Aviation Investigation Final Report

Location:	Hope Mills, North Carolina	**Accident Number:**	ERA19FA201
Date & Time:	June 26, 2019, 22:33 Local	**Registration:**	N664AR
Aircraft:	Beech E55	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of control in flight	**Injuries:**	2 Fatal, 1 Serious
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

Three days before the accident flight, the accident pilot flew two friends/pilots on a cross-country flight in the accident airplane. According to one of the friends, during the first leg of that trip, the attitude and heading reference system (AHRS) fail amber caution light illuminated in the cockpit at engine startup and remained illuminated for 12 to 15 minutes, which included the initial portion of the flight. They discussed continuing the flight under visual flight rules because the autopilot would not engage with the caution light illuminated and would not remain engaged if the caution light illuminated. During the time the caution light was illuminated, no anomalies were observed with the electronic flight information system (EFIS) display. The caution light extinguished, and the accident pilot engaged the autopilot for the remainder of the flight leg. During the return flight, the light remained extinguished and the accident pilot used the autopilot; however, after landing, he turned off the avionics and then back on, and the light illuminated for 3 minutes before he shut down the airplane. He planned to take the airplane to an avionics maintenance facility and also commented that he planned to perform three night landings to maintain his night currency.

On the evening of the accident flight, the accident pilot visited the maintenance facility and was informed that the repair related to the AHRS fail light illumination had not been completed because the facility needed to contact the EFIS manufacturer for more information. The accident pilot elected to fly the airplane without the repair having been completed.

The accident flight was cleared for takeoff, and about 2 minutes later, the pilot reported a problem to air traffic control but did not specify what the problem was; he stated that he wanted to turn around and land. but the pilot noted that there was an “awful lot of control wheel weight.” The flight was cleared to land, and the pilot subsequently stated, "it's really wanting to pitch down bad for some reason." A witness, who was walking his dog at the time, reported seeing the airplane veer sharply, followed by a steep descent about a 45° angle, just prior to impact. The airplane subsequently impacted a residence and terrain about 2 miles southwest of the approach end of the runway.

Examination of the engines did not reveal any preimpact mechanical malfunctions and flight control continuity was confirmed. Examination of the autopilot programming unit and engine monitor revealed that they did not contain any nonvolatile memory. The investigation could not determine if the pilot was troubleshooting or attempting to use the autopilot during the accident flight.

Postaccident testing of the clutch tension of the pitch servo revealed the breakaway force needed was 45 lbs. However, the specified required clutch tension breakaway force setting was 13 +/- 2 lbs. This setting was achieved by tightening the castle nut enough to reach the required force. After that, an orange torque seal strip was applied and a cotter pin was installed. Further examination revealed that the cotter pin used to secure the castle nut retaining the clutch appeared to be new, and the castle nut did not align with the factory orange torque strip setting applied at the time of servo completion and final testing. The orange torque strip on the nut and the orange torque strip on the tension washer were about 3/4 of a turn off. At some point during previous maintenance, the castle nut securing the clutch on the servo was overtightened, which caused the breakaway force needed to be 30 lbs over the specified limit. The overtightened clutch would have greatly increased the force required to override the clutch of the pitch servo.

The pilot operating handbook for the airplane make/model indicated that an uncommanded pitch could be stopped by: turning off the autopilot master switch; pull the autopilot and trim circuit breakers; turn off the radio master switch; turn off the electrical master switch; push the GA switch on the throttle grip; or push TEST EACH FLT switch on autopilot controller..

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The pilot's failure to disengage an uncommanded nose-down pitch input. Contributing to the accident was improper maintenance of the pitch trim servo, which would have precluded a physical override of the pitch servo.

Findings

Personnel issues	Lack of action - Pilot
Aircraft	(general) - Not specified
Personnel issues	Repair - Maintenance personnel
Aircraft	Autopilot trim servo - Incorrect service/maintenance

Factual Information

History of Flight

Approach-VFR pattern base	Sys/Comp malf/fail (non-power)
Approach-VFR pattern base	Loss of control in flight (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On June 27, 2019, about 2233 eastern daylight time, a Beech E-55, N664AR, was destroyed when it impacted a residence and terrain in Hope Mills, North Carolina, during approach to Fayetteville Regional Airport (FAY), Fayetteville, North Carolina. The private pilot and one person in the residence were fatally injured, and a second person in the residence was seriously injured. The personal flight was conducted under the provisions of Title 14 Code of Federal Regulations Part 91. Night visual meteorological conditions prevailed, and no flight plan was filed for the local flight that departed FAY about 2229.

According to radio communication information provided by the Federal Aviation Administration (FAA), the flight was cleared for takeoff from runway 4 at FAY at 2227:36. At 2229:27, the pilot reported a problem to air traffic control but did not specify what the problem was; he stated that he wanted to turn around and land. The controller offered the pilot either runway 28 or runway 4. The pilot stated that he thought runway 4 was “alright” but that there was an “awful lot of control wheel weight." At 2229:44, the flight was cleared to land on runway 4. At 2230:52, the pilot stated, "it's really wanting to pitch down bad for some reason." No further communications were received from the pilot. At 2232:02, the controller asked the pilot if he would be able to make the turn (onto final approach) and, at 2233:18, he initiated emergency procedures. The wreckage was subsequently located about 2 miles southwest of the approach end of runway 4. A witness, who was walking his dog at the time, reported seeing the airplane veer sharply, followed by a steep descent about a 45° angle, just prior to impact.

The pilot's brother was not a certificated pilot but flew often with the pilot. According to the pilot's brother, his most recent flight with the pilot was on June 21, 2019. They flew uneventfully from FAY to Claxton-Evans County Airport (CWV), Claxton, Georgia and returned. While at CWV, they completely fueled the airplane. During the roundtrip flights, the pilot utilized the autopilot often and there were no anomalies. Additionally, the pilot did not report any anomalies or warnings during those flights.

A friend of the accident pilot, who was also a pilot, stated in a postaccident interview that he flew with the pilot 3 days before the accident from FAY to Smith Reynolds Airport (INT), Winston-Salem, North Carolina, in the accident airplane. The friend stated that the airplane had departed FAY with 120 gallons of fuel; he estimated that about 60 gallons would have remained for the accident flight. During engine startup at FAY for the flight to INT, the attitude and heading reference system (AHRS) fail amber caution light illuminated in the cockpit. The pilot remarked during engine runup that the light

usually extinguished then. They departed FAY and discussed continuing the flight under visual flight rules because the autopilot would not engage. The friend added that during the time the caution light was illuminated, he did not observe any anomalies with the electronic flight information system (EFIS) display. To the friend's knowledge, the autopilot would not engage with the caution light illuminated and would not remain engaged if the caution light illuminated. The caution light extinguished after 12 to 15 minutes, and the pilot engaged the autopilot for the remainder of the flight to INT. The friend spoke to the pilot after they both returned to FAY. The pilot reported that the light remained extinguished and that he used the autopilot on the return flight to FAY; however, after landing at FAY, he turned off the avionics and then back on, and the light illuminated for 3 minutes before he shut down the airplane. The pilot planned to take the airplane to an avionics maintenance facility and also commented that he planned to perform three night landings to maintain his night currency.

A maintenance technician reported in a postaccident interview that the accident airplane was at their facility due to an AHRS fail light illumination in the cockpit. The pilot visited the facility about 1800 on the evening of the accident to check the status of the repair. The pilot was informed that the repair had not been completed because the facility needed to contact the EFIS manufacturer for more information and that the only issue would be that the autopilot would not engage. The pilot then took the airplane for the accident flight.

Pilot Information

Certificate:	Private	**Age:**	65,Male
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 None	**Last FAA Medical Exam:**	September 13, 2017
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	480 hours (Total, all aircraft)		

The pilot's logbook was not recovered.

Aircraft and Owner/Operator Information

Aircraft Make:	Beech	**Registration:**	N664AR
Model/Series:	E55 UNDESIGNAT	**Aircraft Category:**	Airplane
Year of Manufacture:	1979	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	TE-1163
Landing Gear Type:	Retractable - Tricycle	**Seats:**	6
Date/Type of Last Inspection:	November 1, 2018 Annual	**Certified Max Gross Wt.:**	5300 lbs
Time Since Last Inspection:		**Engines:**	2 Reciprocating
Airframe Total Time:	2178 Hrs as of last inspection	**Engine Manufacturer:**	Continental
ELT:	C91A installed, not activated	**Engine Model/Series:**	IO-520
Registered Owner:	Industrial Power Inc	**Rated Power:**	285 Horsepower
Operator:	Industrial Power Inc	**Operating Certificate(s) Held:**	None

The airplane was equipped with a Century III autopilot system and an Aspen Avionics Evolution Flight Display EFD1000 EFIS, which used an AHRS. FAA Airworthiness Directive (AD) 2018-SW-100-AD, effective February 7, 2019, was applicable to certain Aspen Avionics flight displays installed on various aircraft and was prompted by reports of flight displays repetitively resetting. The AD indicated that "[b]efore the next flight in IMC [instrument meteorological conditions] or at night, or within 25 hours' time-in-service, whichever occurs first: (1) Disable the Automatic Dependent Surveillance-Broadcast (ADS-B) In function in each unit by following the Procedure, paragraphs 5.2.a and b., of Aspen Avionics Mandatory Service Bulletin No. SB2018-01…" The Aspen service bulletin was applicable to those model flight displays “with ADS-B IN (FIS-B) Weather Interface with SW [software version] 2.9 installed.” Review of the airframe logbook did not reveal any entries indicating compliance with the AD; however, due to damage to the EFIS, the investigation could not determine if the AD was applicable to the accident unit (what the current software version was).

Review of emergency procedures from a pilot operating handbook for the make and model airplane regarding unscheduled electric elevator trim indicated that an uncommanded pitch could be stopped by: turning off the autopilot master switch; pull the autopilot and trim circuit breakers; turn off the radio master switch; turn off the electrical master switch; push the GA switch on the throttle grip; or push TEST EACH FLT switch on autopilot controller.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	FAY,189 ft msl	**Distance from Accident Site:**	3 Nautical Miles
Observation Time:	22:53 Local	**Direction from Accident Site:**	40°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	4 knots /	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	200°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	30.18 inches Hg	**Temperature/Dew Point:**	26°C / 20°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Hope Mills, NC (FAY)	**Type of Flight Plan Filed:**	None
Destination:	Hope Mills, NC (FAY)	**Type of Clearance:**	None
Departure Time:	22:29 Local	**Type of Airspace:**	Class D

Airport Information

Airport:	Fayetteville Regional Airport FAY	**Runway Surface Type:**	Asphalt
Airport Elevation:	189 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	04	**IFR Approach:**	None
Runway Length/Width:	7709 ft / 150 ft	**VFR Approach/Landing:**	Traffic pattern

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	1 Fatal, 1 Serious	**Aircraft Explosion:**	None
Total Injuries:	2 Fatal, 1 Serious	**Latitude, Longitude:**	34.955001,-78.917778

A debris path was observed beginning with freshly cut treetops, descending about a 35° angle, and extending about 50 ft on a magnetic heading of 270° to the back of a residence. Sections of the right wing, left horizontal stabilizer, and right engine came to rest inside the residence, and the main wreckage came to rest in the front yard of the residence, upright and oriented about a magnetic heading

of 180°. The left engine remained attached to the left wing, and the left propeller was separated from the crankshaft propeller flange. One propeller blade exhibited s-bending, chordwise scratching, and leading edge gouges. The other blade exhibited chordwise scratching and tip curling. The right engine was separated from the right wing and recovered from a crater beneath the residence. The right propeller was separated from the right engine and not recovered.

The outboard left wing was separated, and the aileron remained attached. The left wing was crushed and its fuel tank breached. The right wing was separated and fragmented, and both the right flap and right aileron were separated. The vertical stabilizer was separated, but the rudder remained attached to it. The right horizonal stabilizer and right elevator remained attached to the spar. The left horizontal stabilizer was separated, and the left elevator remained attached to it. The cockpit area was crushed, and no readable instruments were recovered except for a fuel gauge.

The landing gear and flaps were retracted. Measurement of the aileron trim actuator corresponded to a full-down tab on the left aileron. Measurement of the rudder trim actuator corresponded a 5° nose-left trim. Measurement of both elevator trim actuators corresponded to 10° tab-up, full nose-down trim. Flight control continuity was confirmed from all control surfaces to the cockpit yoke. The fuel selectors were in the on position.

The top spark plugs were removed from the left engine. Their electrodes were intact and gray. When the crankshaft was rotated by hand, camshaft, crankshaft, and valve train continuity was confirmed to the rear accessory section of the engine, and thumb compression was attained on all cylinders. Only the left magneto was recovered from the left engine, and it produced spark at all leads when rotated via an electric drill. The engine-driven fuel pump and coupling remained intact. Disassembly of the pump and fuel manifold did not reveal any preimpact anomalies. The fuel mixture unit screen was absent of debris.

The top spark plugs were removed from the right engine. Their electrodes were intact and gray. The right engine exhibited more front-end impact damage than the left engine, and the right engine crankshaft was bent. Due to impact damage, the crankshaft could not be rotated by hand; however, a borescope examination of the cylinders did not reveal any preimpact anomalies. Both magnetos were separated from the right engine and only one was recovered; however, it was fragmented and could not be tested. The engine-driven fuel pump and coupling remained intact. Disassembly of the pump and fuel manifold did not reveal any preimpact anomalies. The fuel mixture unit screen was absent of debris.

An autopilot programming unit and an engine monitor did not contain any nonvolatile memory. Additionally, three autopilot servos were retained for examination.

Medical and Pathological Information

An autopsy was performed on the pilot by the North Carolina Office of the Chief Medical Examiner, Raleigh, NC. The cause of death was multiple traumatic injuries.

Toxicology testing was performed on the pilot by the laboratory at FAA Forensic Sciences. The results identified 24 mg/dL ethanol detected in muscle and 36 mg/dL ethanol detected in kidney. Ethanol can be produced after death by microbial activity.

Tests and Research

Testing and examination of the pitch, roll, and trim servos at the manufacturer's facility revealed that the roll servo and trim servo operated within design parameters; however, the pitch servo did not. When power was applied to the servo, the solenoid engaged as required but would not disengage when power was cut off without having to manually spin or bump the clutch. The electrical cable connection was sensitive and resulted in intermittent motor operation, which was likely due to split pins in the connector. Testing of the clutch tension of the pitch servo revealed that the breakaway force needed was 45 lbs. However, the specified required clutch tension breakaway force setting was 13 +/- 2 lbs. This setting was achieved by tightening the castle nut enough to achieve the required clutch tension breakaway force. After that, an orange torque seal strip was applied, and a cotter pin was installed.

Upon further examination, the cotter pin used to secure the castle nut retaining the clutch appeared to be new, and the castle nut did not align with the factory’s orange torque strip setting applied at the time of servo completion and final testing; the orange torque strip on the nut and the orange torque strip on the tension washer were about 3/4 of a turn off. The castle nut securing the clutch on the servo had been overtightened, which caused the breakaway force needed to be about 30 lbs too high. The overtightened clutch would have greatly increased the force required to override the clutch of the pitch servo..

Additional Information

Review of a maintenance invoice dated December 7, 2017, noted “pitch intermittent” and revealed that the pitch trim motor was removed, bench checked, serviced, and replaced in the airplane; however, according to the servo manufacturer, the motor could be removed and serviced without removing the cotter pin and castle nut.

Administrative Information

Investigator In Charge (IIC):	Gretz, Robert
Additional Participating Persons:	Clinton Festa; FAA/FSDO; Greensboro, NC Ricardo Asensio; Textron Aviation; Wichita, KS Mike Council; Continental Motors; Mobile, AL Les Doud; Hartzell Propeller; Piqua, OH
Original Publish Date:	December 3, 2020
Last Revision Date:	
Investigation Class:	Class 2
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=99714