Aviation Investigation Final Report

Location:	Fredericksburg, Virginia	**Accident Number:**	ERA16FA288
Date & Time:	August 12, 2016, 12:22 Local	**Registration:**	N128VB
Aircraft:	Beech 95 B55 (T42A)	**Aircraft Damage:**	Substantial
Defining Event:	Aerodynamic stall/spin	**Injuries:**	6 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The private pilot, who was seated in the left front seat, was making a cross-country flight in the twin-engine airplane with five passengers on board; the passenger seated in the right front seat was a commercial pilot. Shortly after departing, the pilot contacted air traffic control and requested visual flight rules flight following services to the destination airport. A variable quartering headwind prevailed about the time the airplane approached the destination airport's 2,999-ft-long runway, with an approximate headwind component of about 8 knots. Given the airplane's estimated landing weight and the prevailing weather conditions, the airplane's calculated landing distance was between 1,280 and 1,850 feet.

Review of recorded data showed that the airplane crossed the runway threshold for landing at an altitude about 40 ft above the ground and at an estimated airspeed of 95 knots, about 9 knots faster than the airframe manufacturer's recommended final approach speed for its estimated weight. Witness interviews, surveillance video, and recorded data showed that the airplane touched down and bounced several times near the mid-point of the runway. The airplane then started to climb at an estimated airspeed of 68 knots, which was well below the balked landing climb speed of 90 knots, and near the published stall speed of 73 knots with the landing gear and flaps extended. The airplane made a shallow left turn and climbed to an altitude of about 100 ft above ground level. During the climbing turn, airplane's speed further decreased to an estimated 62 knots before it entered an aerodynamic stall and descended to impact terrain.

Examination of the airframe and engines did not reveal any evidence of preimpact mechanical malfunctions that would have precluded normal operation. Postaccident weight and balance calculations indicated that the airplane was below its maximum gross landing weight and that the center of gravity was within limits.

The pilot did not hold a valid Federal Aviation Administration medical certificate and had a history of significant medical issues, including hypertension, high cholesterol, diabetes, and heart disease;

however, it is unlikely that the pilot's hypertension or high cholesterol contributed to the accident. Toxicology testing identified zolpidem, a prescription sleep aid, at below-therapeutic levels; because zolpidem undergoes postmortem redistribution and the tested blood came from the heart, the antemortem level was likely lower than the measured level. As a result, it is unlikely that the sedative effects from the zolpidem contributed to the accident. The pilot's diabetes could have contributed to the accident if he experienced acutely low blood sugar, which causes psychomotor slowing and eventually loss of consciousness, or had difficulty operating the airplane due to diabetic neuropathy. Further, an acute cardiac event in either the pilot or the pilot-rated passenger, who also had significant heart disease, could have contributed to the accident; however, the investigation was unable to determine whether any of the pilots' medical issues contributed the accident, and it is unlikely that both suffered an acute medical event at the time of the landing and subsequent loss of control during the go-around attempt.

It could not be determined which of the two pilots was manipulating the controls and flying the airplane during the landing approach and subsequent go-around, as both the pilot (airplane owner) and the pilot-rated passenger were seated at a fully functional set of flight controls.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot(s) failure to maintain adequate airspeed during an attempted go-around, which resulted in an exceedance of the airplane's critical angle of attack and an aerodynamic stall.

Findings

Personnel issues	Aircraft control - Pilot
Aircraft	Airspeed - Not attained/maintained
Aircraft	Angle of attack - Not attained/maintained

Factual Information

History of Flight

Landing	Landing area overshoot
Landing	Abnormal runway contact
Landing-aborted after touchdown	Attempted remediation/recovery
Initial climb	Aerodynamic stall/spin (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On August 12, 2016, at 1222 eastern daylight time, a Beech 95-B55, N128VB, collided with trees and terrain during an aborted landing at Shannon Airport (EZF), Fredericksburg, Virginia. The private pilot and five passengers, one of whom was a commercial pilot, were fatally injured. The airplane was registered to Ross and Company PLL and operated by the pilot under the provisions of Title 14 Code of Federal Regulations Part 91 as a personal flight. Visual meteorological conditions prevailed near the accident site at the time of the accident, and no flight plan was filed for the cross-country flight, which originated from Shelbyville Municipal Airport (GEZ), Shelbyville, Indiana, about 1015.

The pilot departed Bowman Field Airport (LOU), Louisville, Kentucky, earlier in the day and flew to GEZ to pick up his commercial pilot-rated friend and four additional passengers. A lineman at GEZ stated that after the airplane landed, the pilot parked the airplane next to the fuel pump and requested that the main inboard fuel tanks be "topped off." The pilot was the only person onboard the airplane at the time. The lineman stated that after he topped off the left tank, the pilot-rated passenger requested that he "leave the right tank down an inch or two." The lineman obliged; he added a total of 40.3 gallons of fuel to the airplane. The lineman also stated that he overheard a conversation between the pilot and the pilot-rated passenger, during which the owner stated, "we have 15 gallons in each of the aux[iliary] tanks." Based on the information provided by the lineman, the total fuel on board after the refueling was estimated to be about 100 gallons; The airplane had two auxiliary fuel tanks each holding about 15 gallons and two 37-gallon main tanks that were nearly topped off, with about 4 gallons subtracted from right tank.

A pilot-rated witness reported that once fueling was completed, six people boarded the airplane, with the pilot occupying the left front seat and the pilot-rated passenger occupying the right front seat. The other four passengers occupied the second and third rows of seats. The witness stated that he did not see any luggage or cargo being loaded on board.

The witness also reported that the pilot had difficulty starting the airplane's engines and that the pilot attempted to start the engines for 10 to 15 minutes before the pilot-rated passenger yelled out the door, "Any ideas?" The witness assisted them with troubleshooting procedures that included turning on the boost pumps; the engines were successfully started, and the airplane departed. The witness stated that he noticed that the airplane appeared to "porpoise" down the runway during the takeoff roll. The airplane departed about 1005.

The pilot established contact with air traffic control (ATC) at 1013 and requested radar flight following services to EZF. The flight continued to EZF at an altitude of 7,500 ft mean sea level (msl). Between 1121 and 1136, ATC could not contact the pilot, but communications were reestablished as the flight crossed into the airspace of the North Central West Virginia Airport (CKB), Clarksburg, West Virginia. The flight was subsequently transferred to Washington ARTCC and Potomac Consolidated TRACON before finally being advised to contact approach controllers at Quantico Marine Corps Airfield,(NYG), Quantico, Virginia. Quantico approach advised the pilot that EZF was ahead at 12 o'clock and 4 miles and subsequently issued the pilot a radio frequency change to the common traffic advisory frequency there; the pilot advised he had the airport in sight, which was the last recorded communication with the flight.

An Appareo Stratus 2S ADS-B receiver was recovered from the wreckage and sent to the NTSB Recorders Laboratory in Washington, DC, for examination and download. The recovered data provided position, barometric altitude, and groundspeed, as well as three-axis attitude and acceleration. The timestamps associated with the data were provided in elapsed seconds since the beginning of the recording and are presented in this report as seconds elapsed since the airplane reached a point about 20 nautical miles from EZF.

The airplane approached EZF from the northwest and entered a left crosswind for runway 24 about 807 seconds into the recorded data. The airplane then entered a downwind leg at 827 seconds and began the final approach at 1,027 seconds. At the start of the final approach, about 3/4 nautical mile from the runway, the airplane had descended to an altitude of 614 feet msl and a groundspeed of 102 knots. As the airplane reached about 1/4 nautical mile from the runway, the airplane had reached 232 feet msl and a groundspeed of 95 knots. As the airplane crossed the runway threshold, it had descended to 122 feet msl (about 40 feet above the runway), with a groundspeed of 87 knots. About 500 feet down the runway, the airplane's groundspeed was 77 knots and the altitude was 103 feet msl (about 20 feet above the runway). At 1,097 seconds, the airplane crossed the midpoint of the 2,999-foot-long runway at a groundspeed of 64 knots. About 3 seconds later, as the airplane's speed decreased to 60 knots groundspeed, it pitched up then began a climbing left turn, while slowing to 54 knots groundspeed and a positive pitch of about 15.4°. About 30 seconds after beginning the climb, while on a heading of 198°, the pitch up and left roll increased rapidly immediately before impact.

Several witnesses observed the airplane on final approach to runway 24 at EZF. One witness stated that the airplane appeared "high" as it approached the runway and that it was traveling fast. Two other witnesses stated that airplane "landed long," bounced several times, and initiated a go-around. The witnesses reported that both engines seemed to be producing power.

The airport was equipped with a security camera that captured the departure half of runway 24. The security camera recorded the airplane as it entered the field of view when it was about 1,400 ft from the approach end of runway 24 and continued to record the airplane until it impacted terrain south of the airport. Review and computational study of the recorded video revealed that when the airplane came into view, it was slightly above the runway and moving at a speed of about 70 knots with the landing gear and flaps extended. The airplane then began to climb, and its speed started decreasing. When the airplane was at an altitude of about 50 ft above ground level, the speed decreased to about 58 knots before it abruptly pitched up and rolled to the left, then descended and impacted the ground.

Pilot Information

Certificate:	Private	**Age:**	73,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Unknown
Instrument Rating(s):	None	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	None None	**Last FAA Medical Exam:**	
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	January 7, 2016
Flight Time:	(Estimated) 233.1 hours (Total, all aircraft), 189.1 hours (Total, this make and model), 2.5 hours (Last 90 days, all aircraft), 0 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

Pilot-rated passenger Information

Certificate:	Commercial	**Age:**	64,Male
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	Unknown
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	May 11, 2016
Occupational Pilot:	UNK	**Last Flight Review or Equivalent:**	August 10, 2016
Flight Time:	(Estimated) 2273 hours (Total, all aircraft), 5.9 hours (Total, this make and model), 28.7 hours (Last 90 days, all aircraft), 16.8 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

According to Federal Aviation Administration (FAA) records, the pilot, age 73, held a private pilot certificate with ratings for airplane single-engine and multi-engine land. The pilot did not possess a current medical certificate at the time of the accident. (For more information about the pilot's medical status, see the Medical and Pathological Information section of this report.)
Review of the pilot's logbook revealed that he had accumulated 233.2 total hours of flight experience since April 30, 2001. His first recorded flight in the accident airplane was conducted on March 16, 2008, and he had logged a total of 189.1 hours in the airplane. According to the logbook, the pilot's flying was inconsistent with months of time between flights. In the previous 12 months and 90 days, he had logged 9.4 hours and 2.6 hours, respectively, all in the accident airplane. His most recent flight in the airplane was in June 2016.

The pilot-rated passenger, age 64, held a commercial pilot certificate with ratings for airplane multi-engine land, single-engine land, single-engine sea, and instrument airplane. His most recent FAA second-class medical certificate was issued on May 11, 2016, with the limitation that he must have available glasses for near vision.

A review of the pilot-rated passenger's logbook showed that he had accumulated 2,273 total hours of flight experience, of which 1,149.4 hours were in multi-engine airplanes. He had logged 5.9 hours in the accident airplane make and model (all in the accident airplane), and his last logged multi-engine flight was conducted in the accident airplane on October 22, 2015. Further review of his logbook showed that he had accumulated a total of 66.1 hours flight experience in multi-engine airplanes in the previous 10 years.

Aircraft and Owner/Operator Information

Aircraft Make:	Beech	**Registration:**	N128VB
Model/Series:	95 B55 (T42A) A	**Aircraft Category:**	Airplane
Year of Manufacture:	1969	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	TC-1211
Landing Gear Type:	Retractable - Tricycle	**Seats:**	6
Date/Type of Last Inspection:	May 15, 2016 Annual	**Certified Max Gross Wt.:**	5000 lbs
Time Since Last Inspection:	61 Hrs	**Engines:**	2 Reciprocating
Airframe Total Time:	4224.4 Hrs as of last inspection	**Engine Manufacturer:**	CONTINENTAL
ELT:	Installed, not activated	**Engine Model/Series:**	IO-470
Registered Owner:	ROSS & COMPANY PLLC	**Rated Power:**	260 Horsepower
Operator:	ROSS & COMPANY PLLC	**Operating Certificate(s) Held:**	None

The six-seat, twin-engine, low-wing, retractable-gear airplane was manufactured in 1969. It was equipped with 260-horsepower Continental IO-470-L engines and three-blade, controllable-pitch, Hartzell propellers.

According to the airplane's maintenance records, the most recent annual inspection was completed on May 15, 2016, at an airframe total time of 4,224.4 hours.

The airplane's maintenance records indicated that, on February 1, 2014, at 4,689.0 hours total time and 518 hours since major overhaul, the left engine was "disassembled, cleaned, inspected, repaired, and assembled." Also, at 2,301.4 hours total time and 620.8 hours since major overhaul, the right engine was "disassembled, repaired, and reassembled." On May 15, 2016, 61.9 hours after the February 1, 2014 engine work, both engines underwent their most-recent 100-hour inspection as part of the aircraft's annual inspection.

Weight and balance calculations were performed based on the airplane's empty weight and balance as determined on October 11, 1999. The weights of the two pilots were acquired from medical records, while the weights of the four passengers were estimated based on medical autopsy results. The estimated weight at takeoff was 4,979 pounds, which was below the airplane's maximum gross weight of 5,100

pounds, while the estimated weight at landing was 4,679 pounds. The estimated centers of gravity for takeoff and landing were 84.5 inches and 84.6 inches, respectively, which were within the limits of 81.0 to 86.0 inches.

The pilots operating handbook (POH) for the airplane in section IV, Normal Procedures lists the following airspeeds for safe operations; two-engine best angle of climb speed is 84 knots, the best rate of climb speed is 107 knots, the balked landing climb speed is 90 knots, and the stall speed with landing gear extended and flaps down is 73 knots. The stall speed with the flaps in the retracted position is 79 knots. A calculation of the airplane's expected landing distance assuming an approach at the prescribed airspeed of 86 knots at 50 feet above the ground, the weather conditions that prevailed at the time of the accident, and the airplane's estimated landing weight, indicate that the runway required to safely land and stop was 1,280 feet, with about 1,850 feet needed to clear a 50-foot obstacle.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	EZF,85 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	16:35 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:		**Visibility (RVR):**	
Wind Speed/Gusts:	10 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	200°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.95 inches Hg	**Temperature/Dew Point:**	34°C / 24°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Shelbyville, IN (GEZ)	**Type of Flight Plan Filed:**	None
Destination:	Fredericksburg, VA (EZF)	**Type of Clearance:**	VFR flight following
Departure Time:	10:15 Local	**Type of Airspace:**	Class G

At 1235, the reported weather at EZF was wind from 200° magnetic at 10 knots, wind direction variable from 190° to 250°, visibility 10 statute miles, sky clear, temperature 34°C, dew point 24°C, and altimeter setting of 29.96 inches of mercury.

Airport Information

Airport:	SHANNON EZF	**Runway Surface Type:**	Asphalt
Airport Elevation:	85 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	24	**IFR Approach:**	None
Runway Length/Width:	2999 ft / 100 ft	**VFR Approach/Landing:**	Traffic pattern

EZF was located about 2 miles south of Fredericksburg, Virginia. It was classified by the FAA

as a public airport. The airport elevation was 85 ft msl. Runway 24 was oriented 235 degrees magnetic and was 2,999 feet long by 100 feet wide. It was an asphalt runway in good condition and was equipped with a visual approach slope indicator.

Wreckage and Impact Information

Crew Injuries:	2 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	4 Fatal	**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	6 Fatal	**Latitude, Longitude:**	38.262779,-77.453056

The accident site was located about 700 ft south-southeast of the departure end of runway 24 on an embankment adjacent to a railway service road. All major components of the airplane were accounted for at the scene. Trees surrounding the accident site exhibited gouges, angular-cut branches, and paint transfers from the top of the tree canopy down toward ground level, and several pieces of angular-cut tree branches were discovered near each engine.

The airplane was found upright on the ground with the rear fuselage and empennage suspended from 5-ft-high bushes. The airplane's fuselage, including the nose, instrument panel, cockpit, and cabin, was consumed by a postimpact fire. Both wings were separated from their respective fuselage attach points. The left engine remained partially attached to the left wing and was found in an inverted position about 15 ft from the fuselage. The right engine was separated from the right wing, and the right propeller assembly was separated from the right engine. All right wing components were found within 20 ft of the fuselage.

The elevator and rudder flight control cables were attached to their respective rear fuselage bell cranks. The rear elevator bell crank upper arm was separated, and the separated arm was attached to the up-elevator flight control cable. The elevator and rudder flight control cables were traced forward toward to the cockpit. The right aileron bell crank and right aileron cable were not identified due to thermal and impact damage, and the left aileron cable and the aileron balance cable remained attached to the left aileron bell crank. The left aileron cable was not observed at the point where it entered the cabin area. The cockpit aileron cable and chain assembly and the aileron sprocket were not observed. The flight controls were consumed by fire, but the dual yoke system remained connected to the two independent control chains that went from the center control arm wheel to their respective left and right seat positions.

Visual examination of the left and right flaps indicated that the flaps were in the up/retracted position. The flap handle in the cockpit was destroyed. The left flap actuator had thermal and impact damage, and the flap setting could not be determined. The right flap actuator remained intact and indicated that the flap was in the up/retracted position.

The cockpit trim controls and indicators were destroyed. Visually, the tab trailing edges were in neutral positions. The two fuel selector valve assemblies were partially consumed by the postimpact fire; the fuel valve rotors were positioned to the left and right main wing tanks, respectively.

The landing gear actuator housing was consumed by the postimpact fire. The three landing gear assemblies remained attached to the airplane structure and were found in the retracted positions.

The magneto switches in the cockpit were exposed to impact and thermal damage. The left magneto switch appeared to be positioned on the left magneto, and the right magneto switch appeared to be positioned on both.

Left Engine

The left engine came to rest inverted on the side of the embankment. The engine sustained thermal damage to the aft and bottom sides. The engine contained clean oil, and the observed engine components appeared to be well lubricated. A continuity check resulted in crankshaft and camshaft continuity throughout the drive and valve trains with thumb compression observed on all six cylinders. The spark plugs remained secured to their respective cylinders. The top spark plugs were removed and examined. They all appeared to have minimal wear when compared to the Champion Check-A-Plug chart and did not display any evidence of carbon or lead fouling that would preclude normal operation. No pre-accident anomalies were noted with the engine.

The throttle body remained attached to the aft section of the engine, and the fuel metering unit remained attached to the throttle body. The induction air box remained attached to the throttle body. The throttle and mixture cables remained attached to their respective control levers. Removal of the induction air box revealed that the throttle valve was intact on the shaft, and burnt debris was noted on the throttle plate. The fuel lines to and from the metering unit remained attached to their respective fittings, but the fuel lines were thermally damaged.

The fuel manifold valve remained attached to the topside of the engine, and all fuel lines remained attached to their respective fittings. The fuel injector lines remained attached to their respective nozzles with no pre-accident anomalies noted.

The oil sump was intact, and the quick drain plug was not damaged. The accessory gears appeared to be lubricated and coated with oil. The oil pump remained secured to the aft section of the engine, and no pre-accident anomalies were noted.

The left and right magnetos were secured, and manual manipulation of the magnetos did not result in any slipping/rotation on the pads. The ignition harness remained attached to the magnetos. The housing vent plugs were removed, and the distributor gear teeth were visible with no anomalies noted.

All six cylinders remained secured to the crankcase, and torque putty was present and aligned on the cylinder base nuts. The rocker covers were soot covered but not damaged. External visual and borescope examination revealed no external or internal evidence of operational anomalies with any of the cylinders. No pre-accident anomalies were noted with the pistons, barrels, valves, or valve seats.

The propeller governor remained secured to the front, left side of the crankcase. The propeller control cable remained attached to the lever. The unit was soot covered, and no external anomalies were noted.

The left engine was examined at the manufacturer's facility on September 7 and 8, 2016. Before the left engine was test run at the manufacturer's facility, the left engine-driven fuel pump was examined. Thermal and impact-related damage precluded functional testing of the fuel pump. Manual rotation of the drive gear with the drive coupling installed in the drive shaft resulted in the rotation of the pump. The pump was disassembled with no pre-accident anomalies noted with the internal components. In addition, the left engine fuel metering unit was disassembled. Thermal and impact-related damage precluded functional testing of the unit. The throttle lever and shaft rotated within the housing. The inlet fuel screen was removed, and no obstructions were discovered. The throttle cam was removed from the metering unit, and no pre-accident anomalies were noted. Its o-ring was charred and crumbled when handled but remained inside the setting. The mixture shaft and cam rotated, and the cam and metering plug were removed from the housing. There were no pre-accident anomalies noted with any of the components.
The engine was run in a test cell through various power settings at timed intervals from low to maximum rpm of 2,600. There were no hesitations or stumbling noted. The engine throttle was rapidly moved from idle to full throttle five times with no hesitation noted. The engine rpm dropped during the magneto check and was outside normal operating parameters with the left magneto selected; this was later determined to be a result of a damaged No. 1 bottom spark plug. The damage to the spark plug was due to foreign object debris that had been introduced into the cylinder sometime during engine transport or pre-engine run component/exhaust replacement.. The No. 1cylinder bottom spark plug was replaced, and the engine ran through various power settings with no anomalies noted. No pre-accident anomalies were noted during the examination and test run that would have precluded normal engine operation.

The left propeller remained attached to the engine crankshaft, and the three propeller blades were rotated toward a feathered pitch setting. All three blades displayed bending at the tips in a counter-clockwise direction when viewed from aft of the engine looking forward. The tips of all three blades displayed chordwise gouges and scrapes as well as chordwise paint erosion and leading-edge gouges. Internal examination of the left propeller revealed that there was residual oil in the hub cavity indicating that the propeller was not in a feathered state at the time of impact. The pitch change rod was fractured in tension and bending, and the preload plates had impact marks indicating blade angles between 26° and 24° at the time of impact. According to the propeller manufacturer representative, these blade angles are in the normal range of operation.

Right Engine

The right engine came to rest in a ditch and sustained significant thermal damage on its left and aft sides. A continuity check resulted in crankshaft and camshaft continuity throughout the drive and valve trains with thumb compression observed on four of the six cylinders. No pre-accident anomalies were noted with the engine. The engine remained attached to the engine nacelle via the fuel lines, electrical wires/cables, and engine control cables, but the nacelle was separated from the wing. The propeller was separated from the crankshaft aft of the propeller flange. All three propeller blades remained attached to the propeller hub with two of the blades twisted toward low pitch. The two twisted blades also displayed chordwise scrapes and paint erosion, and the blade that showed the most blade twisting displayed

leading edge gouges.

The No. 2 and No. 4 cylinder rocker covers were partially melted away. The No. 6 rocker cover displayed thermal damage. The left side ignition harness was thermally damaged. The alternator was displaced as was the oil cooler. The induction air box, left side intake system, and a portion of the throttle body were partially melted away. The magnetos remained in place and were secured on the topside of the engine. The ignition harness remained attached to the magnetos, and the terminals remained attached to their respective spark plugs.

The fuel metering unit was separated from the throttle body. The fuel inlet fitting on the engine-driven fuel pump was fractured at the housing. The throttle lever interconnect linkage was bent and fractured. The fuel lines to and from the fuel metering unit and the fuel manifold valve remained in place with no pre-accident anomalies noted.

The crankcase was intact, and the cylinders remained attached with torque putty in place on the securing hardware. The exhaust system remained intact with the left side sustaining some deformation damage. The entire exhaust system was covered in black soot from the post-crash fire. The aft exhaust stacks were cut to facilitate removal from the nacelle. Portions of the induction air box, the throttle body, and the left side intake manifold and risers were burned away.

The left and right magnetos were secured, and manual manipulation of the magnetos did not result in any slipping/rotation on the pads. The ignition harness remained attached to the magnetos. The housing vent plugs were removed, and the distributor gear teeth were visible with no anomalies noted.

The ignition harness remained attached to the magnetos, and the leads remained secured by their terminal ends to their respective spark plugs. The left and right side ignition leads were thermally damaged.

The spark plugs remained secured to their respective cylinders. The top spark plugs were removed and examined. They all appeared to have little wear and did not display evidence of carbon or lead fouling in accordance with the Champion Check-A-Plug chart. The Nos. 2, 4, and 6 cylinders sustained heavy thermal damage, but no preimpact anomalies were discovered that would have would have precluded normal operation.

The fuel pump remained attached to the aft section of the engine, and all the fuel lines and fittings were in place, except for the fuel inlet fitting, which was fractured. All the fuel lines sustained significant thermal damage. The fuel pump was removed from the engine, and the drive coupling was intact.

The throttle body remained attached to the aft section of the engine, but the mount was damaged. The lower portion of the throttle body was destroyed. The metering unit was separated from the throttle body. The throttle and mixture control cables remained attached to the throttle and mixture levers, but the interconnect rod between the throttle body and the fuel metering unit was fractured. Examination of the induction air box revealed that the throttle valve was intact on the shaft, and burnt debris was noted on the throttle plate. The fuel lines to and from the metering unit remained attached to their respective fittings, and the fuel lines were thermally damaged.

The fuel manifold valve remained attached to the topside of the engine, and all fuel lines remained attached to their respective fittings. The fuel manifold cap was removed, and the screen was intact with no contamination or blockage noted. The diaphragm remained intact. No pre-accident anomalies were noted with the unit, and the odor of aviation gasoline was observed upon cap removal. The fuel injector lines remained secured to their respective nozzles, and the nozzles remained secured to their respective cylinders. Removal of the nozzles revealed no blockages or pre-accident anomalies.

The oil sump remained attached to the bottom side of the engine and sustained some deformation damage and a puncture from the outside in. The quick drain plug remained attached and was not depressed. The oil pump remained secured to the aft section of the engine, and no pre-accident anomalies were noted with the housing.

The oil cooler remained attached to the mounting plate on the front right side of the engine with no pre-accident anomalies noted externally. The mounting plate was slightly displaced from the engine crankcase.

The cylinders remained secured to the crankcase, and torque putty was present and aligned on the cylinder base nuts. The rocker covers were soot covered, but not damaged. There were no external signs of operational distress with the cylinders. With the top spark plugs removed, a lighted borescope was used to examine the internal components. No pre-accident anomalies were noted with the pistons, barrels, valves, or valve seats.

The propeller governor remained secured to the front left side of the crankcase. The propeller control cable remained attached to the lever. The unit was soot covered, and no external anomalies were noted.

Internal examination of the right propeller revealed that the pitch change knobs were bent opposite low pitch. The low pitch stop showed an impact impression from the forward pitch change rod screw consistent with the blades having been forcibly rotated towards low pitch. The preload plates had impact marks consistent with a propeller that was at or near the low pitch stop setting at the time of impact.

Medical and Pathological Information

The Office of the Chief Medical Examiner, Richmond, Virginia, performed an autopsy of the pilot. The cause of death for the pilot was thermal injuries and blunt force trauma. According to the autopsy report, his heart was enlarged at 582 grams with wall thickening of the left ventricle, which measured 1.6 centimeters (cm). The septum was 1.2 cm thick, and the right ventricle was 0.3 cm thick. Atherosclerosis of the coronary arteries was described as "moderate to severe." In addition, the kidneys showed evidence of chronic hypertension.

The FAA's Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma, performed forensic toxicology testing of specimens from the pilot.

The pilot's toxicology testing found amlodipine, benazepril, salicylate, ibuprofen, triamterene, and zolpidem in urine and amlodipine and zolpidem (0.021 ug/ml) in blood. Of these drugs, only zolpidem,

which is a prescription sleep aid, is considered impairing. (Amlodipine, benzepril, and triamterene are used to treat hypertension. In addition, testing identified 313 µg/ml of glucose in the urine but none in the vitreous. The pilot's hemoglobin A1C at the time of the accident was 10.6% indicating poor glucose control. He had begun reporting diabetes to the FAA in 2005 and had received special issuance medical certificates for several years after this. At his 2015 examination, he reported using several drugs for diabetes control and had a hemoglobin A1C of 10.1%. His medical certificate was revoked on June 18, 2015, for the use of disqualifying medications and failure to provide additional information. On his 2016 re-application, the pilot reported the use of amlodipine, benazepril, triamterene, and hydrochlorothiazide to treat hypertension, fenofibrate and colesevelam to treat high cholesterol, and canagliflozin and exenatide to treat diabetes. In addition, he reported using esomeprazole, liposome, vitamin D, and low dose aspirin. In June 2016, the FAA was informed that the pilot was no longer using canagliflozin, but other questions asked by the FAA remained unanswered by the time of the accident, thus, the pilot did not have a valid medical certificate at the time of the accident.

The Office of the Chief Medical Examiner, Richmond, Virginia, performed an autopsy of the pilot-rated passenger. The cause of death for the pilot-rated passenger was thermal and inhalation injuries. According to the autopsy report, severe coronary artery disease was identified with 80% stenosis of the left anterior descending artery, right coronary artery, and left circumflex artery. There was no evidence of a previous heart attack. There was thickening of the ventricular wall without overall enlargement of the heart. The left ventricle was 1.5 cm thick, the interventricular septum was 1.4 cm thick, and the right ventricle was 0.4 cm thick.

Forensic toxicology testing of specimens from the pilot-rated passenger performed by the FAA's Bioaeronautical Sciences Research Laboratory found diphenhydramine in urine and heart blood at levels too low to quantify. He had reported no chronic medical conditions or the use of any medications to the FAA.

Administrative Information

Investigator In Charge (IIC):	Mccarter, Lawrence
Additional Participating Persons:	Michael Sapanara ; FAA FSDO; Richmond, VA David Gerlach; FAA AVP; Washington, DC Paul Yoos; Textron; Wichita, KS Nicole Charnon; Continental; Mobile, AL
Original Publish Date:	October 1, 2018
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=93816