



Hartzell Propeller / Hartzell Engine Technologies **Air Safety Investigator Examination Report**

Accident

NTSB File No. CEN17FA071

Date: 1/5/17

Location: Gurdon, AR

Aircraft: Cessna TTx (LC41-550FG), Registration N972JK

Propeller Examination

Location: Analytical Lab of Continental Motors, Mobile, AL

Dates: 3/21/17

Participants: Les Doud – Hartzell Propeller Air Safety Investigator

Alex Lemishko – NTSB Investigator in Charge

Mike Council – Continental Motors Air Safety Investigator

Propeller Description

Model: HC-H3YF-1RF/F7693DFB

Propeller Assembly S/N: LX410B

Blade S/Ns #1: K57551

#2: K57550

#3: K57549

Description: 78" diameter, 3-blade, pressure to increase pitch

The propeller was assembled and inspected at Hartzell Propeller on 7/24/07. The propeller logbook indicated the last service was a 100 hour/annual inspection completed on 6/2/16 by Van Bortel Aircraft. The propeller had a decal from Palm Beach Propeller and a logbook entry implying it was last serviced/overhauled by that company on 11/22/10.

As Received Condition

The propeller remained attached to the engine throughout the impact sequence and was removed prior to shipment to Continental Motors in Mobile, AL in the condition shown in Photos #1 and #2. Three blades were bent aft in varying degrees. The spinner dome was deformed around the propeller cylinder area and displayed rotational deformation characteristics. Two blades could be rotated by hand and one blade felt locked in position. The mounting flange and mounting hardware appeared undamaged.



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Photo #1



Photo #2





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Teardown Examination Findings

A field teardown examination of the propeller was conducted on March 21, 2017 at the Continental Motors Analytical Lab. The teardown was conducted by removing the spinner dome, and separating the hub halves to facilitate removal of the pitch change components and blades. Dried mud was packed under the spinner dome and around the propeller hub assembly as shown in Photo #3. The cylinder, piston and pitch change rod were removed and appeared undamaged. There was some water and corrosion of the piston return spring and on the aft side of the piston. This water was presumably from the swamp conditions at the crash site or during the cleaning of the engine and propeller with a pressure washer according to investigators that witnessed the recovery. The piston O-ring was intact and there was no oil or grease visible on the aft side of the piston.

Upon separation of the hub halves it was evident that all three pitch change knobs fractured from their blade butts. There was also water in the hub cavity, again, presumably from pressure washing of the propeller during the recovery process. The #2 hub-side bearing race was fractured in the aft/trailing edge area. The propeller had been over-serviced with grease; there was grease in the area surrounding the fork.

Photo #3



All three preload plates had damage at the forward/low pitch end of the knob slot and also rubbing damage on the internal surface consistent with pitch change knob fractures during impact. All three pitch change knob fracture surfaces appeared to be overload (see Photo #4).



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Photo #4



Preload plate #3 had a fork bumper rub area approximately 29 degrees forward of the hub parting line (see Photo #5). Preload plate #2 had a bumper rub mark at approximately 24 degrees (or 30 degrees if interpreting the hub parting line marks differently), (see Photo #6). Preload plate #3 had a noticeable fork bumper impression and fork scrape marks at approximately 16.5 degrees forward of the parting line (Photo #7). All the preload plate markings were in the normal range of operation.

Photo #5





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Photo #6



Photo #7





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The pitch change fork had knob block skirt impact marks in all three slots (see Photo #8).

Photo #8



On the aft hub half there was preload plate area damage in blade pockets #2 and #3 (see Photo #9). All three blade pockets had blade contact marks at the aperture that with corresponding damage to the seal rub strip on the blade shanks.

Photo #9





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All three blades displayed bending in the aft direction. Blades #1 and #2 showed twisting in the leading edge down/low pitch direction. The blades were positioned in rotation sequence 3-1-2 which demonstrated the progressive aft bending (Photo #10). The tip on blade #1 was bent forward and the tip on blade #2 was bent aft. There were nicks and dents 8-10" from the tips of blades #1 and #2. The blade leading edge and tip areas showed some accelerated abrasion on the camber side near the tip consistent with rotation through rock free water, mud and/or dirt. Photos #10 through #12 shows the blades in 3-1-2 sequence from left to right.

Photo #10 (Blade leading edge view, blade #2 in foreground)





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Photo #11 (Face side of blades)





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Photo #12 (Camber side of blades)



Propeller Examination Conclusions

Preload plate impact marks indicated the propeller was operating in the normal blade angle range at time of impact. Blade bending and twisting was suggested a low power and/or windmilling at high airspeed condition at time of impact. There were no discrepancies noted that would prevent or degrade normal propeller operation prior to impact. All damage was consistent with high impact forces.



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Turbocharger Examinations

The turbochargers from the accident engine were visually examined. The turbo controller and wastegate assembly were not examined.

Right Turbocharger

Model: TA36

P/N: 646677

S/N: JJL00553

The Serial Number code indicates it was manufactured as new in October, 2006 and had never been overhauled.

1. The turbocharger was found fractured from its mounts at the crash site, was packed full of mud and cleaned with a pressure washer according to on-scene investigators. The exhaust pipe and intake tube were removed prior to this examination. A portion of the mounting bracket remained attached to the turbocharger (see Photo #13). The compressor housing was bent and impinging on the compressor wheel. The compressor housing inlet had a dent on the outermost lip/edge.
2. The rotor group was intact but could not be turned due to the compressor wheel contact with the compressor housing.
3. There were balance cuts observed on the turbine wheel/hub.
4. There was evidence of compressor wheel rub/contact/chatter on the compressor housing (see Photo #14). There was no evidence of rub or contact of the turbine wheel/housing.
5. There was no remarkable FOD damage on either the compressor or turbine side.
6. The turbine housing outlet walls had some exhaust build-up but nothing that appeared to impinge on the turbine blades.
7. The oil drain fitting was removed to view the interior of the center housing.
 - a. Observed were:
 - i. Evidence of oil
 - ii. No evidence of coking which could impede rotation.
 - iii. No evidence of excessive heat indicated by the discoloration of the turbine shaft.
 - iv. There was some wet and oily mud removed via a wire pick, presumably from pressure washing the turbocharger during the recovery process.
 - b. There was no evidence of lubrication blockage (inlet or outlet).



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Photo #13 (Right Turbocharger)



Photo #14 (Right Turbocharger Compressor Wheel)





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Left Turbocharger

The left turbocharger data plate was missing, presumably dislodged during the impact sequence, therefore the P/N and S/N are unknown.

1. The turbocharger was found fractured from its mounts at the crash site, was packed full of mud and cleaned with a pressure washer according to on-scene investigators. The exhaust pipe and most of the intake tube were removed prior to this examination; a small segment of the intake tube remained attached. The mounting bracket remained attached to the turbocharger but had a cut mark partially through it, presumably made during the recovery process (see Photo #15). The compressor housing inlet had a portion of the outermost lip/edge fractured and missing.
2. The rotor group was intact and turned freely by finger force only.
3. There were balance cuts observed on the turbine wheel/hub.
4. There was no evidence of compressor wheel rub/contact on the compressor housing (see Photo #16). There was no evidence of rub or contact of the turbine wheel/housing.
5. There was no remarkable FOD damage observed on either the compressor or turbine side.
6. The turbine housing outlet still had considerable dried mud on and around the turbine wheel.
7. The oil drain fitting was removed to view the interior of the center housing.
 - a. Observed were:
 - i. Evidence of oil
 - ii. No evidence of coking which could impede rotation.
 - iii. No evidence of excessive heat indicated by the discoloration of the turbine shaft.
 - iv. No observed FOD.
 - b. There was no evidence of lubrication blockage (inlet or outlet).

Photo #15 (Left Turbocharger)





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Photo #16 (Left Turbocharger Compressor Inlet)



Photo #17 (Left Turbocharger Turbine Wheel and outlet)





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Turbocharger Examination Conclusions

The right turbocharger compressor housing was bent during impact and impinging on the compressor wheel preventing rotation. There were contact/chatter/rub marks in the compressor housing suggesting rotation at low speed prior to impact, suggesting a low power condition at time of impact.

The left turbocharger turned freely and otherwise appeared functional. There were no discrepancies noted that would prevent or degrade normal turbocharger operation prior to impact. All damage to both turbochargers was consistent with high impact forces and/or damage incurred during recovery.

