



## Memorandum For Record

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**Date: December 3, 2019**  
**NTSB Accident Number: ERA18FA167**

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Loose components/instruments were recovered for further examination which revealed:

Pilot's Altimeter – 29.98, Needle missing, 100 ft (NTSB pictures IMG\_9095-9096)  
Altimeter Faceplate – 30.30 inHg. Needles loose. Hundred Foot pointer missing.  
Altitude Alerter – Recovered. NTSB Photo IMG\_9171  
Right Seat Circuit Breaker Panel – Separated.  
Bendix King Color Radar Indicator  
Bendix King Transponder  
KG102 Directional Gyro  
Passenger Log – Found in debris with comments from people  
Right Oil temperature/pressure – temperature off scale low and pressure needle broken indicating 100 psi  
Watch – Damaged watch found. Silver band and black face. The internals were missing. One band was broken off.  
Bendix King Attitude Indicator (Pilot's Side) – The internals were separated from the housing but recovered. The frame was fractured, and 2 hoses were connected at the back of the instrument with clamps. The electrical connection was missing.  
GNS 530 – was recovered (Retained for Examination by NTSB)  
KX165 – Recovered  
Audio Select Panel – recovered (NTSB Photo IMG\_9159)  
HSI – Heading 090° Heading Bug 045°, OBS 030. The "Nav" and HDG flags were visible.  
Vacuum System Filter – recovered  
Fuel Flow – Separated from panel. 15 gallons-per-hour (green arc) from unknown side  
RPM gauge – Separated from panel. 400 rpm.  
RPM gauge found near seat at aft fuselage – 150 rpm  
Turn Coordinator – Separated from panel. Left bank of about 85°  
Right Fuel Strainer – Found loose. Screen crushed as depicted in NTSB Photo.

Pilot Seat – Separated and Located near Aft Fuselage. The lapbelt remained attached but the outboard lapbelt webbing was cut. The shoulder harness was not attached to the lapbelt. The inboard track remained attached, but the outboard track remained attached to the aircraft.

CoPilot's Seat – Separated. The lapbelt was not latched, and the shoulder harness was not attached to the lapbelt. The inboard track remained attached, but the outboard track remained attached to the aircraft.

Left Side wing and flight control pieces – NTSB Photos 9179-9186. A portion of aileron hinge remained attached to the aileron.

Emergency Exit Window – Separated but recovered.

Forward Rudder Bellcrank – Separated from airplane. Both rudder cables remained attached, but both exhibited tension overload.

IVSI – Instrument separated from panel but recovered. Needle missing. No obvious slap mark Control yoke (co-pilot's side) – Neither horn of the control yoke were fractured.

L35/36 low altitude IFR charts was located on the energy path near the control yoke.

Co-pilot attitude indicator faceplate - Back portion of the instrument was missing.

Examination of the ACR Electronics 110-4 ELT revealed it remained connected and the antenna remained connected. The unit was in the "off" (armed) position, and a red colored light was flashing.

The pilot's side instrument panel which was examined. The following readings were observed:

Airspeed – 0

Suction – Off scale low. Both buttons visible

G4 Insight Engine Monitor – Faceplate present, display and body were separated. The body was later recovered but the SD card was missing and not recovered.

Attitude Indicator – Faceplate was present, but the body was missing.

Heading Indicator – Missing

Autopilot Annunciator – In place and retained by NTSB

ADF – Heading 155°. Course to 040°.

Omni-Head Indicator – Heading 055°

Left Manifold Pressure – Off scale low

Right Manifold Pressure – Separated from panel

Left EGT/CHT – Separated from panel

Right EGT/CHT – CHT off scale low. EGT 6 marks from the bottom

Left Oil Temperature/Pressure – Temp 10° C, needle bent reading lower red line

Annunciator Panel – Separated from the instrument panel and not recovered.

The lower center part of the instrument panel which was found wrapped against a tree above ground level contained instruments. The following observations were noted:

Left Fuel Quantity - ~3/4 capacity

Right Fuel Quantity – Off scale low

Prop Amps – 24

Landing Gear Selector – Switch broken

Flap Position Indicator – Full down

## Flap Selector - Missing

### Aircraft Doors

The cabin door and aft portion of the utility door were recovered. Examination of the cabin entry door revealed the lower forward portion exhibited aft crushing. The majority of the window was not in place. The upper portion of the upper latch hook was fractured. The lower aft and aft door pins were extended. The upper door latch rod remained connected to the inner handle, but the aft and lower latch rod were separated at the inner handle. Examination of the aft portion of the utility door revealed the latch system was not fractured but the linkage was deformed in multiple locations. The aft utility door separated from the hinge. The forward and aft hinges of the utility doors remained connected to the airplane.

Examination of the left engine at the accident site revealed it was separated from its nacelle. Both magnetos remained attached and secured to the mounting pads and manual manipulation of the magnetos did not result in any slippage. All six cylinders were attached. The crankcase was intact except in the area of the engine-driven alternator. The No. 5 cylinder head was fractured and the push rods and push rod housings were missing. The starter motor was separated from the adaptor. The oil pump, oil filter and oil cooler were attached to the engine. The throttle body / fuel metering unit S/N L139506A was separated from the engine but remain attached to the nacelle via the throttle and mixture cables. The throttle and mixture cables remained secured to their respective control shafts. Manual manipulation of the control levers resulted in a coinciding rotation of the control shafts with no slipping or binding noted. All fuel lines to and from the metering unit were separated. Disassembly of the components of the fuel metering unit revealed all components were intact, the fuel inlet screen was clear and the o-rings were in place. No pre-accidents anomalies were noted. The No. 2 rocker cover was fractured. The engine-driven fuel pump and fuel manifold valve remained attached at the engine.

Further examination of the left engine revealed the cylinder cooling fins of all but the No. 4 cylinder were damaged. The No. 5 top and No. 3 bottom spark plugs were fractured, and the right side ignition leads exhibited pinching and tearing damage. Examination of the spark plugs revealed a normal worn appearance with no signs of lead or carbon fouling. All valve springs and rockers except the No. 5 intake rocker were intact; the No. 5 intake rocker was fractured in two places, and the No. 5 rocker shaft bosses were fractured. The oil pump housing cap was removed and residual oil was found throughout the housing. Examination of the oil pump revealed the pump gears were intact, but displayed small areas of corrosion. The oil pump housing walls and oil pump housing cap displayed circumferential scoring consistent with hard particle passage. The oil filter was removed and cut open revealing no visible evidence of metallic debris or contamination. Manual rotation of the propeller flange resulted in crankshaft continuity from the alternator face gear back to the crankshaft gear and out to each connecting rod and piston. Rotation of the crankshaft also resulted in functional testing of the magnetos, with each magneto producing a spark from each ignition lead in firing order. Thumb compression from each of the cylinders was obtained with crankshaft rotation. Camshaft continuity was confirmed throughout the valve train with exception of the No.5 cylinder. Borescope inspection of each cylinder interior revealed no pre-impact anomalies with the pistons, barrels, cylinder heads, valves, or valve seats.

Further examination of the left engine revealed the fuel manifold valve remained secured to the top side of the engine and all lines remained attached to their respective nozzles; however, the Nos. 1 and 3 nozzles were fractured. Disassembly of the fuel manifold valve revealed that it contained residual fuel, the screen was clear and unobstructed, and the diaphragm and plunger were intact. Examination of the Nos. 2, 4, 5, and 6 fuel injector nozzles revealed no lead deposits. The engine-driven fuel pump drive coupling was intact, and rotation of the drive coupling resulted in a coinciding rotation of the pump. The low pressure relieve valve set screw was displaced. Disassembly of the engine-driven fuel pump revealed in no pre-accident anomalies. The propeller governor remained attached to the engine but the cable and the pitch control lever were separated. No external pre-accident anomalies were noted. During rotation of the crankshaft, the prop governor bevel gear rotated freely.

Examination of the right engine at the accident site revealed the right engine crankcase was intact except around the engine-driven alternator. All six cylinders were attached. The throttle body, engine-driven fuel pump and fuel manifold valve were attached. The starter adaptor was separated from the engine. The oil pump, oil filter, and oil cooler were attached. The left magneto was separated from the engine while the right magneto was attached but displaced from the mounting pad. Cylinders Nos. 3, 5, and 6 rocker covers were fractured.

Examination of the right engine following recovery revealed the No. 6-cylinder head was impact damaged, the rocker cover was fractured, and the cooling fins were damaged. The Nos. 3 and 5 rocker covers were fractured, the Nos. 1 and 5-cylinders cooling fins were damaged, and the No. 5-cylinder head was fractured near the push rods. All valve springs, rockers, and rocker shaft bosses were intact. The oil pump housing cap was removed and residual oil was found throughout the housing. Examination of the oil pump revealed the pump gears were intact. Examination of the oil pump housing and gear revealed no pre-accident anomalies. The oil filter was cut open revealing no visible evidence of metallic debris or contamination. Manual rotation of the propeller flange resulting in crankshaft continuity from the alternator face gear back to the crankshaft gear and out to each connecting rod and piston. Thumb compression from each of the cylinders was obtained with crankshaft rotation. Camshaft continuity was confirmed throughout the valve train. Borescope inspection of all cylinders interiors revealed no pre-impact anomalies with the pistons, barrels, cylinder heads, valves, or valve seats (some piston erosion was noted in the Nos. 2, 3, and 5 cylinders consistent with prolonged lean condition). Examination of the spark plugs revealed a normal worn appearance with no signs of lead or carbon fouling; the Nos. 2 and 3 top spark plugs were covered in mud and debris. The left magneto was separated from the engine and the ignitions leads were pulled free from the ignition harness cap. Removal of the damaged harness cap reveal water leaking for the magneto. The right magneto was displaced from the mounting pad. Manual rotation of the right and left magneto drives resulted in a spark from each ignition lead (right ignition harness was utilized for both magneto tests).

Further examination of the right engine revealed the throttle body / fuel metering unit S/N D259621A, was partially separated from the engine but remain attached via a fractured mounting bracket. The inlet fuel fitting was displaced and the outlet fuel fitting was fractured. The mixture and throttle control cable rod ends remain attached to their respective levers. The throttle lever was loose on the shaft and the mixture lever was secure to the shaft. The throttle valve was found

in the open position. Manual manipulation of the mixture control lever resulted in a coinciding rotation with its control shaft with no slipping or binding noted. The inlet and return fuel lines remained attached to their fittings. The fuel inlet screen contained some debris but was not obstructed. Disassembly of the components of the fuel metering unit revealed all components were intact, and the O-rings were in place. No pre-accident anomalies of the throttle body / fuel metering unit were noted. Examination of the engine-driven fuel pump revealed the fuel fittings were fractured except for the line between the pump and fuel metering inlet. Removal of the engine-driven fuel pump revealed the drive coupling was intact. Rotation of the drive coupling resulted in a coinciding rotation of the pump. Disassembly of the engine-driven fuel pump revealed no pre-accident anomalies. The fuel manifold valve remained secured to the top side of the engine and all lines remained attached to their respective nozzles. The fuel manifold valve contained residual fuel, water and mud. The screen was clear and unobstructed, the diaphragm and plunger were intact. Examination of the fuel injector nozzles revealed all were contaminated with water and mud. The propeller governor remained attached to the engine and the control cable rod end remained attached to the pitch control lever. No external pre-accident anomalies were noted. During rotation of the crankshaft, the prop governor bevel gear rotated freely.

Examination of the aft fuselage revealed the right horizontal stabilizer and elevator were displaced/rotated up 90°. The outboard portion of the right horizontal stabilizer was separated and was displaced up and inboard. Both rudder cables remained connected at the bellcrank near the control surface and were continuous to fuselage station (FS) 83, where they exhibited tension overload. Both elevator control cables remained connected at the rear bellcrank and were continuous to where cut for recovery at FS 58. The left elevator push/pull rod remained connected at the aft bellcrank but was fractured in overload at the rod end near the elevator. The right elevator push/pull rod was fractured at the aft bellcrank, but remained connected to the elevator, and the attachment was separated from the elevator.

The ailerons and flaps separated from their wings. Both wingtips were found separated at the first tree line. Both tracks remained attached to the right flap. The inboard track remained attached to the left flap. The outboard track was separated from the flap and remained attached to the wing structure. The left aileron inboard hinge remained attached to the wing structure. The left aileron outboard hinge remained attached to the aileron. The right aileron outboard hinge remained attached to the right aileron. Portions of the right aileron inboard hinge structure remained attached to the aileron but the hinge itself was not observed. The right and left flap actuator were extended 1.7 and 1.6 inches, respectively, which equates to flaps retracted.

The aileron balance cable remained connected at the left bellcrank which was fractured (overload), and both bridle cables clamps with bridle cables remained connected, but the bridle cables exhibited tension overload. The right side of the balance cable exhibited tension overload at the clevis near the outer bellcrank.

A section of the left wing, with part of the main landing gear and portion of cockpit was located west of the road. Examination of the section of wing revealed the aileron trim tab actuator chain was undamaged and separated from the actuator. The aileron trim tab control cables were separated in the area where they entered the fuselage. The separations exhibited tension overload. The left aileron bellcrank was separated from the wing. Both left aileron cables were

separated from the bellcrank and had portions of the bellcrank attached. The left aileron cables exhibited tension overload/broomstrawing at the point of separation. Examination of the fuel selectors revealed the left fuel selector handle was in the crossfeed position and the right fuel selector handle was out of position. The right fuel selector valve was separated from the aircraft and found along the wreckage path. Using air pressure, the right fuel selector valve was determined to be in the right main fuel tank position. The left fuel selector valve remained attached to its mounting structure. The control mechanism on the valve was damaged and the control cable was separated in tension overload. The left fuel selector valve had fuel in the supply line to the left engine. Air pressure was applied to the main supply line and crossfeed supply line of the left fuel selector valve and no air came out. The valve could not be moved. The valve was disassembled and was found to be in a non-standard position. Fuel was found inside the valve and in the fuel line from the valve to the engine. The left fuel strainer was attached to the wing structure. When the strainer was opened fuel was found inside. The strainer screen was clear of debris.