact damage.

Propeller Teardown Report

Date of Investigation: August 25, 2009

Location: Anglin Aircraft Recovery
Clayton, Delaware

Propeller Model: PHC-J3YF-2UF with FC7663-2R blades

Representatives:

Tom McCreary	Hartzell Propeller Inc.
Brian Raynor	NTSB
Ernest Hall	Hawker Beechcraft
John Kent	Teledyne Continental

General Comments:

This type propeller is a 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 a start lock mechanism that holds the blades at a low blade angle during engine start. The blades and hub are of aluminum construction. Propeller rotation is clockwise as viewed from the rear.

Installation Data: (Data reference the 30-inch station)

Low Pitch:	13.0	± 0.2	degrees
Start Lock:	18.5	± 1.5	degrees
Feather:	82.0	± 0.5	degrees

Service History:

Logbook records were not available.

	S/N	Date of manufacture	TTSN	TSO
Left Hub	ED4009A	1FEB99	unknown	unknown
Blades	J24196	1FEB99	unknown	unknown
	J24193	1FEB99	unknown	unknown
	J24190	1FEB99	unknown	unknown
Right Hub	ED4010A	1FEB99	unknown	unknown
Blades	J24192	1FEB99	unknown	unknown
	J24198	1FEB99	unknown	unknown
	J24188	1FEB99	unknown	unknown

Position: **LEFT**

Hub Serial Number: ED4009A **Factory No.: A44492A**

Blade Model: FC7663-2R

S/N L1: J24196
S/N L2: J24193
S/N L3: J24190

Blade Orientation:

Blades were marked L1-L2-L3 clockwise as viewed from the rear of the propeller. The hub serial number was between the L2 and L3 blades.

As Received Condition:

See photos on Page 6.

The propeller had not been removed from the engine and the spinner dome had not been removed. All three blades were in the feather position.

Spinner Assembly:

See photo on Page 13.

L1 blade counterweight had penetrated the spinner dome. The blade/counterweight was at the feather position when the damage occurred.

The dome had light frontal damage. The spinner bulkhead had several dents on the outside diameter.

Propeller Cycling:

Cycling of the pitch change mechanism was not attempted (no tooling available).
The air valve was intact and retained an air charge.

Engine/Propeller Mounting:

Intact and unremarkable

Cylinder:

Intact and unremarkable

Piston:

Intact and unremarkable


L1
L2


L1
L2
L3

Pitch Change Rod:

Intact and unremarkable

Fork:

Intact and unremarkable

Spring/Spring Guides:

Intact and unremarkable

Pitch Stops:

Low Pitch Stop: The low pitch stop had a light impression mark.

Feather Stop: The feather stop was intact and unremarkable.

Start Lock: The start lock was undamaged, intact and operable.

Hub Assembly:

The hub had mild internal damage due to inward movement (impact) of the blades and preload plates.

Preload Plates:

All three preload plates had light scoring from contact with fork bumpers (normal operation). There were no impact marks that could be used to calculate a blade angle. The outboard lip on L1 preload plate was damaged due to inward movement of the blade.

Propeller Blades:

See photos on Pages 8 and 13.

L1 blade was bent aft approximately 30^{o} at 1/3 radius with a large radius bend. It had light angular scoring on the camber side at mid-blade. The pitch change knob and counterweight were intact and unremarkable.

L2 blade was bent forward approximately 30^{o} with a large radius bend at mid-blade. It had spanwise scoring on the flat side on the outer 1/3 of the blade. It had thermal damage to the paint and deicer boot. The pitch change knob and counterweight were intact and unremarkable.

L3 blade was bent slightly aft at mid-blade. Paint was abraded on the camber side on the outer 1/3 of the blade. The pitch change knob and counterweight were intact and unremarkable.


L1
L2
L3


L3
L2
L1


L1
L2
L3

Position: **RIGHT**

Hub Serial Number: ED4010A **Factory No.:** A44497A

Blade Model: FC7663-2R

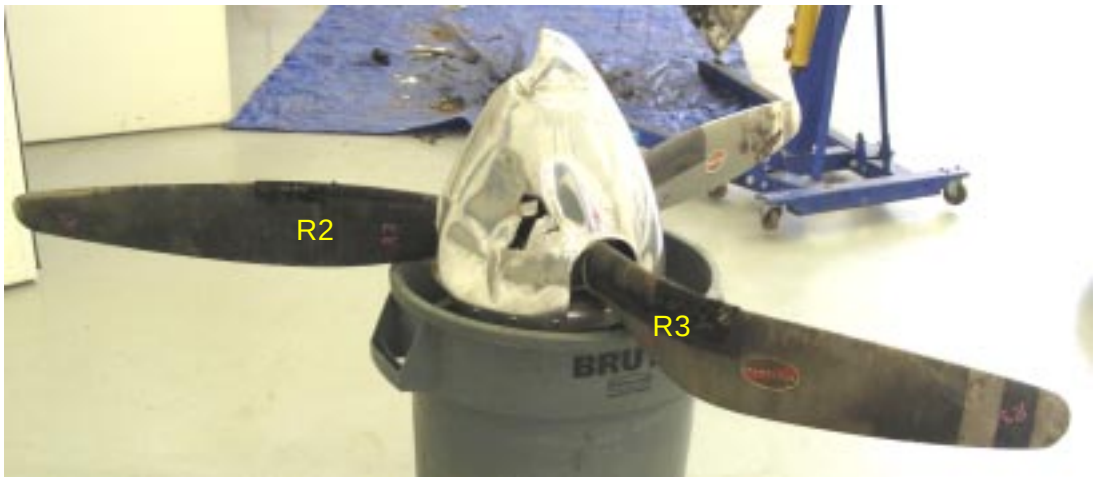
S/N L1: J24192
S/N L2: J24198
S/N L3: J24188

Blade Orientation:

Blades were marked R1-R2-R3 clockwise as viewed from the rear of the propeller.

As Received Condition:

The propeller had separated from the engine and the spinner dome had not been removed. The engine crankshaft was fractured approximately two inches aft of the propeller flange. All three blades were in the feather position.



Spinner Assembly:

See photo on Page 13.

R3 blade counterweight had penetrated the spinner dome. There were two distinct impacts from R3 blade counterweight, one was at the feather position and one was at a low pitch position.

The dome had light frontal damage. The spinner bulkhead had a dent on one side and was otherwise unremarkable.

Propeller Cycling:

Cycling of the pitch change mechanism was not attempted (no tooling available).
The air valve was intact and retained an air charge.

Engine/Propeller Mounting:

The propeller mounting flange, studs and nuts were intact and unremarkable, however, the engine crankshaft was fractured.

Cylinder:

Intact and unremarkable

Piston:

Intact and unremarkable

Piston:

Intact and unremarkable

Pitch Change Rod:

Intact and unremarkable

Fork:

Intact and unremarkable

Spring/Spring Guides:

Intact and unremarkable

\Pitch Stops:

Low Pitch Stop: The low pitch stop had a light impression mark.

Feather Stop: The feather stop was intact and unremarkable.

Start Lock: The start lock was undamaged, intact and operable.

Hub Assembly:

The hub had mild internal damage due to inward movement (impact) of the blades and preload plates.

Preload Plates:

All three preload plates had light scoring from contact with fork bumpers (normal operation). There were no impact marks that could be used to calculate a blade angle.

Propeller Blades:

See photos on Pages 12 and 13.

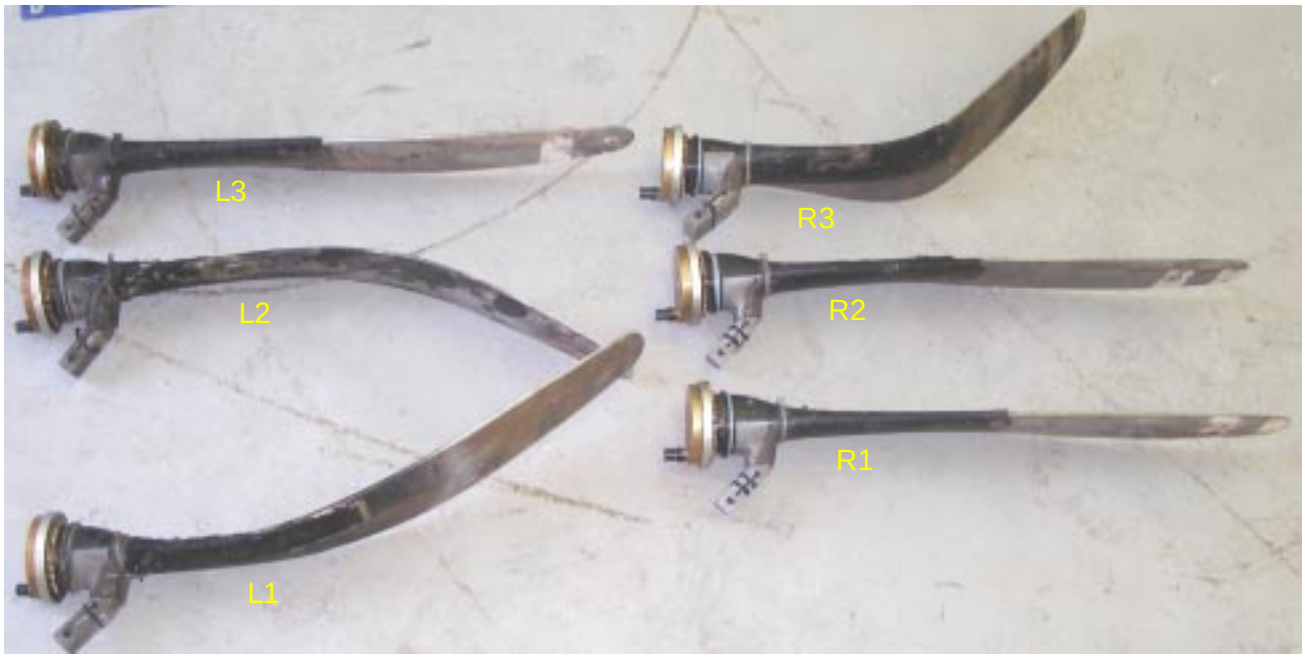
R1 blade was straight with no bends or twisting. It had gouges along the leading edge from the outer end of the de-ice boot to the tip. The pitch change knob and counterweight were intact and unremarkable.

R2 blade was straight with no bends or twisting. It had chordwise scoring in the paint along the leading edge on both the camber side and flat side of the blade. It had thermal damage to the de-icer boot. The pitch change knob and counterweight were intact and unremarkable.

R3 blade was bent aft approximately 45^{o} at mid-blade. The pitch change knob and counterweight were intact and unremarkable.


R3
R2
R1


R3
R2
R1



All Six blades

Both spinner domes

GOVERNORS

The Woodward governor from the left engine was observed in situ on the engine. The propeller control lever was at the high RPM stop position. The governor had provision for an unfeathering accumulator but there was no line attached; the fitting was capped.

The right engine governor was not observed.

PHOTOGRAPHIC SUMMARY

NOTE: The following digital photographs are original and unedited and available on compact disc. 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.

PHOTOGRAPH NUMBER	DESCRIPTION
Dscn3476.jpg	left engine and propeller
Dscn3477.jpg	left propeller
Dscn3478.jpg	left propeller
Dscn3479.jpg	left propeller
Dscn3480.jpg	left spinner dome
Dscn3481.jpg	left spinner dome
Dscn3482.jpg	left spinner dome
Dscn3483.jpg	right propeller
Dscn3484.jpg	right propeller
Dscn3485.jpg	right propeller
Dscn3486.jpg	right propeller spinner/counterweight impact
Dscn3487.jpg	right propeller spinner/counterweight impact
Dscn3488.jpg	right propeller spinner/counterweight impact
	LEFT PROPELLER
Dscn3489.jpg	left propeller
Dscn3490.jpg	left propeller
Dscn3491.jpg	left propeller with piston, cylinder removed
Dscn3492.jpg	left propeller with rear hub half removed
Dscn3493.jpg	all three blade butts/preload plates
Dscn3494.jpg	blades, miscellaneous parts
Dscn3495.jpg	blades, miscellaneous parts
Dscn3496.jpg	L1 preload plate
Dscn3497.jpg	L2 preload plate
Dscn3498.jpg	L3 preload plate
Dscn3499.jpg	L1 blade butt
Dscn3500.jpg	L2 blade butt
Dscn3501.jpg	L3 blade butt
Dscn3502.jpg	fork
Dscn3503.jpg	fork
Dscn3504.jpg	all three pitch change blocks
Dscn3505.jpg	front hub half, internal
Dscn3506.jpg	front hub half, external
Dscn3507.jpg	rear hub half internal
Dscn3508.jpg	low pitch stop
Dscn3509.jpg	low pitch stop screw
Dscn3510.jpg	start lock sleeve
Dscn3511.jpg	start locks
Dscn3512.jpg	rear hub half, internal

Dscn3513.jpg	mounting flange
Dscn3514.jpg	piston, pitch change rod
Dscn3515.jpg	piston, front side
Dscn3516.jpg	feather spring, spring retainer, cylinder
Dscn3517.jpg	cylinder, inside
Dscn3518.jpg	all three blades, camber side
Dscn3519.jpg	all three blades, camber side
Dscn3520.jpg	all three blades, camber side
Dscn3521.jpg	all three blades, flat side
Dscn3522.jpg	all three blades, camber side
Dscn3523.jpg	L1 blade, camber side
Dscn3524.jpg	L3 blade, camber side, tip
	RIGHT PROPELLER
Dscn3525.jpg	right propeller
Dscn3526.jpg	right propeller
Dscn3527.jpg	right spinner dome
Dscn3528.jpg	right spinner dome, counterweight impact
Dscn3529.jpg	right spinner dome, counterweight impact, internal
Dscn3530.jpg	right spinner dome, counterweight impact, internal
Dscn3531.jpg	right spinner dome, counterweight impact, internal
Dscn3532.jpg	right propeller, hub halves removed
Dscn3533.jpg	blades, miscellaneous parts
Dscn3534.jpg	R1 preload plate
Dscn3535.jpg	R2 preload plate
Dscn3536.jpg	R3 preload plate
Dscn3537.jpg	R1 blade butt
Dscn3538.jpg	R2 blade butt
Dscn3539.jpg	R3 blade butt
Dscn3540.jpg	low pitch stop
Dscn3541.jpg	start lock
Dscn3542.jpg	low pitch stop screw
Dscn3543.jpg	start lock sleeve
Dscn3544.jpg	fork
Dscn3545.jpg	fork
Dscn3546.jpg	start lock, low stop parts
Dscn3547.jpg	piston, pitch change rod
Dscn3548.jpg	cylinder, feather spring
Dscn3549.jpg	cylinder, inside
Dscn3550.jpg	cylinder, front
Dscn3551.jpg	rear hub half, internal
Dscn3552.jpg	mounting flange
Dscn3553.jpg	front hub half, internal
Dscn3554.jpg	front hub half, external
Dscn3555.jpg	all three blades, camber side
Dscn3556.jpg	all three blades, camber side
Dscn3557.jpg	all three blades, camber side
Dscn3558.jpg	R2 blade tip, camber side
Dscn3559.jpg	R2 blade tip, flat side
Dscn3560.jpg	R2 blade tip, flat side

Dscn3561.jpg	R3 blade, camber side
Dscn3562.jpg	R3 blade, camber side
Dscn3563.jpg	all three blade, flat side
Dscn3564.jpg	all three blade, flat side
Dscn3565.jpg	all three blade, flat side
	BOTH PROPELLERS
Dscn3566.jpg	all six blades, lead edge
Dscn3567.jpg	all six blades, lead edge
Dscn3568.jpg	all six blades, lead edge
Dscn3569.jpg	both spinner domes
Dscn3570.jpg	both spinner domes
Dscn3571.jpg	both spinner domes