Aviation Investigation Final Report

Location:	Jacksonville, Alabama	**Accident Number:**	ERA18FA146
Date & Time:	May 12, 2018, 20:05 Local	**Registration:**	N486T
Aircraft:	Beech 35A33	**Aircraft Damage:**	Destroyed
Defining Event:	Fire/smoke (non-impact)	**Injuries:**	1 Fatal, 1 Serious
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The airline transport pilot and his daughter were on the return leg of a cross-country flight in night, visual meteorological conditions. While in cruise flight, the pilot saw smoke in the cockpit, so he began turning off electrical components. The engine then sputtered and lost total power. He set up for a forced landing, felt heat from the engine compartment, and then saw flames coming from the same area. He discharged a portable fire extinguisher. At the first indication of heat, his daughter left the right cockpit seat and climbed into the aft cabin; the pilot did not believe she fastened her lap belt. While crossing a ridge, the airplane collided with trees and came to rest on the side of a hill in a forested area. The pilot egressed the airplane and noted that his daughter was no longer in the airplane. He subsequently found her; she had been thrown clear of the wreckage and was seriously injured. First responders arrived soon thereafter, and she later died from her injuries.

Most of the airplane's fuselage, empennage, and right wing was consumed by postcrash fire. The left wing separated during the impact sequence and was not burned. The engine, propeller, nose landing gear, and cowling separated during the impact sequence and were found outside the postcrash fire zone. Evidence of an in-flight fire was observed at the aft section of the engine, with the heaviest fire damage near fuel lines adjacent to the left muffler and heat exchanger. An examination of the muffler and heat exchanger revealed multiple preexisting cracks that could have allowed hot exhaust gasses to escape from the assembly onto the adjacent fuel lines. Damage to those fuel lines prevented determining a definitive origin for the ignition of the inflight fire, though the damage to those fuel lines was consistent with the fire being fuel-fed in nature. The largest crack of the muffler was located at the left side and extended 3.35 inches around the circumference through the muffler wall and coincided with a crack through the heat exchanger end flange that extended 4.25 inches around the circumference. Oxidation and exhaust deposits observed on the crack surfaces indicated the cracks developed and existed for some time before the accident.

The pilot, who owned the airplane, was a certificated airframe and powerplant mechanic with inspection authorization. He performed the airplane's most recent annual and 100-hour inspections about 4 months

before the accident. The airplane maintenance manual recommended that, during 100-hour inspections, the exhaust system should be checked for, in part, deformation and cracks and for thin wall condition, which may occur due to normal internal erosion on stacks that have long service time. About 2 months before the accident, the pilot replaced the left exhaust stack; however, he did not replace the associated muffler and heat exchanger.

The cracking observed on the muffler and heat exchanger displayed signatures consistent with them having developed over time, so the pilot should have been able to detect them by thoroughly inspecting the exhaust system, including the left muffler and heat exchanger, during the most recent 100-hour inspection as recommended, or when he removed and replaced the exhaust stack. Due to his inadequate inspection of the exhaust system, he failed to note the cracks and corrosion and missed an opportunity to replace the muffler and heat exchanger. This allowed the cracks to develop to failure, leading to hot gasses escaping on to the adjacent fuel lines, and ultimately resulting in the subsequent in-flight fire.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot/mechanic's inadequate inspection of the exhaust system, including the left muffler and heat exchanger, which precluded his detection of preexisting cracks and led to a missed opportunity to replace the components. The inadequate inspection allowed the cracks to develop to failure, leading to exhaust gasses escaping onto adjacent fuel lines, resulting in the subsequent fuel-fed in-flight fire.

Findings

Aircraft	Noise suppressor - Inadequate inspection
Aircraft	(general) - Inadequate inspection
Aircraft	(general) - Fatigue/wear/corrosion
Personnel issues	Scheduled/routine inspection - Pilot
Personnel issues	Scheduled/routine inspection - Maintenance personnel
Personnel issues	Forgotten action/omission - Passenger

Factual Information

History of Flight

Prior to flight	Aircraft maintenance event
Enroute-cruise	Fire/smoke (non-impact) (Defining event)
Enroute-cruise	Loss of engine power (partial)
Emergency descent	Off-field or emergency landing
Emergency descent	Collision with terr/obj (non-CFIT)

On May 12, 2018, about 2005 central daylight time, a Beech 35-A33 airplane, N486T, collided with trees and terrain during a forced landing near Jacksonville, Alabama. The airline transport pilot was seriously injured, and the passenger was fatally injured. The airplane was destroyed. The airplane was registered to the pilot who was operating it as a Title 14 *Code of Federal Regulations* Part 91 personal flight. Night, visual meteorological conditions prevailed near the accident site, and no flight plan was filed. The flight originated from Hartselle-Morgan County Regional Airport (5M0), Hartselle, Alabama, about 1924, and was destined for Falcon Field (FFC), Peachtree City, Georgia.

The pilot reported that he was familiar with the route from 5M0 to FFC and had previously flown it numerous times. He added that visual meteorological conditions prevailed and that he planned the route at 5,500 ft mean sea level. All ground operations and the departure from 5M0 were uneventful.

The pilot stated that his first indication of a problem was the smell of smoke. He was not immediately sure that it was coming from the airplane; he thought that it could have been coming from outside. However, he continued to smell the smoke and started turning off electrical equipment to determine the source. The flight kept progressing as the pilot analyzed the situation. He stated that the engine suddenly "sputtered and quit" just after the airplane crossed over the boundary of the Talladega National Forest, so he reversed course because it "appeared darker there." He then turned the fuel boost pump on and established the airplane's best glide airspeed. He believed at this point that the engine may have recovered some power and noted that the propeller was windmilling. He stated that he maneuvered the airplane toward a pasture and that, although it was night he could still see the ground.

The pilot stated that, after setting up the glide to a general area, he felt "heat." The passenger, who was his daughter, then climbed into the rear cabin. He did not believe that she fastened her lap belt after going to the aft seat. He saw flames coming from the engine compartment and discharged a fire extinguisher. The smoke continued and got heavy, so he opened the side window to clear the smoke so that he could see. The flames persisted. While crossing a ridge, the airplane struck trees, spun around, and then crashed. He was still inside the airplane, but his daughter was not. The wreckage was on fire. He egressed the cockpit and ran clear of the wreckage. He found his daughter, and she was injured. Shortly thereafter, first responders arrived. The fire eventually subsided and burned itself out.

A witness, who was outside of his home, stated that, about 2002 on the night of the accident, he saw what he thought was a single-engine airplane fly overhead traveling westbound. He added that the

engine was "misfiring" and that he saw a "ball of light" and that the ball of light then "got bigger." Although he did not see any smoke coming from the airplane, it was getting dark at the time. He did not observe the crash.

Pilot Information

Certificate:	Airline transport; Flight instructor	**Age:**	52,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Lap only
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine	**Toxicology Performed:**	No
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	July 5, 2017
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	May 23, 2017
Flight Time:	3360 hours (Total, all aircraft), 65 hours (Total, this make and model), 3360 hours (Pilot In Command, all aircraft), 24 hours (Last 90 days, all aircraft), 5 hours (Last 30 days, all aircraft)		

The pilot held an airline transport pilot certificate with airplane single- and multiengine land ratings. He also held flight and ground instructor certificates. He reported 3,360 hours total flight experience, including 65 hours in Beech 35 airplanes. He was also an airframe and powerplant mechanic with inspection authorization and performed the maintenance on the airplane, including the annual inspections, preventive maintenance, and repairs.

Aircraft and Owner/Operator Information

Aircraft Make:	Beech	**Registration:**	N486T
Model/Series:	35A33 NO SERIES	**Aircraft Category:**	Airplane
Year of Manufacture:	1961	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	CD-311
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	January 15, 2018 Annual	**Certified Max Gross Wt.:**	3000 lbs
Time Since Last Inspection:	12 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	5326 Hrs as of last inspection	**Engine Manufacturer:**	Continental
ELT:	C91 installed	**Engine Model/Series:**	IO-470-K
Registered Owner:		**Rated Power:**	225 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

The low-wing, single-engine, four-seat, retractable tricycle landing gear-equipped airplane was manufactured in 1961. It was powered by a Continental IO-470-K, 225-horsepower reciprocating engine equipped with a Hartzell constant-speed propeller. The pilot purchased the airplane in October 2015.

The pilot completed annual and 100-hr inspections of the airframe and engine on January 15, 2018, at 5,326.5 hours total aircraft time. A review of the airplane's maintenance log entries revealed no entries referencing any exhaust system components or indicating that any were replaced at this time. On March 20, 2018, at 5,329.3 hours total aircraft time, the pilot removed and replaced the left exhaust stack. He did not replace the left heat exchanger.

The Beech 35-A33 Maintenance Manual, under "Periodic Inspections," included the following step to be accomplished during 100-hr inspections:

24 – EXHAUST SYSTEM – Check for deformation, security, cracks, leaks, loose or missing nuts and clamps. Check for thin wall condition which may occur due to normal internal erosion on stacks which have long service time.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	ANB,612 ft msl	**Distance from Accident Site:**	14 Nautical Miles
Observation Time:	19:53 Local	**Direction from Accident Site:**	207°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/ N/A
Altimeter Setting:	30.09 inches Hg	**Temperature/Dew Point:**	23°C / 17°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Hartselle, AL (5M0)	**Type of Flight Plan Filed:**	None
Destination:	Peachtree City, GA (FFC)	**Type of Clearance:**	VFR flight following
Departure Time:	19:24 Local	**Type of Airspace:**	Class G

Anniston Regional Airport (ANB), Anniston, Alabama, located about 14 miles southwest of the accident site, reported, at 1953, wind calm, visibility 10 statute miles, sky clear, temperature 23°C, dew point 17°C, and altimeter setting 30.09 inches of mercury.

Official sunset at ANB occurred at 1934, about 31 minutes before the accident, and the end of civil twilight occurred at 2002. Moonset was at 1642. The moon was in a waning crescent phase with 10% of it illuminated.

Wreckage and Impact Information

Crew Injuries:	1 Serious	**Aircraft Damage:**	Destroyed
Passenger Injuries:	1 Fatal	**Aircraft Fire:**	Both in-flight and on-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal, 1 Serious	**Latitude, Longitude:**	33.798053,-85.72528(est)

The airplane crashed on the side of a hill in a forested area, about 2 miles southeast of the Jacksonville town center. The wreckage path was oriented on a westerly heading and was about 150 ft long. All the airplane components were accounted for at the accident site. The main wreckage consisted of the fuselage, empennage, and right wing. Most of the main wreckage, from the engine firewall aft, was consumed by postcrash fire. The left wing, which had separated during the impact sequence, was the first major airplane component found along the wreckage path about 65 ft east of the fuselage; it was not burned or soot-covered. All three landing gear were found in the retracted positions. The wing flaps were found retracted.

Flight control continuity was confirmed from all flight control surfaces to the cockpit controls. No residual fuel was found in the area of the wing fuel tanks. The fuel selector and fuel strainer were not located.

The engine, propeller, nose landing gear (NLG), and engine cowling separated during the impact sequence. The engine was found resting inverted against a tree about 15 ft from the main wreckage and postcrash fire site. The engine displayed black soot and heat damage on the aft accessory section. Several fuel lines were burned. The upper cowling, which was clear of the postcrash fire zone, displayed soot aft of the engine baffling, and there was brown discoloration and burned and blistered paint on the interior and exterior surfaces of the cowling. The NLG tire was burned on the surface closest to the engine.

An initial exterior examination of the engine revealed that the crankcase remained intact and displayed minor impact damage and significant thermal damage to the aft portion of the crankcase. The propeller flange remained attached to the rest of the crankshaft, and no visible cracks were noted in the crankshaft. All six cylinders displayed minor impact damage, and the Nos. 1 and 2 cylinders displayed minor soot discoloration at their aft sections. The exhaust system remained attached to the engine and displayed impact damage. The left exhaust muffler and heat exchanger assembly displayed several cracks in multiple locations.

The left and right magnetos remained attached at their installation points and displayed minor impact damage, and no thermal damage was noted. During manual crankshaft rotation, the impulse couplings operated normally. Both magnetos created a spark to each ignition lead in the correct order.

The ignition leads remained attached to the magnetos and spark plugs. Several of the ignition leads displayed impact damage, were partially severed, and exhibited no signs of thermal damage. No anomalies were noted with the ignition harness.

All the spark plugs remained in their cylinders. The top spark plugs were removed, and the electrodes displayed normal operating and wear signatures when compared to a Champion Check-A-Plug chart. The bottom spark plugs were inspected using a lighted borescope. The No. 1 spark plug was oil-soaked; the other electrodes displayed normal operating and wear signatures.

The engine-driven fuel pump remained attached at its installation point and displayed thermal damage. The fuel inlet fitting was found loose and was about 90° of turn from tight; the vapor return, fuel pump outlet, and mixture return fittings were all tight. The vapor return fuel line displayed thermal damage, and the hose was destroyed. The fuel pump inlet fuel line displayed thermal damage, and most of the fuel line was destroyed by fire. The fuel pump outlet and mixture return fuel lines displayed thermal damage near the fittings at the fuel pump. The heaviest areas of heat and fire damage to the fuel lines were adjacent to the left muffler and heat exchanger.

The engine-driven fuel pump was removed, and the pump drive was intact and capable of rotation. After removal, 100LL aviation fuel was poured into the fuel pump inlet with the inlet fitting set at the position as found at the recovery facility. Fuel leaked from the fitting as well as multiple locations along the thermally damaged fuel line. After fuel was poured into the pump, the pump drive was rotated by hand, and it was capable of pumping the residual fuel.

The throttle and metering assembly remained attached at its installation point and displayed impact damage; no thermal damage was noted. All the fuel lines were found secured. The fuel inlet screen was removed, and it was clear of any contaminants or obstructions. The fuel manifold valve remained attached at its installation point and displayed minor impact damage; no thermal damage was noted. All the fuel lines were found secured. The manifold valve was disassembled, and the internal components exhibited normal operating signatures. All fuel nozzles were installed in their respective cylinders and were undamaged. All the fuel lines supplying the fuel nozzles were found secured.

All the cylinders were inspected using a lighted borescope. The piston faces, cylinder bores, and valve heads displayed normal operating and combustion signatures. The overhead components (valve, springs, and rocker arms) displayed normal operating and lubrication signatures. During manual crankshaft rotation, all the cylinders displayed compression and suction using the "thumb" method. Continuity was established between the crankshaft, camshaft, connecting rods, and associated components.

The crankcase remained intact and displayed minor impact damage. The aft portion of the engine displayed thermal discoloration and soot. No signs of oil leaks were found around the crankcase. The oil screen remained installed and was secure. The screen was removed, and no metallic material was present.

The two-blade, constant-speed propeller remained attached to the crankshaft and displayed impact damage. Both propeller blades remained within the propeller hub. One of the propeller blades displayed minor twisting deformation at the propeller blade tip, and a portion of the tip was sheared from the rest of the blade. The other propeller blade displayed minor damage, and no bending or twisting deformation was noted.

Metallurgical examination of the muffler and heat exchanger revealed cracks in multiple locations in the left muffler and heat exchanger, including (1) at the forward left side of the assembly where the muffler end face was displaced forward at the outer circumference, exposing a crack opening from the interior to the exterior of the muffler and heat exchanger,(2) in the mufflers forward and aft end faces, adjacent to welds for internal baffles attached to the end face next to the exhaust stack attachment, and (3) through the aft heat exchanger end flange. Fracture features were generally covered with oxides and exhaust deposits across the thickness of the fracture. Near the ends of the muffler wall crack, light gray fracture features were observed, consistent with a relatively recent overstress fracture. The through-thickness oxidized portion of the crack in the muffler wall was 3.35 inches long circumferentially, and the wall crack was co-located with a 4.5-inch long oxidized crack through the heat exchanger end flange.

In a mounted and polished metallurgical section through the muffler wall crack location, the muffler wall aft of the fracture showed significant thickness variations associated with oxidation, and in one area aft of the crack, the wall was corroded nearly through the thickness in the plane of polish. The muffler wall showed branching intergranular cracks through the thickness at the fracture surface and through much of the thickness in areas forward of the fracture. Branching intergranular cracks were also observed on, and adjacent to, the fracture through the heat exchanger forward end flange.

The muffler had four cracks through the end faces, and each crack was approximately 0.8 inch to 0.9 inch long. Three of the cracks were through the aft end face, and one crack was through the forward end

face. Some cracks were displaced open, and the fracture features on the opened cracks had fracture features that appeared to be covered with oxidation and exhaust deposits.

Two cracks were present at the aft end of the heat exchanger. A crack through the aft end flange at the upper side of the assembly was 4.25 inches long and was not associated with deformation to the aft end flange. A second crack in a deformed portion of the aft end flange had oxidized features through the thickness along a length of 2.25 inches.

For additional information regarding the examination of the muffler and heat exchanger, see the NTSB Materials Laboratory Factual Report, located in the public docket for this investigation.

Administrative Information

Investigator In Charge (IIC):	Hicks, Ralph
Additional Participating Persons:	Dale White; FAA/FSDO; Birmingham, AL Henry Soderlund; Textron Aircraft; Wichita, KS Kurt Gibson; Continental Motors; Mobile, AL
Original Publish Date:	April 8, 2019
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=97240