

HARTZELL PROPELLER INC.

Aircraft Accident/Incident Report No.: 150709

PROPELLER TEARDOWN REPORT

Date of Investigation: August 6, 2015 & October 5, 2015

Location: Souther Field Aviation (August 6, 2015)
Jimmy Carter Regional Airport
223 Airport Road
Americus, GA 31709

Hartzell Propeller Inc. (October 5, 2015)
One Propeller Place
Piqua, OH 45356

Propeller Model: HC-B3TN-3D with T10282N+4 blades

Representatives:	Les Doud	Hartzell Propeller Air Safety Investigator
	Steve Davidson	FAA Atlanta FSDO
	Michael Pupek	FAA Atlanta FSDO
	Don Peters	Air South Insurance
	David Huie	Old Republic Aerospace
	Scott Lewis	Aircraft Owner

General Comments:

This model propeller is a 3-blade, single-acting, hydraulically operated, constant speed model with feathering and reversing capabilities. Oil pressure from the propeller governor is used to move the blades to the low pitch (blade angle) direction. Blade mounted counterweights and feathering springs actuate the blades towards the high pitch direction in the absence of governor oil pressure. The propeller incorporates a Beta mechanism that actuates when blade angles are lower than the flight idle position. The blades are of aluminum construction. The hub and blade clamps are steel. Propeller rotation is clockwise as viewed from the rear.

Installation Data: Refer to Installation Data Sheet #123 and
Aircraft TCDS A4SW
(Angles referenced at the 30-inch radius)

Reverse:	-8.0 $\pm$ 0.5	degrees
Low Pitch:	18.0 $\pm$ 0.1	degrees
Feather:	87.0 $\pm$ 1.0	degrees
Counterweight	Positive	

Propeller Serial Number: BUA32424 **Factory No.:** D4048A(P/N 840-60 Rev.O)

Blade Model: T10282N+4

S/N Blade #1:	L27844
S/N Blade #2:	L27840
S/N Blade #3:	L27843

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Service History:

	<u>S/N</u>	<u>Date of manufacture</u>	<u>TTSN</u>	<u>TSO</u>
Hub	BUA32424	10/6/2012	UNK	UNK
Blades	L27844	8/18/2012	UNK	UNK
	L27840	8/18/2012	UNK	UNK
	L27843	8/18/2012	UNK	UNK

Last overhaul: Unknown

Blade Orientation:

The blades were identified as 1-2-3 clockwise as viewed from the rear of the propeller. The propeller serial number was between the #1 and #2 blades.

“As Received” Condition:

The propeller remained attached to the engine and was removed after recovering the wreckage and prior to my arrival at Souther Field Aviation. Photo #1 shows the condition when I arrived. All three blades showed similar bending in the aft direction and twisting leading edge down (toward flat pitch). Photo #2 shows how the cylinder, piston, feathering spring assembly and guide collar had separated from the hub unit. With the cylinder separated, all three blades had rotated beyond (more negative) the normal reverse position.

Photo #1 – Propeller As-Received



Photo #2 – Separated Cylinder Assembly



Spinner Dome: The spinner dome was not presented for examination.

Spinner Bulkhead: The spinner bulkhead was intact and unremarkable.

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

Engine/Propeller Mounting: The engine/propeller mounting flange was unremarkable.

Blade/Clamp Rotation: All three blade clamps could be rotated by hand after the link arm was disconnected from the piston. The witness tape on all three blades indicated there was no slippage between the blade and clamp.

Pitch Stops:

Low Pitch Stop: The low pitch stop nuts on the beta rods were present. The piston was pushing against the low pitch stop nuts which pulled the beta ring forward.

Feather Stop: The feather stop screws on top of the spring retainer cup were present with no remarkable damage. There were multiple, light impact marks in the top of the piston made by the feather stop screws.

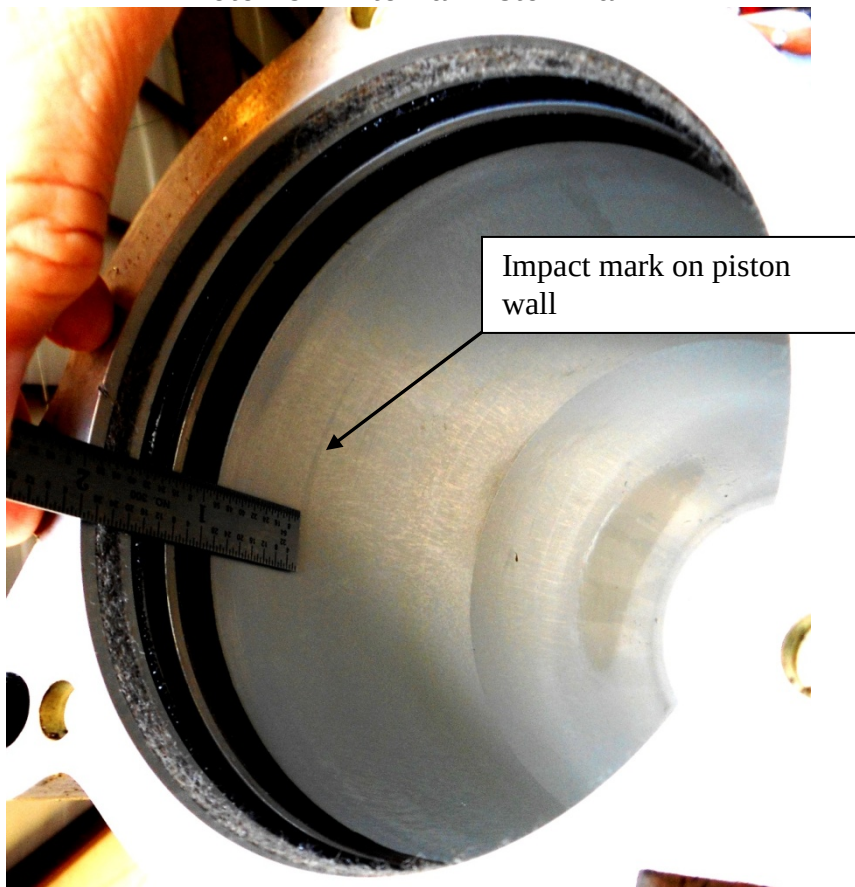
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Beta ring/rods: The beta ring was pulled forward against the spinner bulkhead and was undamaged. All beta rods were intact, in place and unremarkable.

Piston and Beta Guide Collar: The piston was still attached to the cylinder/pitch change rod and feathering spring assembly. The cylinder assembly separated at the hub attachment threads. The piston showed an internal impact mark (made by top corner of cylinder) adjacent to the #2 blade providing some blade angle information (see Photo #3). This mark was approximately 2" from the bottom edge of the piston which equates to a blade angle of approximately 12°. 12° is the approximate running flight idle blade angle (18° low pitch stop setting - ~6° beta valve null out travel = 12°). This mark implies the piston was extended at the low pitch position during the impact sequence and prior to the cylinder separation. The feathering spring assembly remained intact and under compression with the spring keepers in place. No attempt was made to remove the compressed feathering spring on-site.

The piston also had impact marks made by the counterweight arms/slugs adjacent to each blade arm. These impact marks were made during the initial series of blade strikes but prior to cylinder separation.

Photo #3 – Internal Piston Mark



The guide collar was fractured near an impact mark made by the #2 link arm. The guide collar clamps around the cylinder attaching threads, retains the beta ring return springs and guides the

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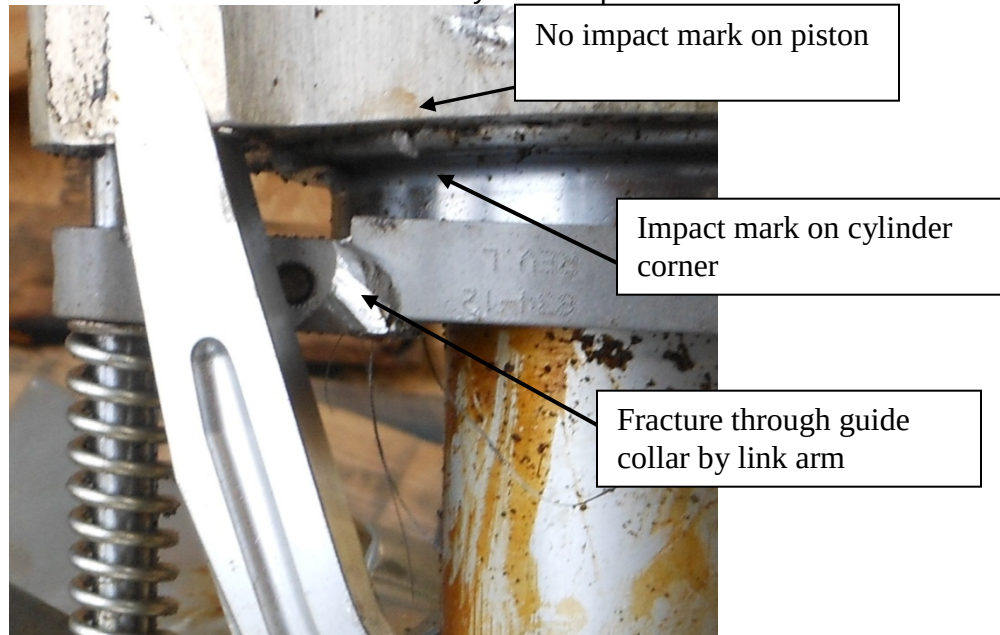
beta rods. There were impact marks on the guide collar made by the link arms at all three blade locations but only one fracture adjacent to the #2 link arm (see Photo #4).

Photo #4 – Beta Rod Collar



There was an impact mark in the bottom corner of the cylinder adjacent to the #2 blade and corresponding to the location of the guide collar fracture but no corresponding impact mark on the piston. This impact mark on the cylinder could only have been made prior to cylinder separation (with the piston extended in a low blade angle position) without marking the piston in the same location (see Photos #5 and #6). This damage is consistent with the counterweight impact marks on the side of the piston made prior to cylinder separation.

Photo #5 – Beta Rod Fracture and Cylinder Impact Mark



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Photo #6 – Cylinder As-Removed



Link Arms: All three link arms remained attached to their respective clamps at the link pin and their piston attachment point. All three link arms had visible compression bending indicating a force pushing the piston forward, caused by forcible blade twisting towards low pitch during repeated ground strikes under power.

Cylinder: The cylinder was forced off the hub mounting threads during repeated blade ground strikes. The threads on the cylinder were damaged with some thread whiskers visible on the cylinder and hub (visible in Photo #6 and Photo #9).

Feathering Spring Assembly: The feathering spring assembly was intact and captive on the pitch change rod in the as-received condition. The outer spring support sleeve had annular impact marks where it contacted the hub center bore after the cylinder assembly separated. The feathering spring was removed during the cylinder inspection at Hartzell Propeller on October 5, 2015 (see Photo #7). The aft spring seat had visible indentations from the split keeper gaps indicating a high axial load in the forward direction (see Photo #8)

Photo #7 – Cylinder Assembly Components



Photo #8 – Aft Spring Seat

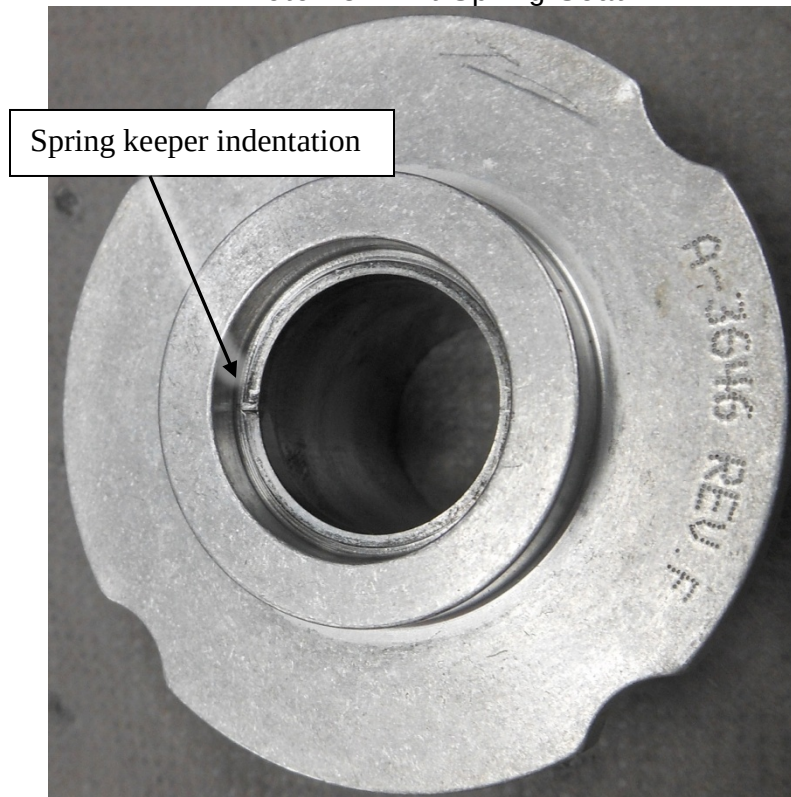
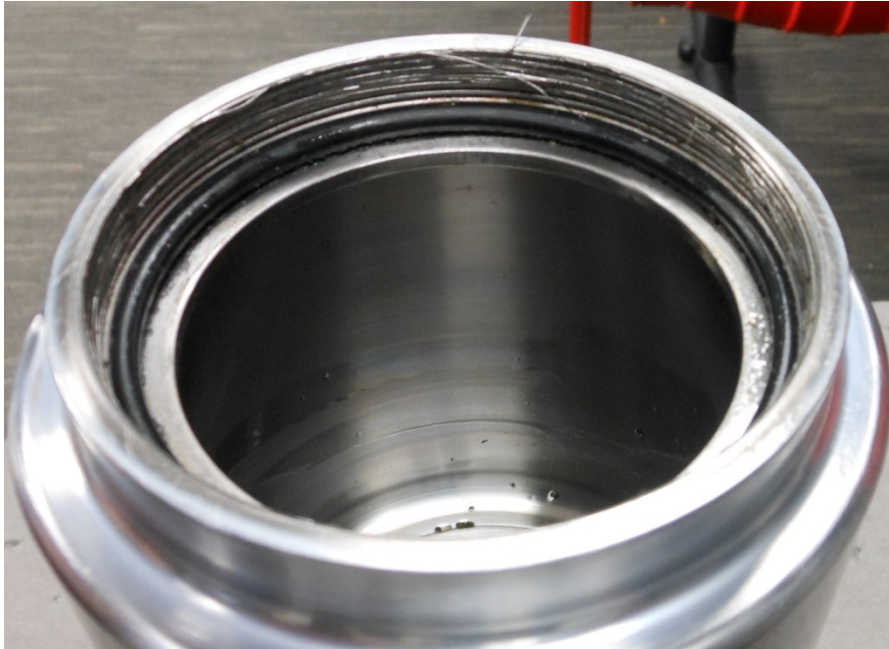


Photo #9 – Cylinder Attachment Threads



Pitch Change Rod: The pitch change rod was intact and unremarkable.

Clamps and Counterweights: All three inboard counterweight slugs had evidence of contacting the piston that was consistent with the damage on the piston.

Clamp serial numbers: (P/N C-1301-9S)

- #1 S/N EM26049 Counterweight was intact and attached to clamp.
- #2: S/N EM26010 Counterweight was intact and attached to clamp.
- #3: S/N EM26059 Counterweight was intact and attached to clamp.

Hub Unit: (Factory S/N D4048A)

The propeller mounting flange face appeared undamaged.

All three blade arms, pilot tubes and hub-side bearing races remained intact. There were contact marks on the hub arms where the clamp link pin scraped over the hub when the angles traveled beyond the reverse stop.

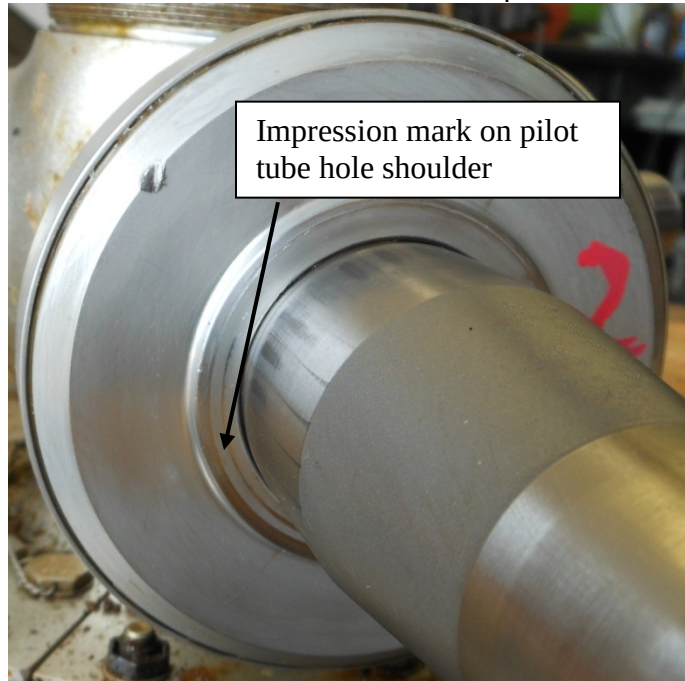
Cylinder attachment: The cylinder was forced off its hub mounting threads but the hub-side threads appeared undamaged (hub is heat treated, cylinder is not heat treated).

Impression marks from blade butts: There were discernible blade butt impression marks on all three blade arm/pilot tube shoulders made by the blade material surrounding the pilot bore bearing. These marks were consistent with the deformation on the individual blade butts. These impression marks were in the

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aft/trailing edge quadrant indicating both rotation and forward aircraft speed (see Photo #10). There were also visible pilot tube bearing marks on the pilot tube.

Photo #10 – Blade Arm/Blade Butt Impression Mark



Blades: (See Photos #11 through #13)

Blade #1

- Paint, camber side - Chordwise and spanwise scoring from 30" radius to tip.
- Paint, flat side - Normal wear and abrasion.
- Bend - Bending aft starting at approximately 12" from butt.
- Twist - Leading edge towards low pitch.
- Lead edge damage - Local leading edge deformation curled down ~8-12" from tip.
- Trail edge damage - Local deformation/waviness ~8-12" from tip.
- Butt impression - Pilot tube shoulder impression centered ~aft/trail quadrant.

Blade #2

- Paint, camber side - Chordwise and spanwise scoring from 18" radius to tip.
- Paint, flat side - Some chordwise paint scuffs otherwise normal wear and abrasion.
- Bend - Bending aft starting at approximately 12" from butt.
- Twist - Leading edge towards low pitch.
- Lead edge damage - Local leading edge waviness last 6" to tip.
- Trail edge damage - Local trailing edge waviness last 6" to tip.
- Butt impression - Pilot tube shoulder impression centered ~aft/trail quadrant

Blade #3 (See Photo #6)

- Paint, camber side - Chordwise and spanwise scoring from 18" radius to tip.
- Paint, flat side - Some chordwise paint scuffs otherwise normal wear and abrasion.
- Bend - Bending aft starting at approximately 12" from butt.
- Twist - Leading edge towards low pitch.
- Lead edge damage - Last 4-6" of tip fractured.
- Trail edge damage - Local deformation/waviness ~8-12" from tip.
- Butt impression - Pilot tube shoulder impression centered ~aft/trail quadrant

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Photo #9 (Camber Side)



Photo #10 (Camber Side)



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Photo #11 (Face Side)

