

Date of Accident: April 25, 2016

Location: Boone, NC

NTSB File No.: ERA16FA169

Aircraft: PA-32-300
Type Certificate Data Sheet A3SO

Registration No.: N43576

Serial No.: 32-7440135

Owner: per FAA registry:
John F Worsley II



Written by: Les Doud
Air Safety Investigator – Hartzell Propeller Inc.

Date: June 30, 2016

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ACCIDENT SYNOPSIS

According to the NTSB preliminary report:

"On April 25, 2016, about 1300 eastern daylight time, a Piper PA-32-300, N43576, was destroyed after a collision with trees, terrain and post-crash fire in Boone, North Carolina. The pilot and pilot-rated passenger were seriously injured. The rear seat passenger was fatally injured. Visual meteorological conditions prevailed at the time and no flight plan was filed for the Title 14 Code of Federal Regulations (CFR) Part 91 personal flight. The airplane was originating at the time of the accident from Boone Inc. Airport (NC14), Boone, North Carolina.

According to a witness at the approach end of runway 31, he stated that the airplane was approaching at a high rate of speed prior to landing. He said that he did not see the airplane touchdown, but shortly after he saw a plume of smoke on a golf course. Another witness that was in a house on a hill on the right side of the departure end of runway 31, stated that when she saw the airplane, the left wing was low and it collided with a pine tree. She said that the airplane seemed as if it was attempting to gain altitude but collided with another pine tree before descending and "crashing into the golf course." Witnesses on the golf course reported that they watched the airplane climb out; they stated that the airplane was "bobbling" up and down before hitting the top of a stand of pine trees. The airplane nosed down and collided on the golf course before bursting into flames. The witnesses on the golf course observed the occupants exit the airplane and assisted them before the local authorities arrived.

Examination of the wreckage site revealed that the airplane initially impacted a stand of 75-foot-tall pine trees. Parts of the left wing and fresh cut branches were observed throughout the stand of pine trees. The airplane continued on the wreckage path until it came to rest on a golf course. The debris path was orientated on a magnetic heading of about 310 degrees and extended about 126 ft. The main wreckage consisted of the fuselage, the rudder and vertical stabilizer, the left and right horizontal elevator. The outboard section of the left wing was fragmented along the wreckage path. The right wing was located with the main fuselage and it was consumed by fire. A post-impact fire consumed the cockpit, cabin, and baggage area. The instrument panel and avionics were destroyed by fire. The airplane was retained for further examination.

At 1255, surface weather observation for NC14, about .50 miles northwest of the accident site, included wind from 330 degrees at 4 knots, visibility 10 statute miles. The temperature was 21 degrees Celsius (C), the dew point was 6 degrees C, and the altimeter setting was 30.11 inches of mercury."

Aircraft Damage: Destroyed
Injuries: 2 fatal; 1 serious

SUMMARY OF FINDINGS

The propeller was removed from the engine by the aircraft recovery personnel and shipped to Hartzell Propeller for this examination. The propeller mounting flange did not display any damage. Both blades had leading edge damage and rotational/chordwise scoring; the camber side had the most severe scoring. One blade appeared to be in a high pitch position and could be partially rotated by hand force; the pitch change knob on that blade was found to be fractured from overload. This blade was also bent aft and had spanwise scoring. The other blade had noticeable face side scoring and displayed some S-bend characteristics. Other than one pitch change knob being fractured, the remainder of the pitch change components were intact. The pre-load plate markings indicated the propeller was operating in the normal range of operation at impact. The propeller was over-serviced with grease; grease partially filled the hub cavity.

[REDACTED]

[REDACTED]

Propeller Teardown Report**Date of Investigation:** May 20, 2016**Location:** Hartzell Propeller Engineering Test Lab
350 Washington Ave.
Piqua, OH 45356**Propeller Model:** HC-C2YK-1(BF) with F8475D-4 blades**Representatives:** Les Doud Hartzell Propeller Inc.
Bob Craig FAA Cincinnati FSDO**General Comments:**

This type propeller is a 2-blade single-acting, hydraulically operated, constant speed model. Oil pressure from the propeller governor is used to move the blades to the high pitch (blade angle) direction. A spring and blade twisting moment move the blades toward the low pitch direction in the absence of governor oil pressure. The blades and hub are of aluminum construction. Propeller rotation is clockwise as viewed from the rear.

Installation Data: Reference Hartzell Propeller Installation Data Sheet No. 829 or aircraft Type Certificate Data Sheet A3SO.
(Data reference the 30-inch station)Low Pitch: 13.5 $\pm$ 0.2 degrees
High Pitch: 34.0 $\pm$ 1.0 degrees**Service History:** Unknown

The propeller logbook records were not available when this examination was performed.

	<u>S/N</u>	<u>Date of manufacture</u>	<u>TTSN</u>	<u>TSO</u>
Hub	CH33789B	11/16/99	UNK	UNK
Blades	H40576	10/18/91	UNK	UNK
	H40592	10/18/91	UNK	UNK

Propeller Serial Number: CH33789B**Factory Serial Number:** A48109B**Blade Model:** F8475D-4Blade #1: S/N H40576
Blade #2: S/N H40592

Blade Orientation:

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

As Received Condition: (Photo #1 and #2)

The propeller was removed from the engine and shipped to Hartzell Propeller in the condition shown in Photo #1 prior to the examination documented herein. The propeller mounting flange did not display any damage. One blade appeared to be in a high pitch position and could be partially rotated by hand force. Both blades had rotational/chordwise scoring; the camber side had the most severe scoring. One blade was bent aft and had spanwise scoring. The blade with the most prominent face side scoring displayed some S-bend characteristics.

Spinner Dome & Bulkhead:

The spinner assembly is a Piper-supplied part and was not included with the propeller for examination. A small piece of the forward bulkhead and shim remained attached to the propeller cylinder by four, safety-wired bolts.

Propeller Cycling:

Propeller cycling was not attempted.

Engine/Propeller Mounting: (Photo #3)

The propeller mounting flange and fasteners appeared undamaged. There were no indications of fretting or corrosion on the face of the mounting flange.

Pitch Change Mechanisms (Piston, Rod, Fork, Cylinder and Spring): (see Photo #4)

The piston and spring were intact and appeared functional. The piston had a small nick on the aft edge. The low and high pitch stops were intact and in proper position. The pitch change rod and fork appeared normal. The low pitch stop/pitch change rod contact surface did not have any remarkable impact impressions. The cylinder had one small dent – appeared to be impact damage – in the forward corner that was not deep enough to reach the piston area and did not appear to distort the overall shape of the cylinder.

Hub Unit: (see Photos #5 and #6)

There were no visible cracks or fractures on the hub surface and all bolts were installed and secure. Upon separating the hub halves, it was evident the bearings had been over-serviced with grease; grease partially filled the hub cavity. The internal surfaces of the hub unit displayed impact damage to the preload plate contact surfaces on both the front and aft halves as well as the lead and trail edge areas.

Preload Plates: (see Photo #7)

NOTE: For this propeller model, when the blade knob is aligned with the hub parting line, the blade angle at the reference station is 46° (knob $\phi=10^\circ + 36 = 46^\circ$). On a two-blade Compact series propeller, pitch change knob impressions are sometimes made on the opposite-side preload plate during an impact sequence. The impression marks can be measured to provide some blade angle information.

In Photo #7 the knob impressions in the range $24-39^\circ$ equates to blade angles of $7-22^\circ$ which encompass the normal range of operation. Impressions below the low pitch setting of 13.5° could have been made during the impact sequence when the blades were forcibly twisted beyond the low pitch and either fractured the knob and/or rotated the preload plate out of position. The most prominent impression is on preload plate #1 near 25° which equates to a blade angle of 21° which is in the normal range of operation.

The preload plates were damaged around the periphery of the lip and at points where they impacted the internal hub surfaces. The forward end (low pitch end) of the pitch change knob slots also had damage where the knob and plate contacted during the impact sequence.

Blade Bearings and Pitch Change Knobs: (see Photos #8 and #9)

Both bearing assemblies (races and ball bearings) had an ample amount of grease, but the grease appeared dirty. Photo #8 shows the blade #1 bearing race fracture with ball bearing impressions near the fracture. Photo #9 shows the blade #2 bearing races.

The pitch change knob for blade #1 was fractured. Evidence indicates the knob was fractured when the blade rotated and forced the knob into the preload plate during the impact sequence. The pitch change block for blade #2 was fractured and fragmented. Blade #2 pitch change knob had a similar impact mark from the preload plate and was visually bent towards high pitch but was not fractured.

Propeller Blades: (see Photos #10 through #15)**# 1 blade**

paint, camber side	- Chordwise/rotational scoring and spanwise scoring from the shank outboard
paint, flat side	- Unremarkable, some evidence of charring
bend	- Bent aft starting 7" from butt
twist	- Leading edge down
lead edge damage	- Dents and gouges 24" from butt, nicks and aggressive erosion near tip
trail edge damage	- No remarkable damage
knob condition	- Fractured/overload
blade butt	- Contact mark with preload plate on the face side

2 blade

paint, camber side	- Chordwise/rotational scoring outboard 20" of blade
paint, flat side	- Chordwise/rotational scoring and abrasion 11" from tip
bend	- "S-bending" characteristics, bent forward at 20" from but, then aft near tip
twist	- Leading edge down starting at 20"
lead edge damage	- Aggressive/1" wide erosion outboard of mid-blade, nicks in tip region.
trail edge damage	- No remarkable damage
knob condition	- Visually bent toward high pitch, impact damage with preload plate, pitch change block fractured and fragmented
blade butt	- Contact mark with preload plate in the face/trailing edge quadrant

Photo #1 – As-received



Photo #2 – As-received/unwrapped



Photo #3 – Propeller mounting flange



Photo #4 – Pitch change components



Photo #5 – Over-servicing with grease



Photo #6 – Hub internal surfaces

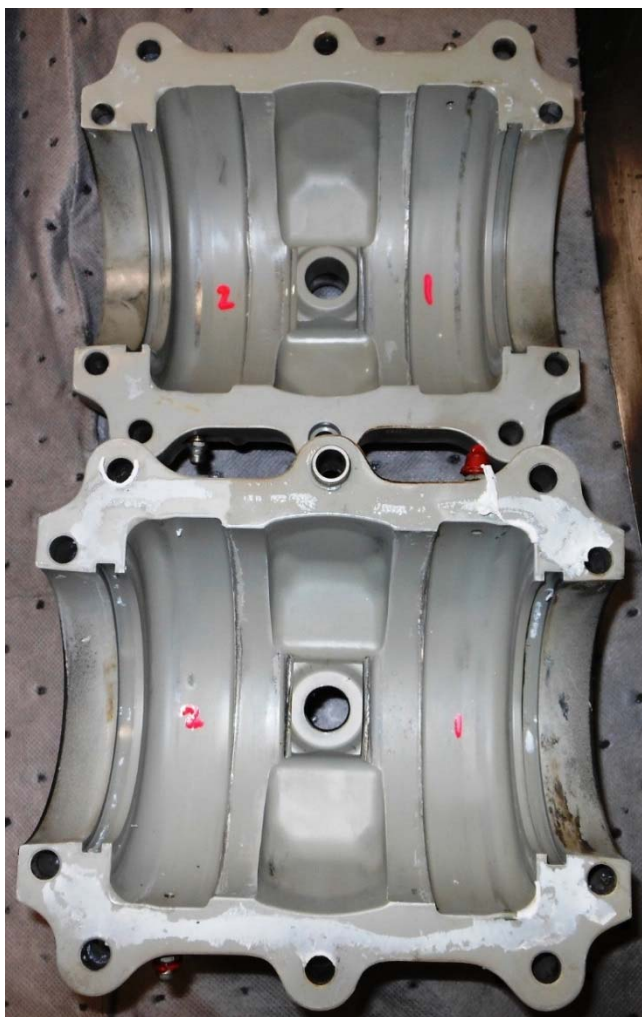


Photo #7 – Preload plates



Photo #8 – Blade #1 bearing races and pitch change knob



Photo #9 – Blade #2 blade bearing races



Photo #10 – Camber side



Photo #11 – Camber side tip area



Photo #12 – Face side



Photo #13 – Face side tip area



Photo #14 – Trail edge view



Photo #15a – Blade #1 butt

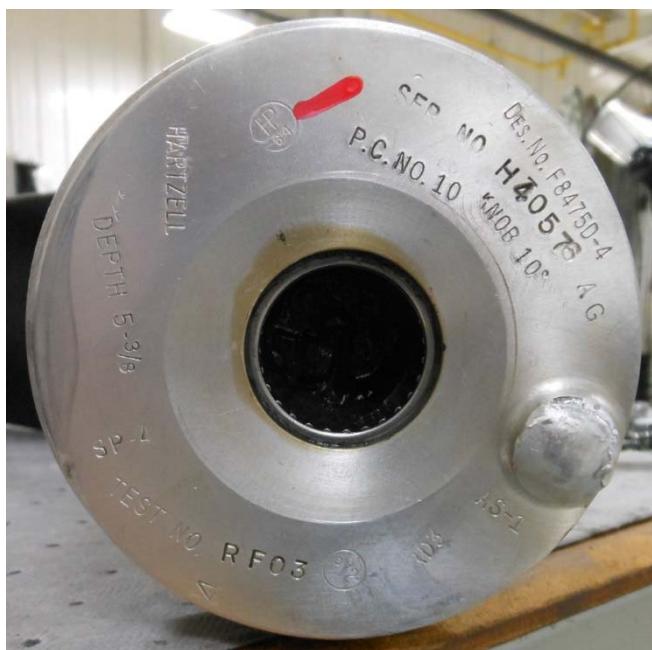


Photo #15b – Blade #2 butt



PHOTOGRAPHIC SUMMARY

NOTE: The following digital photographs are original and unedited and available in digital format. 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>
DSCN3125.JPG	Propeller wrapped on shipping pallet A
DSCN3126.JPG	Shipping document
DSCN3127.JPG	Propeller wrapped on shipping pallet B
DSCN3128.JPG	Propeller as-received unwrapped on pallet A
DSCN3129.JPG	Propeller as-received unwrapped on pallet B
DSCN3130.JPG	Propeller as-received unwrapped on pallet C
DSCN3131.JPG	Propeller as-received on bench
DSCN3132.JPG	Propeller model and S/N stampings
DSCN3133.JPG	Spinner fragments and attach bolts on cylinder A
DSCN3134.JPG	Spinner fragments and attach bolts on cylinder B
DSCN3135.JPG	Mounting flange A
DSCN3136.JPG	Mounting flange B
DSCN3137.JPG	Hub internal over serviced with grease A
DSCN3138.JPG	Hub internal over serviced with grease B
DSCN3139.JPG	Hub internal over serviced with grease C
DSCN3140.JPG	Hub internal over serviced with grease D
DSCN3141.JPG	Preload plates
DSCN3142.JPG	Aft hub internal
DSCN3143.JPG	Fwd hub internal
DSCN3144.JPG	Hub halves internal
DSCN3145.JPG	Erroneous picture (switched preload plate position)
DSCN3146.JPG	Erroneous picture (switched preload plate position)
DSCN3147.JPG	Erroneous picture (switched preload plate position)
DSCN3148.JPG	Erroneous picture (switched preload plate position)
DSCN3149.JPG	Rod, piston, fork, cylinder, spring
DSCN3150.JPG	Blades camber side A
DSCN3151.JPG	Blades camber side B
DSCN3152.JPG	Blades camber side tip area A
DSCN3153.JPG	Video of blade #2 camber tip area
DSCN3154.JPG	Blade #2 camber side tip area
DSCN3155.JPG	Blade #1 camber side tip area
DSCN3156.JPG	Blades camber side tip area B
DSCN3157.JPG	Blades camber side C
DSCN3158.JPG	Blades face side
DSCN3159.JPG	Blades face side tip area
DSCN3160.JPG	Blades face side shank area
DSCN3161.JPG	Blade butt #2 A

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DSCN3162.JPG	Blade butt #2 B
DSCN3163.JPG	Blade butt #1
DSCN3164.JPG	Blade butt #2 C
DSCN3165.JPG	Blades trail edge view A
DSCN3166.JPG	Blades trail edge view B
DSCN3167.JPG	Blades camber shank view
DSCN3168.JPG	Blades lead edge view
DSCN3169.JPG	Blades lead edge shank
DSCN3170.JPG	Preload plate #1 damage A
DSCN3171.JPG	Preload plate #1 damage B
DSCN3172.JPG	Preload plate #2 damage A
DSCN3173.JPG	Preload plate #2 damage B
DSCN3174.JPG	Blade #1 preload plate and bearings A
DSCN3175.JPG	Blade #1 preload plate and bearings B
DSCN3176.JPG	Blade #2 preload plate and bearings
DSCN3177.JPG	Blade #1 pitch change knob and block
DSCN3178.JPG	Blade #2 pitch change block
DSCN3179.JPG	Piston nick
DSCN3180.JPG	Top of pitch change rod
DSCN3181.JPG	Low pitch stop screw and pitch change rod
DSCN3182.JPG	Small dent in cylinder forward corner