



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Western Pacific Region

May 16, 2018

ACCIDENT SITE / AIRFRAME / ENGINE EXAMINATION SUMMARY

WPR18FA045

This document contains 0 embedded photos.

A. ACCIDENT

Location: Geneva, Florida
Date: December 8, 2017
Aircraft: Beech C90, N19LW
NTSB Investigator-in-Charge: Joshua Cawthra

B. DETAILS OF THE INVESTIGATION

1.0 Accident Site

GPS Coordinates: 28.76478, -81.0610

Examination of the accident site revealed that the airplane impacted the waters of Lake Harney near the northwestern shoreline, just south of the final approach course for the ILS Runway 27R instrument approach. Wreckage was spread throughout a 200 square ft area along the bottom of the lake. The reported water depth of 10 feet.



Figure 1: Accident location overlaid over a sectional map and instrument approach plate.

2.0 On Scene – Recovered Airframe Examination

Various wreckage was recovered from the floor of the lake. The fuselage was fragmented into multiple portions. The outboard portions of both wings were recovered and severely buckled/accordion compression throughout. The outboard left flap remained attached to the left wing. The left aileron was separated from the left wing. The left aileron control cables remained attached to the bell crank. The left aileron trim tab actuator was extended 1.25 inches, consistent with between 0 and 5 degrees tab up. The aileron and trim cables were cut in an area where the outboard section of the engine nacelle would be placed.

The empennage was separated. The left horizontal remained attached, however the left elevator was separated. The left elevator trim tab actuator was extended about 1.25 inches, consistent with 0 and 3.5 degrees tab up. The vertical stabilizer and rudder remained attached. The upward 2 to 3 feet of the vertical stabilizer was crushed aft in a tapering manner. About 2 or 3 feet of the upper portion of the rudder was bent downward. The rudder trim tab remained attached to the rudder and appeared to be in a neutral position. The right horizontal and elevator were separated. The elevator remained attached to the horizontal stabilizer.

Rudder cables remained attached to the control horn in the empennage. Rudder trim cables appeared to be attached to the actuator. The up and down elevator cables remained attached to the elevator bell crank. Elevator push/pull tubes remained attached to the bell crank, however, were separated from the elevator torque tubes. The elevator cables remained attached to the forward bellcrank.

The pitch trim servo cables were present and attached to the aft elevator bell crank. The yaw servo cables remained attached to the rudder bridles and cap stand. The electric trim cables remained attached to the cap stand. However, one cable was fractured just aft of the motor.

Various avionics boxes were located attached to various wiring harnesses in the forward part of the fuselage.

According to recovery company personnel, the recovery of the wreckage from the lake spanned about 8 days with the use of a diver that specialized in underwater construction and operation. The diver reported that the underwater visibility was about 5 inches. A dredger was utilized to displace the mud/silt in order to locate additional debris. However, they reported that due to the restricted underwater visibility, various parts and/or components may not have been located.

3.0 Recovered Wreckage Examination – Florida Air Recovery - February 21/22, 2018

Examination of the recovered wreckage revealed that the fuselage was severely fragmented. The structure was bent, buckled, and torn throughout. Remains of the cockpit area were located within the wreckage, which included the control column, a rudder pedal, and trim wheel pedestal.

The empennage was separated from the fuselage. The right horizontal stabilizer and elevator were separated. The right elevator trim tab actuator was found in a position consistent of about 5

degrees tab up. The left elevator was separated from the left horizontal stabilizer. The left elevator trim tab actuator was found in a position consistent of about 3.5 degrees tab up. The leading edge of the vertical stabilizer was crushed aft. The upper portion of the vertical stabilizer was crushed aft and downward in a tapered manner. The rudder trim tab remained attached to the rudder, however, the upper portion of the trim tab was partially separated about the upper 15 inches. The rudder trim tab actuator was found in a position consistent of a tab left between 0 and 5 degrees. The rudder control cables remained attached to the rudder horn located in the empennage. The rudder trim tab control cables were continuous in the tail cone and remained attached to the sprocket.

The elevator control cables remained attached to the aft elevator bell crank. The elevator push-pull tubes remained attached to the bellcrank, however were separated from the elevator torque tubes. The elevator pitch trim cables remained on the capstand and were attached to the elevator bellcrank. The yaw servo remained attached to the capstand the bridals remained attached to the rudder cables. The electric elevator trim cables remained attached to the capstand. One of the trim cables was fractured just aft of the electric trim motor. The cable appeared to have been severed by surrounding structure. All control cables in the tailcone/empennage were cut by recovery personnel.

The left wing exhibited accorded style compression damage throughout. The left aileron and inboard flap were separated from the left-wing structure. The outboard left flap remained attached. The left aileron cables remained attached to the left aileron bellcrank, which was loosely located within the outboard left-wing area. The left aileron control cables had been cut by recovery personnel near the point where the left wing attaches to the outboard side of the left engine nacelle. The left aileron trim cables were also found separated in the same general area and appeared to have separated in overload.

The right wing exhibited accorded style compression damage throughout. The right aileron, inboard and outboard flaps were separated. The right aileron bellcrank and control cables were separated. The right aileron control cables remained attached to the bellcrank and were separated near the aileron quadrant in a manner consistent with overload. One of the right aileron control cables remained attached to the roll servo bridal clamp.

The aileron control cables were continuous from the cockpit control column aft to the aileron control quadrant, which was separated and exhibited impact damage.

The left and right engine nacelle structure and the inboard portions of the left and right wing structure from the nacelles to the fuselage was fragmented. Portions of the structure were located, however a majority of it was not identified.

The instrument panel was fragmented into multiple portions with numerous instruments displaced.

Recovered Instruments:

Flaps: Slight right of up

Vertical Speed: In excess of 3,000 fpm descent
Altimeter: Impact damaged / unreadable
Left % RPM : 86%
Right % RPM: Excess of 100%
Left Prop rpm: 2000
Right Prop: 1940
ITT: Impact damaged
Torque: 1400 / impact damaged
Torque: impact damaged / missing needle
Attitude Indicator: Impact damaged, approximate 40-degree down angle, left bank

Various avionics boxes were recovered from the wreckage, however, the EGPWS was not located.

The directional gyro and compass gyros were removed from their housings and exhibited rotational scoring.

4.0 Recovered Engine and Propeller Examination (Florida Air Recovery)

Both engines were separated from the airframe. Wreckage recovery company personnel reported that both engines were located about 15 feet under the floor of the lake within the mud/silt. In addition, both propeller assemblies were separated from the engines.

Left Engine:

Portions of the engine mount remained attached. Various lines and accessories remained attached.

Right Engine:

Portions of the engine mount remained attached. Various lines and accessories remained attached.

Left Propeller:

The left propeller blade damage is consistent with rotation under power. Blade angle was unable to be determined, however, witness marks were consistent with a near “low” pitch blade position. Blade damage includes bending and twisting opposite direction of rotation, and a tip fracture on one blade.

Right Propeller:

The right propeller blade damage is consistent with rotation under power. Blade angle was unable to be determined, however, witness marks were consistent with a near “low” pitch blade

position. Blade damage includes bending and twisting opposite direction of rotation. One blade fractured at the blade shank location and exhibited “S” bending.

The engines were boxed in shipping containers for shipment to P&W Canada for further examination.

5.0 Left Engine Examination (Pratt & Whitney Canada)

Examination of the left engine revealed the engine was partially covered with environmental debris. Various level of corrosion was present on all surfaces and more predominant on the magnesium made housings of the reduction gearbox and accessories gearbox. Structural deformation of the gas generator and exhaust cases was such that the nose of the engine (reduction gearbox) was bent at an approximate 45° angle towards the 1 o’clock position.

Reduction Gearbox: The forward housing was externally corroded.

Exhaust Duct: Heavy compressive and impact damage observed on all surfaces. The bottom section was punctured and partially torn near “C” flange. The No. 3 & 4 bearing housing was displaced at an approximate 45° angle and heavily deformed.

Gas Generator Case: Compressive and impact deformation was found on all external surfaces. The damage resulted in axial bending of the case behind the fuel nozzle plane. The compressor housing also showed compressive deformation.

Accessory Gearbox: The external surfaces were corroded.

Inlet Case: The bolting flange to the AGB was partially fractured. The inlet struts were cracked. The inlet screen was completely displaced in a forward direction and a significant amount of organic debris was recovered from the engine inlet.

Power Control and Reversing Linkage: The linkage was bent and partially fractured. The control rod leading the FCU was bent.

Pneumatic Lines

Compressor Discharge Air (P3): Despite the deformation due to impact, all fittings were tight and secure.

Power Turbine Control (Py): All fittings were tight and secure. The line was deformed from impact.

Chip Detectors and Filters

Reduction Gearbox Chip Detector: Found covered with corrosion and organic debris. A piece of magnetic material measuring approximately 0.200” wide by 0.125” thick was found on the prongs accompanied by 2 small chips. The large piece showed distinct machining lines which are not characteristic of any gear teeth or bearing components. The origin of this piece

is likely from the 3 & 4 bearing housing (fractured bearing support flanges).

Oil Filter: Clean. The residual oil appeared clear but contained some non-magnetic debris.

Fuel Filter: Dirty with presence of water.

5.1 Left Engine Disassembly

Compressor Section

The compressor components were generally corroded and dirty with environmental residues.

Compressor 1st, 2nd, and 3rd Stage Discs and Blades: All blades were in place. The 1st stage exhibited bent blades in the opposite direction of rotation associated with impact damage. The 2nd and 3rd stages showed no major physical damage other than tip rubbing.

Compressor 1st, 2nd, and 3rd Stage Stators and Shrouds: All vanes were in place and displayed tip rubbing. A few vanes from the 1st and 3rd stages were bent in the direction of rotation.

Compressor 1st, 2nd, and 3rd Stage Spacers: Rubbing on the full circumference noted.

Centrifugal Impeller: Heavy rubbing of the blade profile observed.

Centrifugal Impeller Shroud: Rubbing of the full profile consistent with the damage observed on the impeller.

Front Stub Shaft: The end of the shaft was flared out and the CT disk splines were heavily worn.

No. 1 Bearing and Airseals: Rubbing on the airseals found. The bearing was contaminated with environmental debris and corroded, however no spalling or pre-impact damage was noted.

No. 2 Bearing and Airseals: Rubbing of the airseals was found. The bearing outer race was still in place but fractured. The inner race was fractured in multiple pieces. The cage was fractured and flared out; most rollers had separated from the cage and were recovered within the bearing cavity. No evidence of spalling or pre-impact damage was found. The rubbing damage found on the various blades, shrouds, spacers as well as the impeller and its shroud is indicative that the compressor was rotating at impact.

Combustion Section

Combustion Chamber Liner: The liner was crushed against the PT housing due to impact. There was no evidence of burning or pre-impact major damage on any of the surfaces.

Large Exit Duct: Deformed by impact. No other damage noted.

Small Exit Duct: Deformed by impact. No other damage noted.

ITT Probes, Busbar, and Harness: Heavily deformed by impact. It was not removed.

Power Turbine Housing: Heavily deformed by impact, it was not removed.

Power Turbine Guide Vane Ring and Interstage Baffle: The vane ring was destroyed and recovered in multiple pieces which all showed heavy impact damage. The baffle was also deformed and exhibited significant rubbing damage on both sides from contact with the CT and PT disks.

Power Turbine Shroud: Battered from impact from the blades however no evidence of high energy impact was found.

Power Turbine: All blades were either axially displaced in a downstream direction or completely dislodged from their fixings. 28 of 41 blades were recovered all exhibiting fractures at various locations within the airfoil. Many blade fragments were recovered. The fracture surfaces displayed features characteristic of overload. Amongst the blade fragments were shrouded blade tips which exhibited rubbing damage from contact with the blade shroud. Heavy circular rubbing was noted on the upstream face of the disk causing partial fracture of the balancing rim. The centre disk hub was rubbed away by impact. The circular rubbing and contact signatures described above is indicative that the PT disk was rotating with power at impact. The blade fractures likely occurred at impact as a result of structural deformation of the exhaust case and subsequent rubbing of the blades against their shroud.

Power Turbine Shaft and Shaft Housing: Heavily deformed by impact. It was not removed.

Reduction Gearbox (RGB)

All components of the RGB were corroded and covered with magnesium oxide.

Rear Housing: The inner portion was corroded and filled with magnesium oxide.

1st Stage Sun gear: The visible portion appeared intact. It was not removed.

1st Stage Planet Gear Carrier: No evidence of major damage.

1st Stage Planet Gears: No evidence of major damage. Not removed.

1st Stage Ring Gear: No evidence of major damage. Not removed.

Torque Meter: Not accessed.

2nd Stage Sun Gear and Flex Coupling: No evidence of major damage. Not removed.

2nd Stage Planet Gear Carrier: No evidence of major damage. Not removed.

2nd Stage Planet Gears: No evidence of major damage. Not removed.

2nd Stage Ring Gear: No evidence of major damage. Not removed.

No. 5 & 6 Bearings: Not accessed.

Propeller Shaft: Fractured behind the propeller flange. The fracture surfaces exhibited features characteristic of overload.

Forward Housing: Heavily corroded.

Accessory Gearbox (AGB)

An accumulation of organic debris was found upon opening the AGB. All gears and bearings were corroded however no evidence of pre-impact damage was noted.

Controls and Accessories

Ignition System

Exciter Box: Not received.

Ignition Leads: Both were severed.

Ignition Plugs: Both were dirty but otherwise not damaged.

Fuel System

Fuel Heater: Impact damage found on the heat exchanger. The mounting flange was fractured.

Fuel Pump: Physically intact.

Fuel Control Unit: Surface corrosion, the throttle lever was bent, partial separation between flow and drive body observed.

Flow Divider: Not available for examination.

Fuel Nozzles: No. 8 nozzle was missing. The remainder of the nozzles showed bent/fractured transfer tubes and impact damage.

Air System

Compressor Bleed Valve: Dirty. The piston was capable of free movement with normal resistance from the diaphragm.

Oil System

Propeller Governor: Damaged by impact. Missing speed setting lever.

Overspeed Governor: Fractured from its mounting flange and not available for examination.

6.0 Right Engine Examination (Pratt & Whitney Canada)

The engine was mostly covered with environmental debris. All external components showed various levels of corrosion. The propeller shaft was fractured. The internal portions of the gas generator and exhaust case were filled with large quantities of environmental dirt.

Reduction Gearbox: The front housing exhibited corrosion on all surface resulting in perforation at the 12 o'clock position.

Exhaust Duct: Structural deformation observed resulting in the nose of the engine having been displaced at an approx. angle of 45° towards the 3 o'clock position. The case was perforated from impact between the 6 and 9 o'clock position. The No. 3 & 4 bearing housing was pushed against the PT shroud at the 9 o'clock position.

Blade impact damage and scoring was noted just downstream of the PT shroud. This damage is consistent with the plane of the axially displaced PT disk, suggesting that the blade impact was caused during or after the deformation of the case occurred.

Gas Generator Case: Impact damage covered all surfaces.

Accessory Gearbox: The external portion of the housing showed significant paint loss and corrosion. No structural damage noted.

Inlet Case: The case was cracked along the top strut.

Power Control and Reversing Linkage

The linkage was battered and fractured. All connections to and from the linkage were also fractured.

Pneumatic Lines

Compressor Discharge Air (P3): The line was deformed by impact. All fittings were tight.

Power Turbine Control (Py): The line was deformed by impact. All fittings were tight.

Chip Detectors and Filters

Reduction Gearbox Chip Detector: Covered with oil and corrosive residues. There were no metallic particles on the magnetic prongs.

Oil Filter: Some non-metallic debris found on the filter element.

Fuel Filter: Dirty. The residual fuel showed no evidence of water content.

6.1 Right Engine Disassembly

Compressor Section

The compressor inlet was found full of environmental debris. All components showed various levels of corrosion.

All compressor components were covered with organic debris and corroded.

Compressor 1st, 2nd, and 3rd Stage Discs and Blades: Impact damage was found on the leading edges of the 1st stage blades. The impact resulted in bending of the damaged blades in the opposite direction of rotation. One blade was fractured near the root.

Considering the absence of major damage to downstream components, it was determined that the blade fracture likely occurred at impact. All blades from the 3 stages of compressor exhibited tip rubbing and light leading edge impact. All blades were in place.

Compressor 1st, 2nd, and 3rd Stage Stators and Shrouds: The shrouds showed rubbing damage from contact with the blade tips. The stator vanes were all in place and showing light impact damage.

Compressor 1st, 2nd, and 3rd Stage Spacers: Rubbing noted on the full circumference.

Centrifugal Impeller: Heavy rubbing of the vanes and splitter profiles observed.

Centrifugal Impeller Shroud: Corresponding rubbing damage found on the entire profile.

Front Stub Shaft: No visual damage.

No. 1 Bearing and Airseals: The airseals were rubbed and the bearing was corroded. No evidence of pre-impact damage found on the bearing.

No. 2 Bearing and Airseals: The airseal was rubbed such that all labyrinth fins were obliterated. The bearing was corroded however no evidence of pre-impact damage noted.

Combustion Section

The entire combustion section displayed a large accumulation of organic debris.

Combustion Chamber Liner: The liner exhibited deformation of the Large Exit Duct mating flange due to the impact.

Large Exit Duct: The mating flange to the liner was deformed from impact.

Small Exit Duct: No visible damage.

Turbine Section

Compressor Turbine (CT) Guide Vane Ring: No visible damage to the airfoils. The downstream edge of the inner shroud exhibited rubbing from contact with the CT blades.

Compressor Turbine Shroud: Rubbing from contact with the blade tips was noted on most of the circumference.

Compressor Turbine: All blades were in place. The upstream side of the blade fixings adjacent to the platforms displayed rubbing from contact with the CT vane ring inner shroud. Blade tip rubbing also noted. The downstream side of the disk exhibited significant circular rubbing which separated the balancing rim from the disk

Portions of the rim were found in the debris surrounding the area. The blades showed rubbing damage causing partial fractures of the trailing edges. The rubbing damage found on the disk faces and centre hub is indicative of rotation with power at impact.

ITT Probes, Busbar, and Harness: Deformed from impact. The temperature probes were fractured.

Power Turbine Housing: Deformed from impact.

Power Turbine Guide Vane Ring and Interstage Baffle: All of the airfoils were fractured resulting in complete liberation of the inner shroud. The inner shroud itself was fractured in 3 pieces. The outer shroud was fractured in 2 pieces. All remaining airfoils exhibited heavy impact damage. Both sides of the baffle displayed circular rubbing from contact with the adjacent CT and PT disks.

Power Turbine Shroud: Showing impact damage and deformation however, there was no evidence of high energy impact.

Power Turbine: All blades were either fractured or liberated from their fixings. Heavy rubbing damage was present on the upstream side of the disk from rotational contact with the vane ring. The blade fracture surface displayed features characteristic of overload. Many blade fragments were recovered from the exhaust area, amongst them blade tips which exhibited significant rubbing. The damage observed on the disk and blades is indicative of rotation with power and is the result of structural engine deformation during the impact.

Power Turbine Shaft and Shaft Housing: Heavily deformed and bent (consistent with the damage found on the exhaust duct). It was not removed.

Reduction Gearbox

The propeller shaft was fractured just behind the propeller mounting flange. The fracture surface exhibited features characteristic of overload. Considering the findings on the remainder of the engine, the RGB was not disassembled.

Accessory Gearbox

The AGB was opened and revealed large quantities of environmental dirt. cursory visual examination of the components revealed significant corrosion but no evidence of pre-impact major damage.

Controls and Accessories

Ignition System

Exciter Box: Not available for review.

Ignition Leads: Both leads were severed.

Ignition Plugs: The plugs were dirty, but no evidence of excessive wear was noted.

Fuel System

Fuel Heater: Fractured from its mount. The oil tubes leading to and from the unit were fractured. The heat exchanger was punctured from impact.

Fuel Pump: The mounting flange was fractured and incomplete.

Fuel Control Unit: The throttle lever shaft was bent.

Flow Divider: Not available for review.

Fuel Nozzles: No. 8 nozzle was not available for review. All nozzles were dirty.

Air System:

Compressor Bleed Valve: Dirty. The piston was capable of movement but with stiff resistance.

Oil System:

Propeller Governor: Damaged by impact; the speed setting lever and the top of the housing were missing; fractured off of the unit.

Overspeed Governor: Damaged by impact.

7.0 Engine Examination Summary

Both engines were heavily contaminated with organic debris. Both propeller shafts were fractured behind the propeller bolting flange. Heavy impact and structural deformation was present on all structural cases.

Heavy circular rubbing contact was observed on the power turbine disks, compressor turbine disks as well as all components of the compressors indicative of rotation during impact. The contact signatures between both engines were similar in appearance.

No pre-impact damage was found on the main bearings and examined gears within the reduction gearboxes and accessories gearboxes. Examination of available engine accessories revealed no evidence of pre-impact damage which could have prevented normal operation.

There were no pre-impact anomalies observed which could have prevented either engine from producing power prior to impact.

Submitted by: Joshua Cawthra