



NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

May 16, 2016

POWERPLANT GROUP CHAIRMAN'S FACTUAL REPORT

NTSB No: ERA15FA129

A. ACCIDENT

Location: Miami Executive Airport- Miami, Florida

Date: February 11, 2015

Time: 1439 eastern standard time (EST)

Aircraft: Beechcraft 1900C, Venezuelan Registration Number YV1674

B. POWERPLANT GROUP

Group Leader: Robert Hunsberger
National Transportation Safety Board
Washington, D.C.

Member: Nathan Rohrbaugh
Federal Aviation Administration
Washington, D.C.

Member: Leslie Doud
Hartzell Propeller
Piqua, Ohio

Member: Ricardo Asensio
Textron Aviation
Wichita, Kansas

Member: Paul Yoos
Textron Aviation
Wichita, Kansas

Technical Advisor: Jeffery Davis
Pratt & Whitney Canada
Bridgeport, West Virginia

C. SUMMARY

On February 11, 2015, at 1439 eastern standard time, a Beech 1900C, Venezuelan registration YV1674, registered to and operated by Aeropanamericano, C.A., was destroyed during collision with terrain, following a loss of engine thrust during initial climb from Miami Executive Airport (KTMB), Miami, Florida. The two foreign certificated pilots and two passengers were fatally injured. The repositioning flight was conducted under the provisions of 14 Code of Federal Regulations Part 91. Visual meteorological conditions prevailed and an instrument flight rules flight plan was filed for the planned flight to Providenciales International Airport (MBPV), Providenciales, Turks and Caicos.

A powerplants group was formed after the initial on scene portion of the investigation to examine the left (No. 1) engine, a Pratt & Whitney Canada (PWC) PT6-65B turboprop and review the findings from the field teardown of the left and right propellers, both Hartzell Propeller HC-B4MP-3A model propeller four-blade propellers. The left engine was shipped to the PWC facility in Bridgeport, WV for examination and disassembly on March 24, 2015. A second examination of the left propeller was completed at Hartzell Propeller in Piqua, Ohio on March 3, 2016. The powerplant group included members from PWC, Textron Aviation, Hartzell Propeller, the Federal Aviation Administration (FAA), and the National Transportation Safety Board (NTSB).

The left engine was exposed to a post impact fire and all external surfaces were heavily sooted but the engine core remained intact. The first stage compressor rotor blades and second stage compressor nozzle vanes were coated with dirt. Dirt and sand were also observed in the compressor turbine (CT) and power turbine (PT) sections of the engine. During disassembly, light rub marks were noted on the CT blade tips, fir tree attachments and disk center bore. The first stage PT disk also exhibited light rub mark on the blade shrouds. The propeller governor was damaged during impact and could not be bench tested; however, the governor was disassembled and there were no indications of pre-impact failure of the internal components.

Examination of the left propeller revealed that three of the four propeller blades were fractured during the impact but the blade clamps, link arms and counterweights remained intact. The propeller piston assembly was disassembled and impact marks were present on the inside surface of the piston with coincident damage on the feather stop screws due to contact between the two parts. No internal anomalies were noted in the propeller that would have prevented normal operation.

D. DETAILS OF THE INVESTIGATION

1.0 ENGINE INFORMATION

1.1 Propulsion System Description

The PWC PT6-65B is a reverse flow turboprop engine featuring a four stage axial compressor, a single stage centrifugal compressor, an annular combustion chamber, a single stage compressor turbine, a two stage independent power turbine, and a hydromechanical fuel control. According to the FAA type certificate data sheet E4EA, Revision 24 dated June 21, 2007 the engine has a maximum continuous sea level thrust rating of 1,173 shaft horsepower¹. **Figure 1.**

¹ The engine ratings are based on static sea level condition 29.92 in Hg pressure, compressor intake screen installed, no external accessory loads and no air bleed.

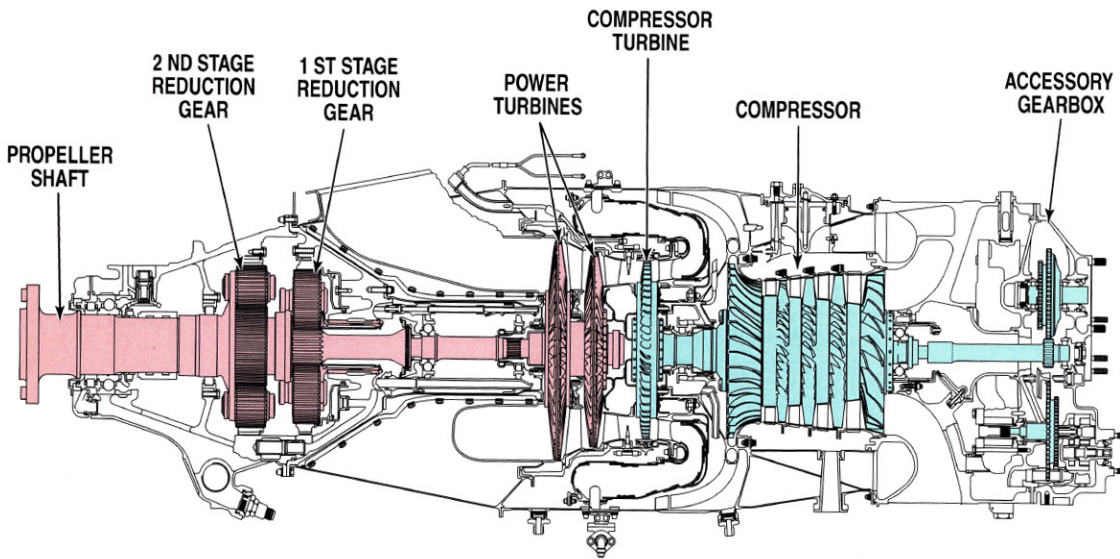


Figure 1- Pratt & Whitney Canada PT6-60 Series Engine

All directional references to front and rear, right and left, top and bottom, and clockwise and counterclockwise are made aft looking forward (ALF).

1.2 Engine History

According to the airplane logbook, the left engine was installed on the accident airplane on September 29, 2014. The engine gas generator had accumulated 35,561 hours time since new (TSN) and 47,914 cycles since new (CSN). The engine power section had accumulated 34,764 hours TSN and 46,571 CSN. Both the gas generator and power turbine had accumulated 2,331 hours time since overhaul (TSO) and 2,905 cycles since overhaul (CSO).

2.0 PROPELLER INFORMATION

2.1 Propeller System Description

The Hartzell Propeller HC-B4MP-3A model propeller is a four-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 features a beta mechanism that actuates when blade angles are lower than the flight idle position. **Figure 2.**

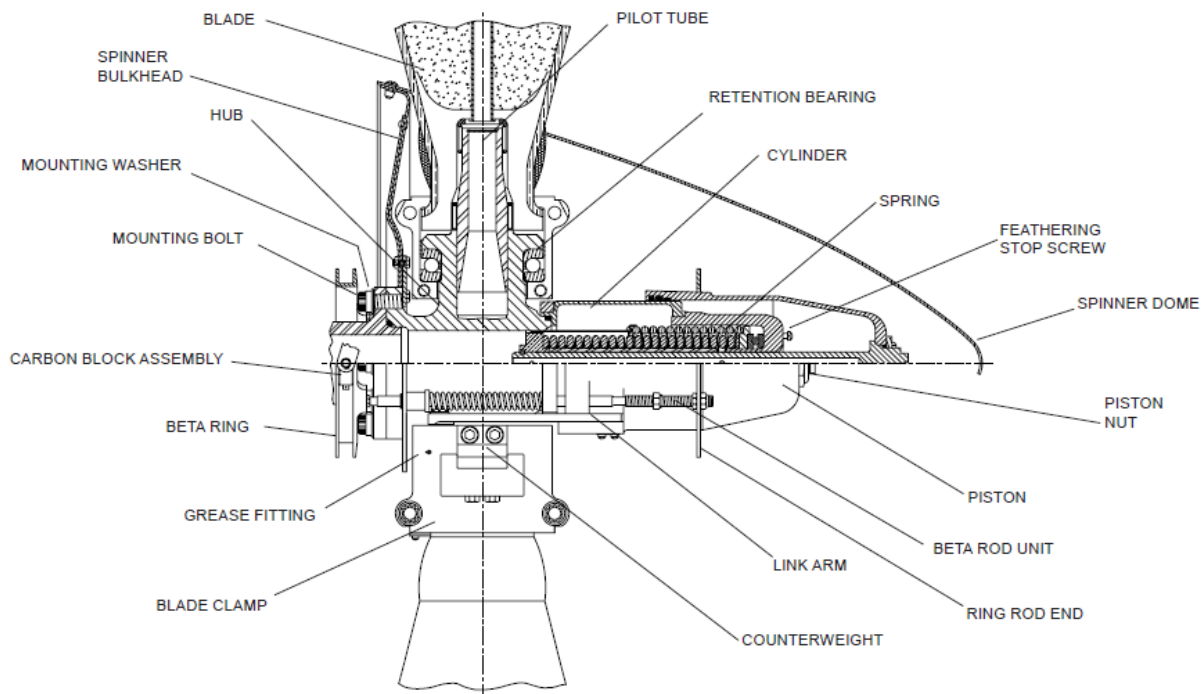


Figure 2- Representative Hartzell Propeller Diagram

The four propeller blades were model M10877K and were composite construction. When installed they had a 109.5 inch diameter and featured a deicing boot. The propeller rotation is clockwise as viewed aft looking forward.

2.2 Propeller History

The left propeller, serial number FWA2232 was a newly overhauled propeller that was installed immediately prior to the accident flight.

3.0 LEFT ENGINE EXAMINATION AND DISASSEMBLY (ESN PC-E 32138)

Engine serial number PC-E 32138 was received at PWC on a large pallet wrapped in plastic. Multiple airframe components were still attached to the engine and were removed in order to allow installation into a work stand (**Photos 1 and 2**). A visual examination of the engine was conducted beginning at the propeller gearbox (forward end) proceeding in the clockwise direction around the engine. All external engine surfaces were sooted from exposure to the post-crash fire.

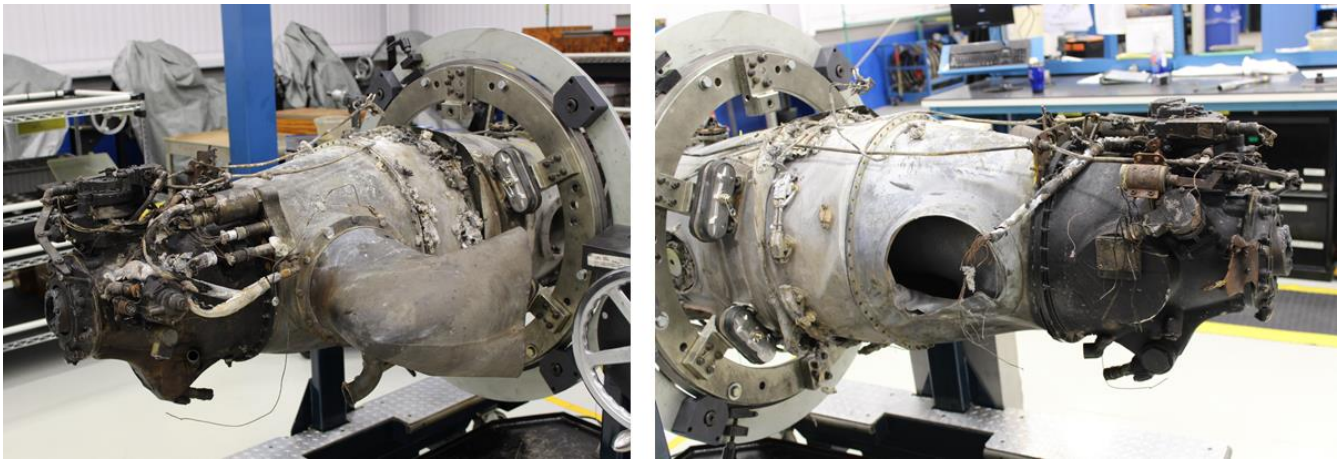


Photo 1- (L) Left Side of Engine (R) Ride Side of Engine, as Received



Photo 2- Engine Data Plate

The propeller governor was present but the N_p (propeller) speed control lever was separated and missing. The propeller governor reversing (beta) lever arm was found above the guide pin and the beta carbon block was separated/broken and missing (**Photo 3**). The propeller governor cable rigging was attached but the sleeve nut that connects to the clevis was fractured, adjacent to the cambox. The cambox was fractured and the connecting rod between the fuel control and the cambox was bent. The P_y pressure sensing line from the propeller governor to the fuel control was intact. The propeller overspeed governor was in place but its cannon plug was severed. The exhaust case was missing the right side exhaust port and stack sections and the case exhibited impact deformation (crushing) on the lower right side between the 3 and 6 o'clock positions (**Photo 4**). The fuel nozzles were all present but the fuel transfer tubes were thermally damaged (melted). The flow divider was present but was thermally damaged on the left side. The exciter box was separated and resting loosely on the engine with both

leads attached. The right exciter lead was severed at the gas generator case exciter plug port. The gas generator case exhibited impact deformation at the 1 o'clock position near the bleed valve. When viewed through the inlet screen, the inlet case was melted from the 12 to 3 o'clock positions. The inlet screen was loose around the inlet and the screen connection flange was separated. The oil pump was missing and not shipped with the engine. The fuel control and fuel pump were intact and in position. The P3 pressure sensing line from the fuel control to the gas generator case port was intact. The fuel-oil heat exchanger was separated from its mount and hanging from the engine (**Photo 5**).

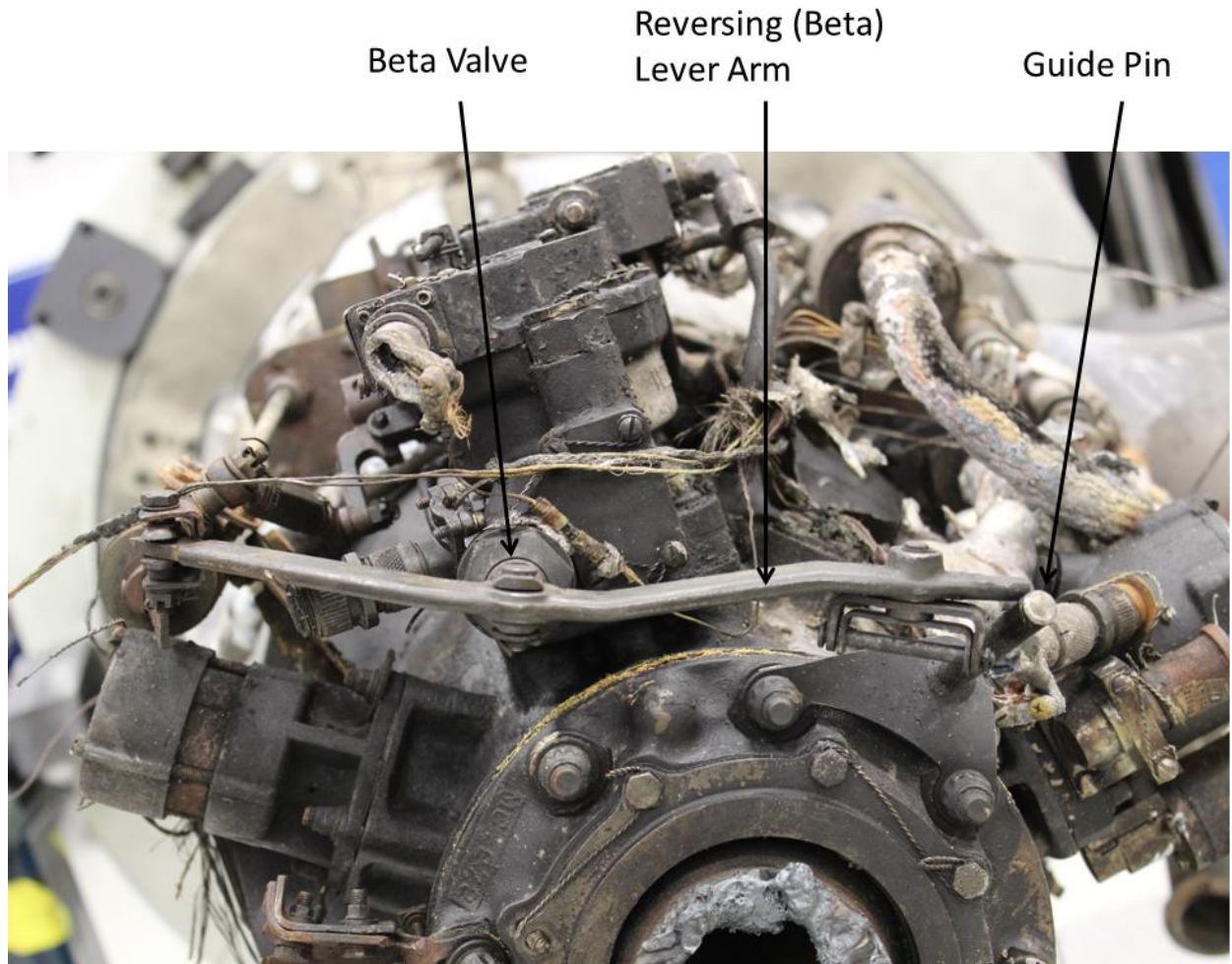


Photo 3- Propeller Governor, Guide Pin Position



Photo 4- Right Side Exhaust Port and Stack Separated, Exhaust Case Impact Deformation

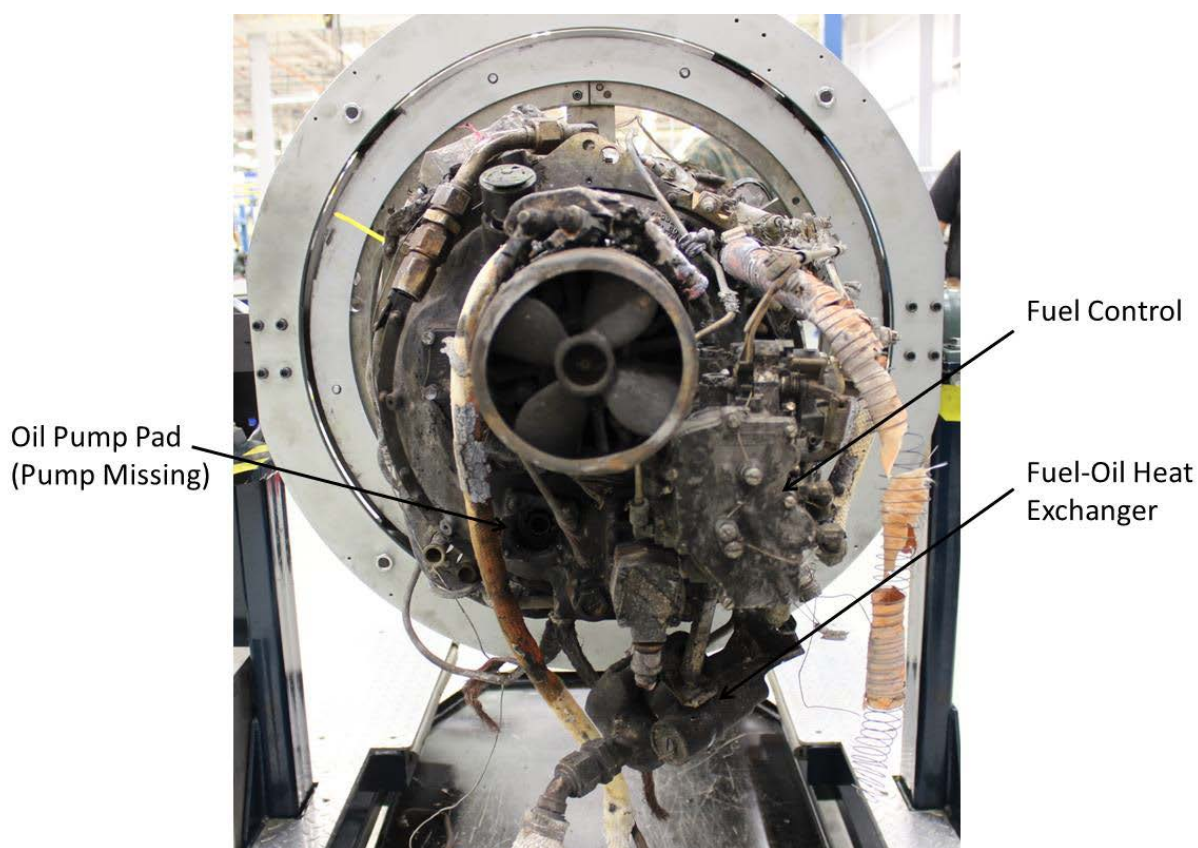


Photo 5- Aft End of Engine, Components Labeled

The oil filter was removed from the engine and did not contain debris but had a strong acrid smell consistent with thermal exposure. The propeller gearbox chip detector plug was clean. The rubber

potting compound that holds the magnetic electrodes in place in the plug assembly was bulged/protruding consistent with thermal exposure.

3.1 Compressor Assembly

The compressor assembly was separated from the accessory gearbox (AGB). Both the No. 1 and No. 2 bearings were oil wetted and spun freely. The first stage compressor rotor blades were discolored and covered in a layer of soot and dirt debris. All first stage blades were intact and did not exhibit indications of deformation or thermal damage (**Photo 6**). After removal of the first stage rotor the second stage nozzle was exposed and it was also coated with dirt and debris, intact and otherwise unremarkable. The compressor assembly was initially seized, but after some manipulation to force the stator assembly off the compressor lands, the compressor stators was spun while the rotor was held stationary. The remaining three axial compressor stages and single centrifugal compressor stage were not disassembled because there were no indications of internal damage.



Photo 6- First Stage Axial Compressor

3.2 Accessory Gearbox

The AGB rotated freely without binding indicating that all internal gears were intact. The AGB was not disassembled due to a lack of evidence suggesting there was internal damage.

3.3 Combustor

The combustion liner was intact with no burn through, fuel streaking, or localized hot spots. All fuel nozzles were present and free of coking.

3.4 Compressor Turbine

The compressor turbine (CT) disk downstream (forward) face exhibited some light rub along the blade tips and on the blade fir trees over a 90 degree section (**Photo 7**). The CT disk center bore had light rub marks 360 degrees around the circumference. A coincident rub mark was found on the turbine baffle shroud center dome between the 12 and 6 o'clock positions (**Photo 8**). The compressor turbine nozzle assembly was intact but sooted and superficial rub marks were identified between the 3 to 6 o'clock and the 10 to 11 o'clock positions on the CT shroud.

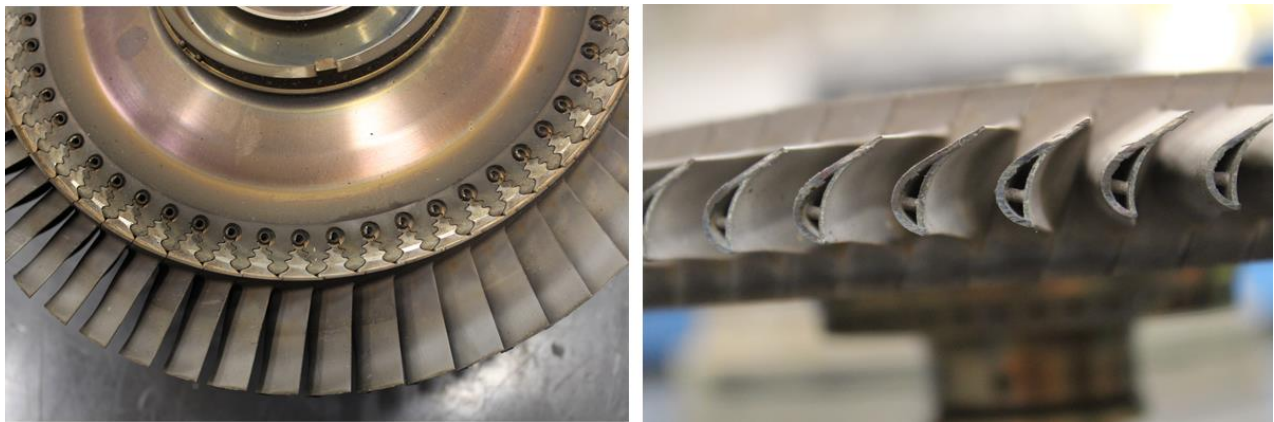


Photo 7- CT Disk Rub (L) Fir Tree Rub, (R) Tip Rub



Photo 8- Turbine Baffle Center Bore Rub

3.5 Power Turbine Assembly

The power turbine case was axially displaced from the exhaust duct leaving a gap at the mating flange (**Photo 9**). The power turbine assembly was separated and all components were covered in soot and dirt debris but both turbine disks and nozzles were intact and in good condition. The first stage disk exhibited some light blade shroud tip rub 360 degrees around (**Photo 10**).



Photo 9- Power Turbine Case to Exhaust Duct Mating Flange Separation

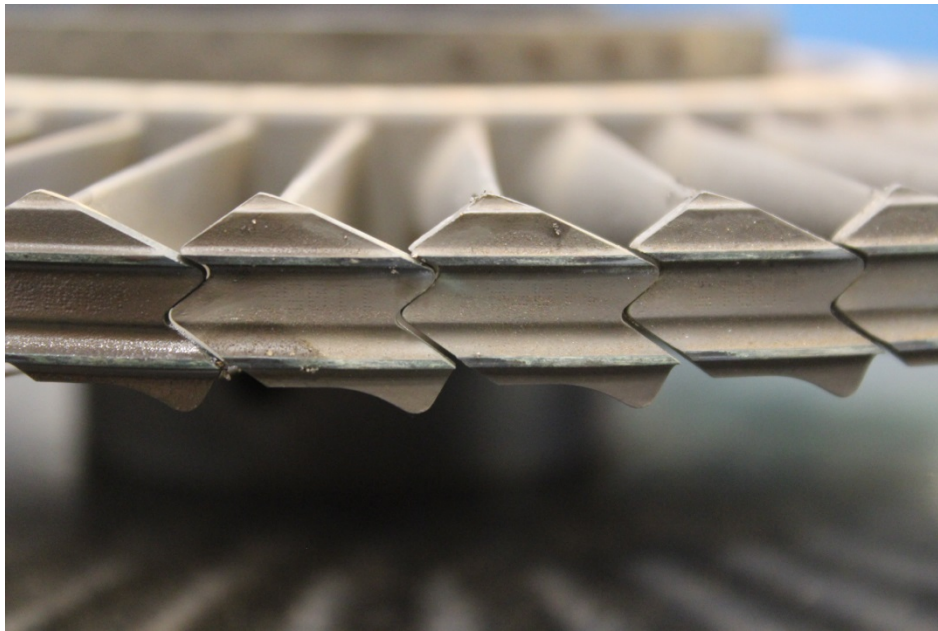


Photo 10- First Stage Power Turbine Shroud Rub

3.6 Reduction Gearbox

The reduction gearbox first stage carrier gear rotated freely consistent with the No. 3, 4, and 5 bearings being in good condition. The second stage carrier gear, the propeller shaft, and No. 6 and 7 bearings were seized and could not be spun by hand. The assembly was not further disassembled because all noted damage was consistent with impact.

4.0 LEFT PROPELLER EXAMINATION AND DISASSEMBLY (FWA 2232)

The left propeller assembly was shipped from Florida Air Recovery to Hartzell Propeller in Piqua, Ohio for a second examination. The components were received in a wooden crate and secured in place with fabric straps. The first exam was conducted at the accident scene and findings from the field teardown are available in the docket under the title: “Hartzell Aircraft Accident/Incident Report No.: 150211.” The powerplant group was not formed until after the on scene portion of the investigation was complete so this report will only cover the findings from the second examination.

4.1 Propeller Blades

The propeller blades were separated from the hub during the field teardown and the blade numbering established in the Hartzell report was retained during the second examination (**Photo 11**). Three of the four blades had fractured airfoils, with two of the blades fractured near the blade butt (blades 2 and 3) and one blade fractured at about quarter span (blade 4). There was one complete blade (blade 1) that was twisted. All blades were sooted and thermally damaged. The blade butts were labeled to identify the face and camber surfaces and examined for witness marks to help identify blade pitch angle at the time of impact (**Photo 12**). Two blade butts (blades 2 and 3) exhibited witness marks consistent with contact with the hub. The witness marks on the butt of blade 2 were consistent with the blade impacting the ground at about 180 degrees from the normal operating pitch range. The witness

marks on the butt of blade 3 were consistent with the blade impacting the ground at or near feather pitch. The other two blades (blades 1 and 4) did not have witness marks on their respective blade butts. No anomalies were noted to the pilot tubes, blade clamps, or blade butt surfaces.



Photo 11- Left Propeller Blades, as Received at Hartzell Propeller

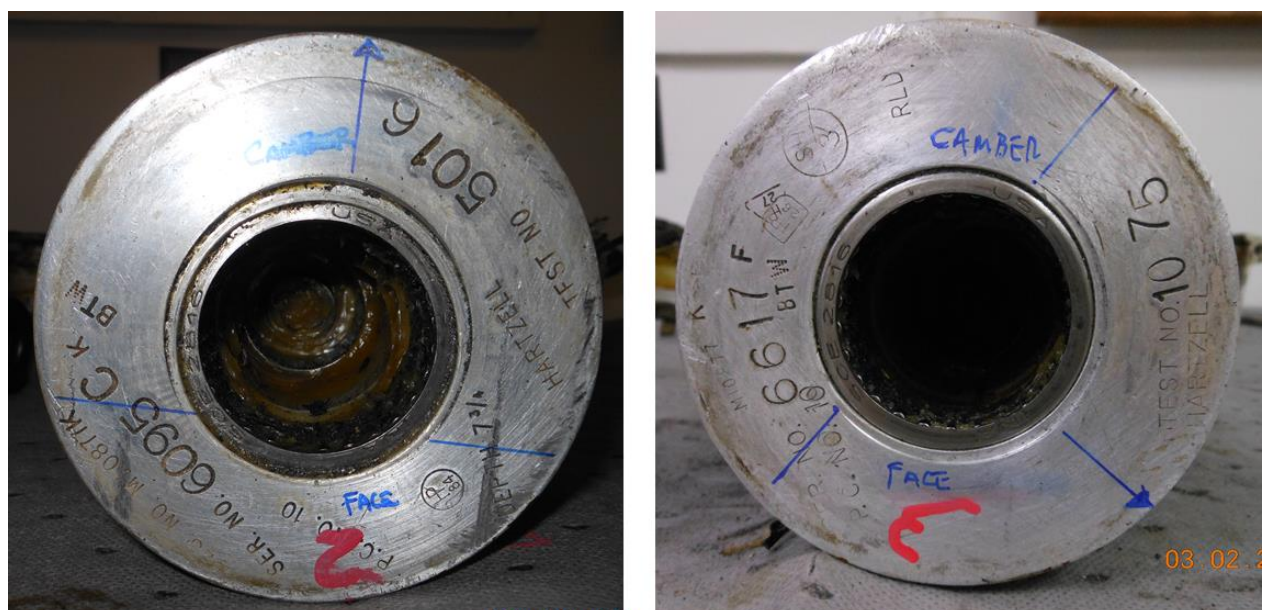


Photo 12- Labeled Blade Butts

4.2 Blade Clamps, Link Arms and Counterweights

All four propeller blade clamps were intact but appeared to be thermally distressed. The link arms were all securely fixed to the link pins and did not exhibit deformation consistent with low or no propeller rotation at the time of impact (**Photo 13**).² The blade counterweights were present and intact but were sooted.

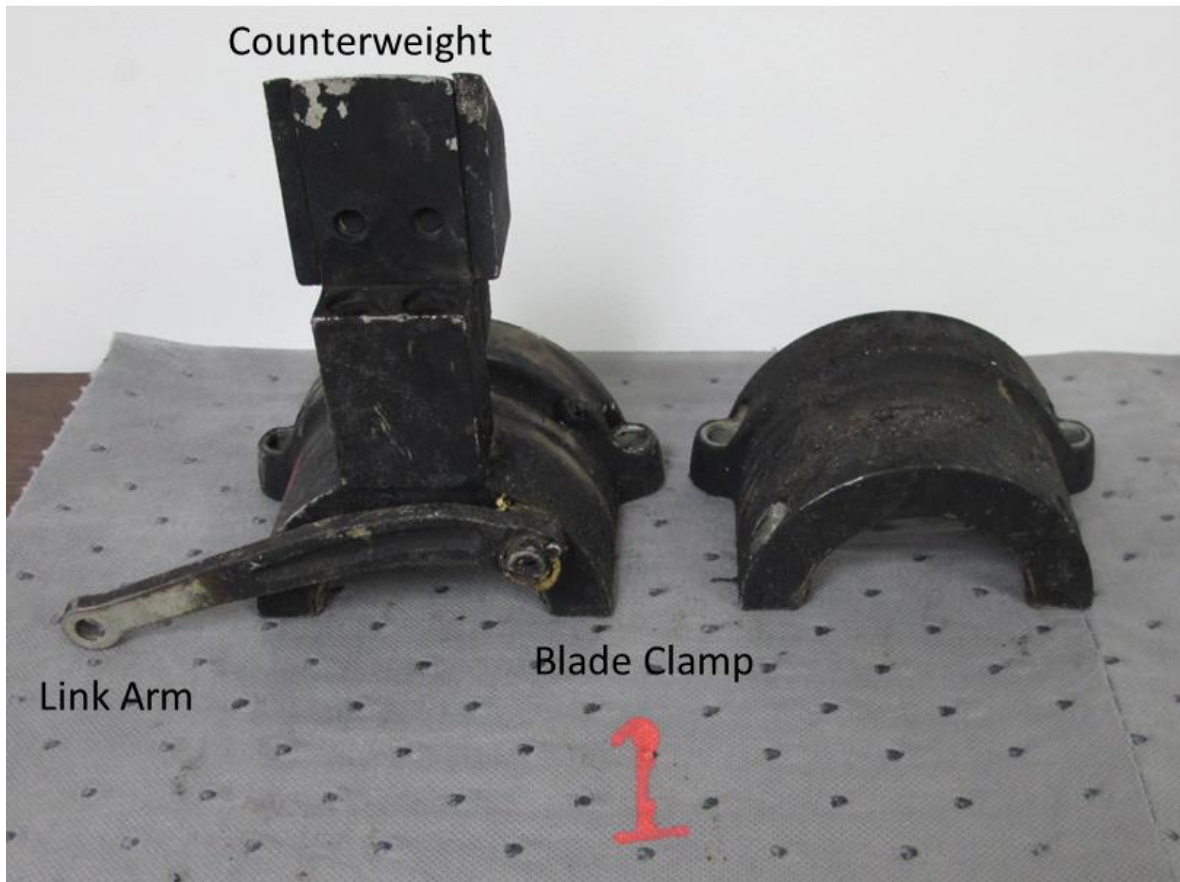


Photo 13- Blade Clamp, Counterweight, and Link Arm

4.3 Propeller Piston and Spring

The propeller piston assembly was intact and in good condition. When the piston housing was removed impact marks were observed at the top internal surface of the piston consistent with contact with the feather stop screws (**Photo 14**). The spring assembly extends and moves closer to the piston as the blades move to feather and contact between the two components can only occur when the blades are at or near feather. The hydraulic effect of oil prevents contact between the piston and feather stop screws when the blades are at pitch angles other than feather. The piston nut was removed and the spring and cylinder were visually examined and in good condition.

² Propeller blade link arm dimensions were checked by placing each arm against a 1:1 scale Hartzell Propeller drawing.

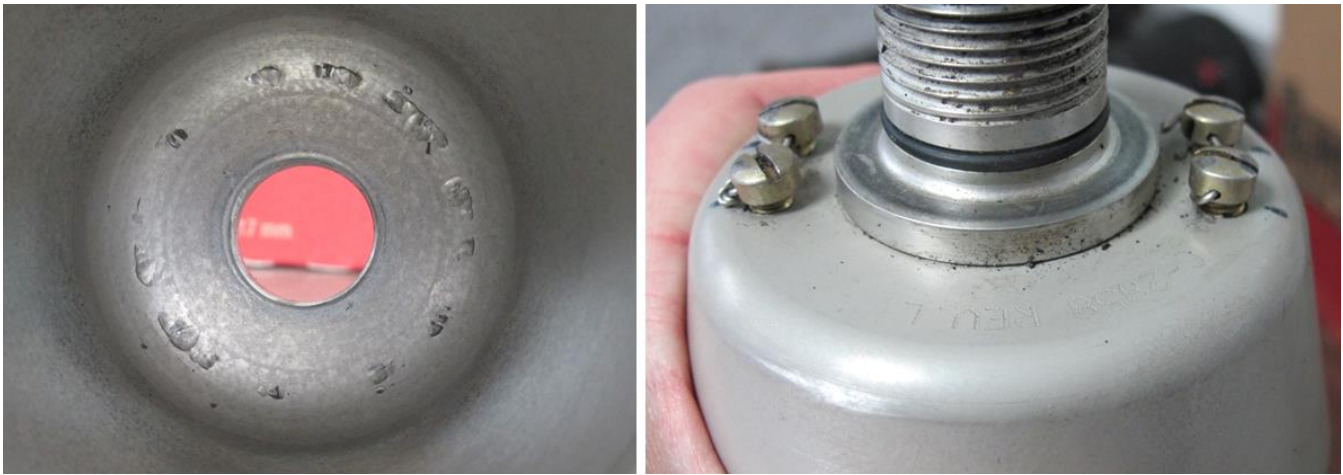


Photo 14- Piston Damage and Coincident Feather Stop Screw Deformation

4.4 Propeller Hub

The propeller hub was partially disassembled to inspect the blade retention bearings. All four bearings were intact and the grease around the bearings was fresh. The beta rod return springs were sooted but intact and in good condition. The propeller shaft was sawed off during the recovery process and substantial damage was noted on the aft side of the hub.

4.5 Spinner

The spinner exhibited impact damage including deformation, buckling and tearing. A section of the spinner was missing and not shipped with the other components. A tear in the sheet metal was present where a blade counterweight was pushed through during the impact process.

5.0 ADDITIONAL INFORMATION

5.1 Left Propeller Reversing Lever and Propeller Governor Guide Pin

As noted earlier in this report, the propeller governor guide pin was found under the reversing lever arm as opposed above the reversing lever arm as called out in the aircraft maintenance manual. The guide pin acts as a mechanical stop that holds the beta carbon block in place and restricts motion of the lever arm for proper feedback of the propeller control system (**Photo 15**). By placing the guide pin below the lever arm the mechanical stop is no longer present and the linkage and carbon block could move in the radial direction. This radial movement could cause the beta valve to stroke outward (forward) and reduce propeller oil pressure and moves the propeller blades toward the feather position.

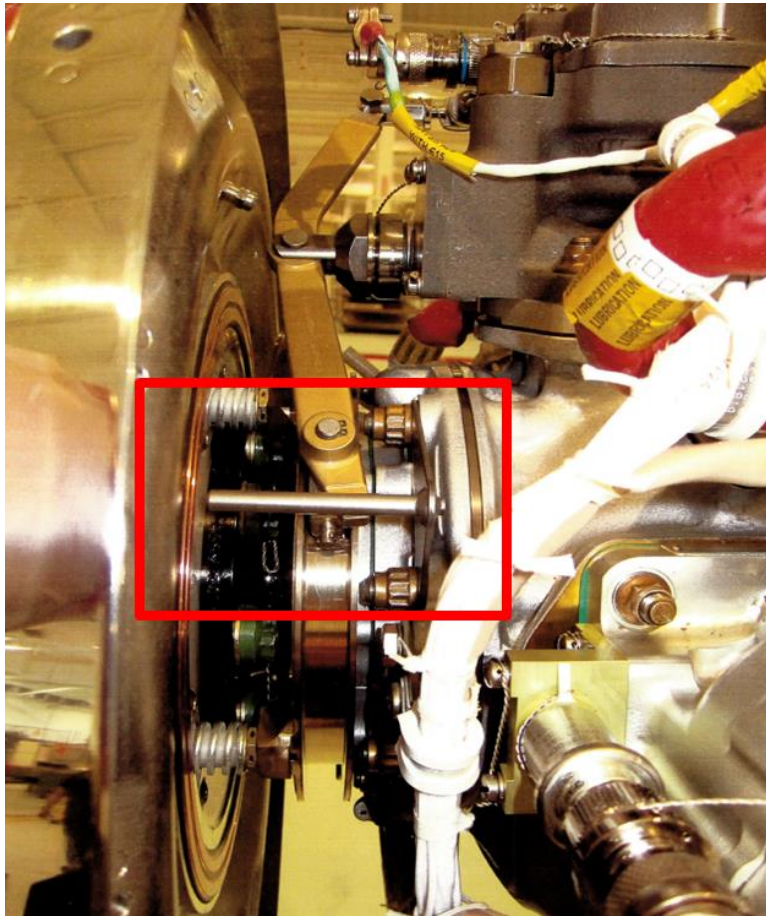


Photo 15- Exemplar Photo With Guide Pin in the Correct Position

The guide pin mounting plate was bent aft toward the overspeed governor (**Photo 16**). The bottom surface of the guide pin exhibited curl shaped galling from about the mid-length of the pin to the free end. The upper side of the reversing (beta) arm had indications of material wear that changed the contour of the arm surface (**Photo 17**). The bottom surface of the beta arm was unremarkable.

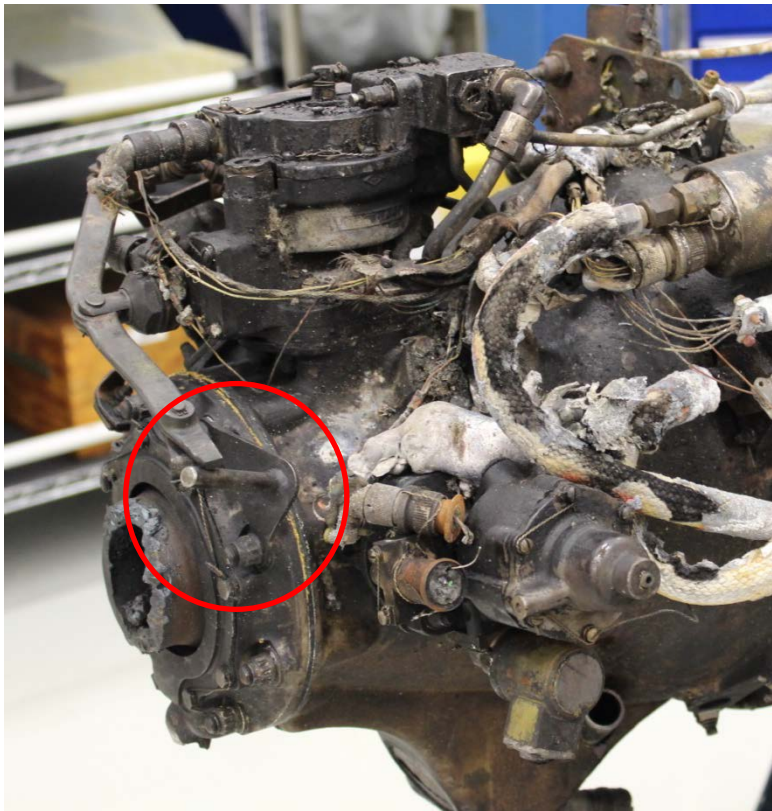


Photo 16- Guide Pin Mounting Plate, Bent Aft

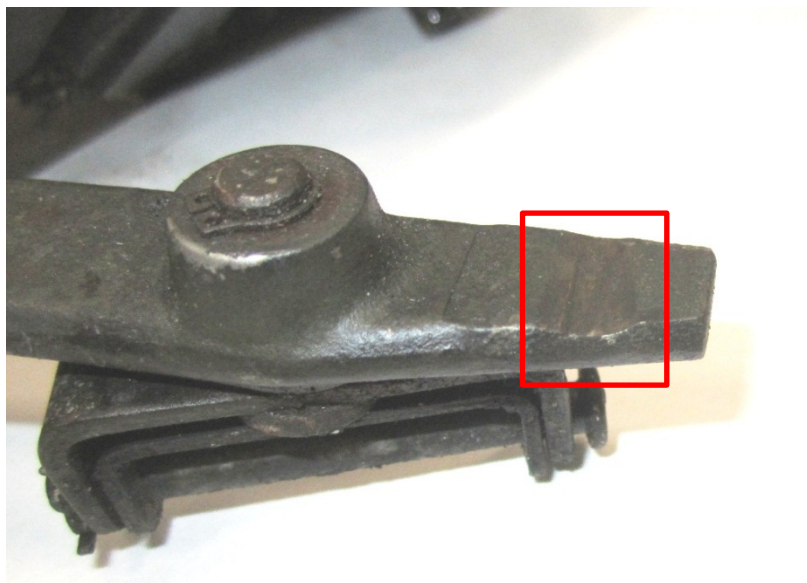


Photo 17- Reversing (Beta) Arm Top Surface Contact Wear

6.0 METALLURGY

The propeller governor, reversing lever (beta arm), and guide pin were shipped to the PWC Materials Laboratory in Longueuil, Quebec, Canada for examination. The propeller governor could not be bench tested due to damage caused by impact and post-crash fire. The governor's external surfaces were covered with oil, soot and dirt. The N_p (propeller) speed control lever was broken and dirt was lodged in the opening left by the missing lever. The N_f (engine power turbine) reset lever and feathering valve were stuck but the governor drive shaft could be rotated by hand without resistance. When the governor cover was removed all components were present and intact but were covered in acrid smelling oil and dirt. The beta valve and oil pressure regulating valve were inspected and no anomalies were noted.

The flat area on the top side of the reversing lever was shiny indicating that material was recently worn away due to contact. Additional contact rubs were noted along the top edge of the reversing lever between the guide pin contact groove and the tip (**Photo 18**).

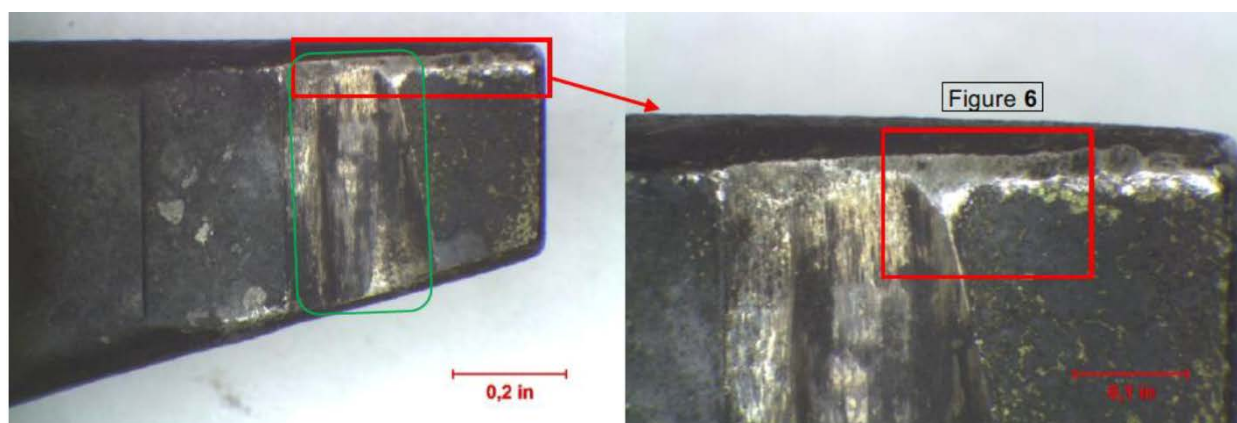


Photo 18- Reversing Lever Top Surface

The guide pin had a curl shaped wear mark on the underside of the pin. The mark was examined using scanning electron microscope (SEM)- electron dispersive spectroscopy (EDS) and a piece of debris within the groove was found to be rich in cadmium which is consistent with the plating material on the reversing lever. According to PWC, the material findings were consistent with the reversing lever arm being installed in the correct position, below the guide pin at the time of impact. The PWC Materials Laboratory findings were reviewed and corroborated by the NTSB Materials Laboratory and a full report titled: "Materials Laboratory Factual Report" is available in the docket.

7.0 FLIGHT DATA RECORDER

A flight data recorder (FDR) was not required on the accident airplane but one was installed under a special type certificate (STC). A limited set of engine and propeller parameters including: left and right engine torque and left and right propeller speed (revolution per minute (RPM)) were recorded and plotted for the accident flight (**Figure 3**). A full report titled: "Flight Data Recorder Specialist's Factual Report" is available in the docket.

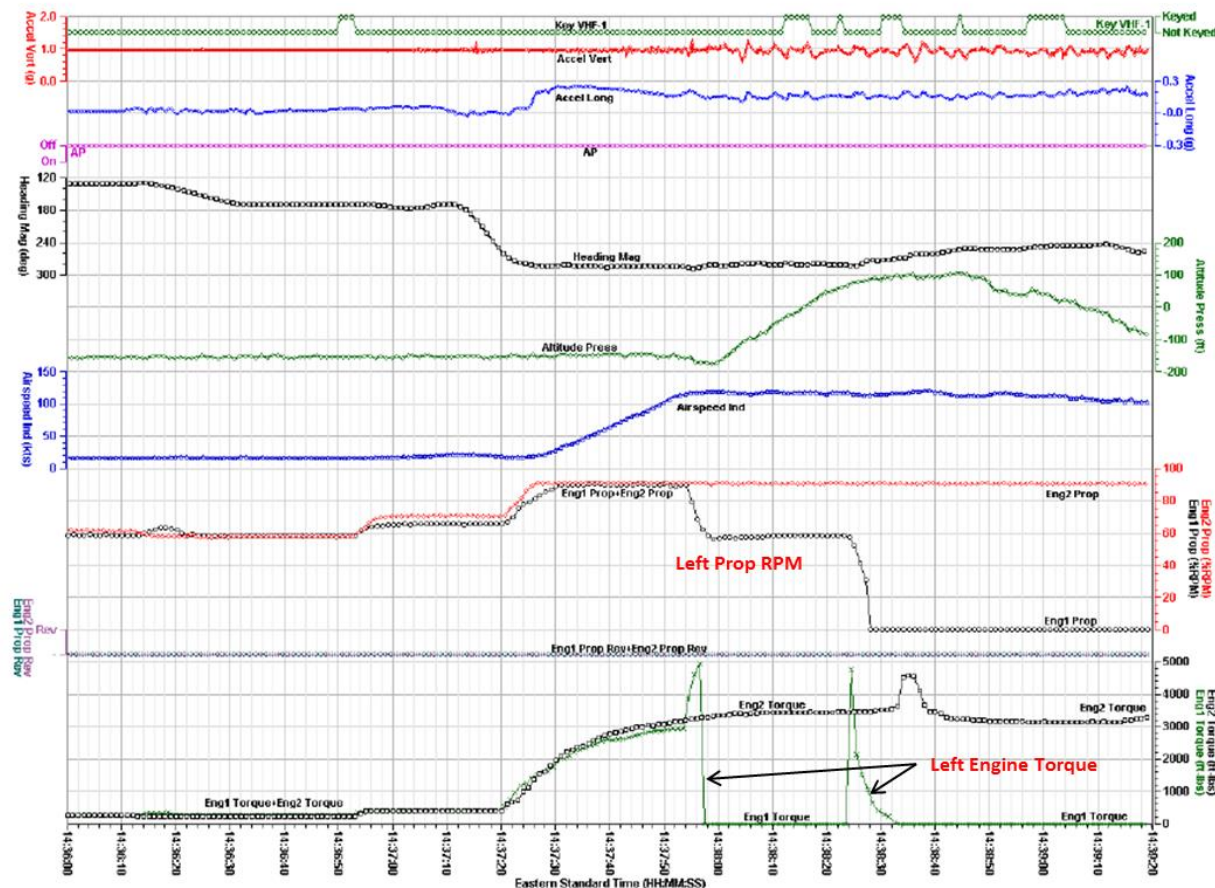


Figure 3- FDR Plot of Accident Flight at Takeoff

During takeoff, the torque and propeller rpm readings climbed normally as the airplane accelerated on the runway. When the plane rotated for takeoff the left propeller rpm decreased to about 60% and the left engine torque spiked to the maximum recordable value (5,000 ft-lbs). The left engine torque value then abruptly drops to zero, consistent with an exceedance of the maximum recordable value. A left engine torque reading near the maximum value does not appear again for about 27 seconds at which point both the left engine torque value and left propeller rpm dropped to zero.

Robert Hunsberger
Aerospace Engineer
Powerplants