



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

March 5, 2020

EXAMINATION SUMMARY

ERA18FA251

A. ACCIDENT

Location: Woburn, Massachusetts
Date: September 15, 2018
Time: 1103 EDT
Airplane: Columbia Aircraft Mfg LC41-550FG, N2536T

B. INVESTIGATION PARTICIPANTS

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C. SUMMARY

On September 15, 2018, about 1103 eastern daylight time, a Columbia Aircraft Mfg LC41-550FG, N2536T, collided with trees and terrain during an instrument approach at Woburn, Massachusetts. The private pilot and one passenger were fatally injured. The airplane was destroyed. The airplane was registered to the pilot and was operated under the provisions of Title 14 *Code of Federal Regulations* Part 91 as a personal flight. Day, instrument meteorological conditions prevailed, and an instrument flight rules flight plan was filed for the flight. The flight originated at Republic Airport (FRG), Farmingdale, New York at 0954 and was destined for Laurence G. Hanscom Field (BED), Bedford, Massachusetts.

1.0 Accident Site

The aircraft impacted trees and terrain and traveled through a wooded area for about 100 yards before coming to rest at the base of a hill in a residential area (Figure 1). The coordinates of the main wreckage were N 42° 27.224' W 071° 10.995' (GPS). Elevation: 222 ft. The airframe was highly fragmented. There was a postaccident fire that consumed about 20% of the wreckage. The engine separated from the firewall and the propeller separated from the engine during the impact sequence. All primary structural components and flight control surfaces were accounted for within the debris field. All wreckage, with the exception of one SD memory card, was examined at the accident site.

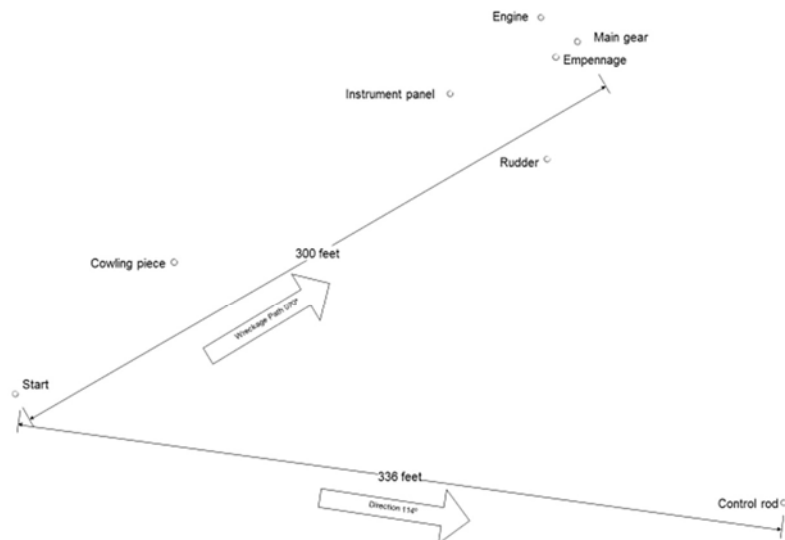


Figure 1 – Wreckage Diagram

2.0 Airframe Examination

Both wingtips and both horizontal stabilizer tips were located approximately halfway through the wreckage path. Portions of all flight controls were located along the path. The empennage and main landing gear were located the greatest distance from the initial impact point.

The aileron and elevator control tubes were found connected to the left and right side control sticks. The aileron control rod was intact from the side stick to the aileron torque tube bellcrank. The elevator push/pull tube was attached to the elevator interconnect assembly. The wing aileron control tubes and the fuselage elevator control tubes separated from their mounts and were found along the wreckage path.

The rudder cables were attached to the rudder torque tubes. The cables had separated in tension overload at approximately the middle of the fuselage. The rudder separated from the empennage.

The elevator trim tab cable exhibited failure under tensile load.

The fuel strainer was not disassembled due to swelling from post-impact fire.

Two wheels and two wheel pants were found near the middle of the wreckage path.

The cabin seats detached from their mounting points during impact. The seat bases were fractured into multiple pieces and dispersed from the final impact point in several directions.

A memory card presumed to be from the G1000 was retained by the NTSB to be analyzed.

The engine sustained severe impact damage to the left side which prevented full rotation of the crankshaft. Crankshaft continuity was confirmed. Partial compression and valve train continuity were established. The left magneto was loose from its mounting pad but remained attached to the engine by the ignition leads.

The propeller was detached from the engine during impact. The blades were bent aft and exhibited chordwise scratching indicative of rotation under power as the aircraft traveled through the trees. Multiple branches, three to four inches in diameter, exhibited cuts that were consistent with propeller contact.

At the time this report was written, the examination of the SD card presumed to be from the G1000 had not been completed.

3.0 Engine Examination

Photographs of the last maintenance entries revealed that the engine underwent an annual inspection on December 14, 2017 at an engine total time of 1,339.6 hours. At that time, the #1

and #2 cylinders were replaced with overhauled units. The engine then underwent two oil changes subsequent to the cylinder replacement, the last of which was on August 16, 2018 at a total time of 1,395.4 hours. The last maintenance entry was for a replaced alternator on September 7, 2018 at a total time of 1,404.1 hours.

The engine sustained significant impact damage that precluded functional testing of the engine. However, crankshaft and camshaft continuity were confirmed, and borescope examination of the cylinders revealed no pre-impact anomalies. There were no pre-accident anomalies noted with the fuel, ignition, and turbocharger systems. No anomalies were noted that would have prevented the engine from produced full, rated power.

The engine was separated from the aircraft and came to rest in an upright position. The propeller, starter motor, intercoolers, turbochargers, and turbo charger components were separated from the engine. The left magneto was separated from the mounting pad but remained attached to the engine via the ignition leads. The left cylinders sustained significant impact damage that fractured numerous cooling fins, damaged the top sparkplugs, and displaced the #2 cylinder head in toward the engine centerline. The left intake tubes were separated from their cylinders. There were no external pre-accident anomalies noted with the engine or engine-related components.

The exhaust system sustained impact damage and numerous components were separated. However, no pre-accident anomalies were noted with the observed components.

The induction system was fragmented with only the right intake tubes, intake plenum and throttle body remaining attached to the engine. The overboost valve and intercoolers were separated and impact damaged.

The left magneto was separated from its mounting pad and the housing sustained impact damage that deformed the housing in the capacitor area. The left magneto's ignition leads were cut near the harness cap. The magneto drive was manually rotated and a spark was observed in firing order during the audible snap of the impulse coupling.

The right magneto remained attached to the mounting pad. Manual manipulation of the magneto revealed it was secured in place. The magneto was removed and the drive was manually rotated. The impulse coupling produced an audible snap, but a spark was not observed from any of the leads.

The ignition harness remained attached to each magneto. The left cylinders' ignition leads were fragmented. The damaged leads were cut from the harness for the functional testing of the magnetos. The terminal ends on the right cylinders' sparkplugs and the bottom left sparkplugs remained in place.

The top sparkplugs were removed from the cylinders with the exception of the #2 cylinder, which was displaced and impinging on the fractured cooling fins. The bottom sparkplugs were examined utilizing a lighted borescope. All of the sparkplugs displayed normal wear and light combustion deposits with no signs of lead or carbon fouling.

The engine-driven fuel pump remained attached to the backside of the engine. The vapor return fitting was fractured, but all remaining b-nuts remained in place with no blue discoloration noted. The mixture control cable remained attached to the lever and the lever remained attached to the shaft. The lever, shaft and nut were marked and rotation of the lever resulted in a coinciding unbound rotation of the shaft. Fuel was recovered in the line between the engine-driven fuel pump and the fuel metering unit. Residual fuel was also recovered from the engine-driven fuel pump. Removal of the pump revealed that the drive coupling was intact. Rotation of the drive coupling while it was installed in the shaft resulted in a rotation of the pump.

The throttle body and intake plenum were displaced to the right side of the engine. The throttle cable remained attached to the throttle lever which remained attached to the shaft; however, the shaft was bent. The lever, nut, and shaft were marked and rotation of the lever resulted in slipping of the lever (this was attributed to the bending damage of the shaft). Residual fuel was recovered in the line between the fuel metering unit and the fuel manifold valve even though the inlet fitting of the fuel manifold valve was fractured.

The fuel manifold remained attached to the displaced throttle body. The manifold valve was disassembled, and residual fuel was observed in the housing and the screen was clear.

The left fuel injector nozzles were fractured and the right nozzles remained in place with the lines attached. The right fuel injector nozzles were free from obstructions. The portions of the fractured #2 and #6 nozzles were observed and were free from obstructions. The #4 nozzle was not observed.

The oil sump was displaced up around the base of the engine and a large tear was present with wood embedded in the torn area. Residual oil was observed leaking from the torn area, and it was caramel in color with no abnormal odors.

The oil pickup tube and screen were not observed.

The oil pump cap was removed and residual oil was observed in the pump housing. The gear were intact with no pre-accident anomalies noted with the gear and the housing walls.

The oil filter remained attached to the adapter and the safety-wire was intact. There was no sign of lubrication or thermal distress on any of the observed engine components.

The oil cooler was separated from the engine.

Cyl 1: The cylinder remained attached to the engine with no external anomalies noted. Borescope examination of the cylinder revealed light combustion deposits with no pre-accident anomalies noted with the piston, barrel, valves or valve seats. During the partial rotation of the crankshaft the cylinder produced thumb compression.

Cyl 3: The cylinder remained attached to the engine with no external anomalies noted. Borescope examination of the cylinder revealed light combustion deposits with no pre-accident

anomalies noted with the piston, barrel, valves or valve seats. During the partial rotation of the crankshaft the cylinder produced thumb compression.

Cyl 5: The cylinder remained attached to the engine with no external anomalies noted. Borescope examination of the cylinder revealed light combustion deposits with no pre-accident anomalies noted with the piston, barrel, valves or valve seats. Piston/connecting rod movement was confirmed during the partial rotation of the crankshaft.

Cyl 2: The cylinder remained attached to the crankcase but sustained significant impact damage that fractured and displaced the head toward the engine centerline. The intake and exhaust tubes were displaced from the cylinder and the sparkplugs were damaged. Only a portion of the cylinder's internal components was visible via borescope placement through the intake port. No pre-accident anomalies were observed with the observed components.

Cyl 4: The cylinder remained attached to the crankcase. It sustained impact-related damage to the cooling fins, intake port, fuel injector, and top sparkplug. Borescope examination of the cylinder revealed light combustion deposits with no pre-accident anomalies noted with the piston, barrel, valves or valve seats. Piston/connecting rod movement was confirmed during the partial rotation of the crankshaft.

Cyl 6: The cylinder remained attached to the engine with impact-related damage sustained by the cooling fins, top sparkplug, fuel injector, and intake port. Borescope examination of the cylinder revealed light combustion deposits with no pre-accident anomalies noted with the piston, barrel, valves or valve seats. During the partial rotation of the crankshaft the cylinder produced thumb compression.

The crankcase remained intact and all the cylinders remained attached to the crankcase.

The crankshaft was fractured aft of the propeller flange where it exits the nose seal of the crankcase. The fracture surface displayed 45-degree shear lips. The crankshaft was manually rotated by inserting an adapter into the right accessory drive gear. The crankshaft could not be rotated in its entirety due to the displaced #2 cylinder head, which prevented full movement of its connecting rod/piston. However, crankshaft continuity was confirmed from the aft accessory end, forward to the fractured crankshaft and gear-driven alternator on the front right side, and out to each connecting rod/piston.

The camshaft was not observed, but camshaft continuity was confirmed during partial rotation of the crankshaft.

The starter motor was separated from the adapter and was not observed.

The adapter remained attached to the backside of the engine and rotation of the drive pulley was observed during partial rotation of the crankshaft. No pre-accident anomalies were observed.

The engine-driven alternator remained attached to the front right side of the engine but sustained impact damage. It was not examined as part of this investigation.

The belt-driven alternator Remained attached to its bracket which sustained deformation damage. It was not examined as part of this investigation.

The two turbochargers were separated from the engine. One turbocharger remained intact with no pre-accident anomalies noted with the impeller or turbine blades. The other turbocharger induction housing was separated, and impacted with wood fragments. The associated turbocharger's impeller blades were fractured and wood fragments were observed at some of the fracture points. The turbine blades were intact.

The pressure controller was separated from the engine and residual oil was observed in the inlet line, which remained attached. The cap of the controller was partially displaced.

The waste gate actuator remained with a piece of exhaust. The actuating arm remained attached to the wastegate with no pre-accident anomalies noted.

The overboost valve remained attached to a flattened and distorted piece of intake tubing. No pre-accident anomalies were noted with the poppet valve.

The propeller governor remained attached to the front left side of the engine, but the control lever/shaft was separated from the housing.

4.0 Propeller Examination

The three-bladed propeller hub remained intact and all three blades remained attached to the hub. All of the blades rotated independently within the hub, indicative of pitch change link fractures. The blades were arbitrarily labeled A, B, and C for descriptive purposes. Blade A displayed chord-wise paint burnishing, significant blade twisting toward low pitch, and s-bending on the trailing edge. Blade B was bent in in half with impact-related damage on the trailing edge. Blade C was bent aft, twisted toward low pitch, with slight s-bending on the trailing edge. Two tree branches were observed at the accident site that displayed an angular cut with gray paint transfers.