Aviation Investigation Final Report

Location:	Poughkeepsie, New York	**Accident Number:**	ERA15LA286
Date & Time:	July 25, 2015, 10:40 Local	**Registration:**	N6677D
Aircraft:	Beech A36	**Aircraft Damage:**	Substantial
Defining Event:	Fuel starvation	**Injuries:**	1 Minor, 1 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot landed the airplane at an intermediate airport to refuel before resuming his cross-country flight. After refueling and sumping the tanks, he taxied, performed an engine run-up, checked the magnetos, and cycled the propeller. During takeoff, the pilot noticed a vibration and unusual noise as the airplane rotated. He applied the brakes, as he thought the wheels were rotating and causing the vibration, and retracted the landing gear, but the vibration continued. The engine then lost partial power. He checked that the propeller, throttle, and mixture controls were full forward, but the airplane would not climb. He indicated that, due to the low airspeed, he could not return to the airport, so he pulled back on the control wheel to clear power lines, "forced the nose down" to prevent a stall, and landed gear-up, during which the airplane sustained substantial damage.

Examination of the wreckage revealed no evidence of preimpact failures or malfunctions of the airplane or engine. Fuel was observed in both the left and right wing tanks.

A postaccident engine test run was performed in a test cell. The engine started normally; accelerated normally without any hesitation, stumbling, or interruption in power; and produced rated horsepower. Testing of the auxiliary fuel pump, which was designed so that fuel would flow through it regardless of whether it was on or off, revealed that although it was operating within specifications, the discharge fitting was leaking, which allowed air into the fuel system. Disassembly of the discharge fitting revealed that it had likely been installed to the proper torque but that there were deep scratches on the O-ring boss on the pump side of the fitting and a piece of metal embedded in the O-ring, which indicates that it had been damaged before or during installation. After the fittings were replaced, no leaks were found.

Probable Cause and Findings

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

A leaking fuel discharge fitting, which resulted in a partial loss of engine power and an off-airport, gear-up landing.

Findings

Personnel issues	Installation - Maintenance personnel
Aircraft	Fuel pumps - Incorrect service/maintenance
Aircraft	(general) - Incorrect service/maintenance
Aircraft	Fuel distribution - Damaged/degraded

Factual Information

History of Flight

Prior to flight	Aircraft maintenance event
Takeoff	Fuel starvation (Defining event)
Initial climb	Loss of engine power (partial)
Emergency descent	Off-field or emergency landing
Landing	Collision during takeoff/land

On July 25, 2015, about 1040 eastern daylight time, a Beech A36; N6677D, was substantially damaged during an emergency landing, after a partial loss of power during takeoff at Duchess County Airport (POU), Poughkeepsie, New York. The private pilot received minor injuries, and the passenger was uninjured. Visual meteorological conditions prevailed, and an IFR flight plan was filed for the flight, conducted under the provisions of Title 14 Code of Federal Regulations Part 91, destined for Burlington National Airport (BTV), Burlington, Vermont.

According to the pilot, after arriving at POU from Lehigh Valley International Airport (ABE), Allentown, Pennsylvania, he purchased 15 gallons of fuel and then sumped the tanks in preparation for the next leg of the flight to BTV.

After starting the engine he taxied out, did his engine runup, checked the magnetos, and cycled the propeller. Then during the takeoff from runway 24, he noticed a vibration and unusual noise as he rotated. He believed that it may have been from the wheels and applied the brakes to stop the wheels from rotating and retracted the landing gear but, the vibration continued. He was however unable to continue climbing, as the engine suddenly incurred a partial loss of power.

He checked that the propeller, throttle, and mixture, was full forward but the airplane still would not climb. With the airspeed being low, he knew that he could not make it back to the airport without stalling the airplane.

There were "trees everywhere" and a set of power lines directly ahead of him. He then pulled back on the control wheel, was able to clear the power lines, and then "forced the nose down" to prevent the airplane from stalling, and landed gear up about 300 feet from the power lines.

Pilot Information

Certificate:	Private	**Age:**	67,Male
Airplane Rating(s):	Single-engine land; Single-engine sea	**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:**	No
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	August 5, 2014
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	February 1, 2015
Flight Time:	8954 hours (Total, all aircraft), 6311 hours (Total, this make and model), 8896 hours (Pilot In Command, all aircraft), 92 hours (Last 90 days, all aircraft), 34 hours (Last 30 days, all aircraft), 7 hours (Last 24 hours, all aircraft)		

Passenger Information

Certificate:		**Age:**	Female
Airplane Rating(s):		**Seat Occupied:**	Right
Other Aircraft Rating(s):		**Restraint Used:**	3-point
Instrument Rating(s):		**Second Pilot Present:**	No
Instructor Rating(s):		**Toxicology Performed:**	No
Medical Certification:		**Last FAA Medical Exam:**	
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:			

According to Federal Aviation Administration (FAA) and pilot records, the pilot held a private pilot certificate with ratings for airplane single-engine land, airplane single engine sea, and instrument airplane. His most recent application for a FAA third-class medical certificate was dated August 5, 2014. The pilot reported that he had accrued approximately 8,954 total hours of flight experience, of which 6,311 hours were in the accident airplane make and model.

Aircraft and Owner/Operator Information

Aircraft Make:	Beech	**Registration:**	N6677D
Model/Series:	A36	**Aircraft Category:**	Airplane
Year of Manufacture:	1979	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	E-1581
Landing Gear Type:	Retractable - Tricycle	**Seats:**	6
Date/Type of Last Inspection:	December 17, 2014 Annual	**Certified Max Gross Wt.:**	3651 lbs
Time Since Last Inspection:	97 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	6796.6 Hrs as of last inspection	**Engine Manufacturer:**	Continental
ELT:	Installed, activated, did not aid in locating accident	**Engine Model/Series:**	IO-520-BB
Registered Owner:		**Rated Power:**	285 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

The accident airplane was a low wing, retractable single engine airplane, of conventional metal construction, equipped with retractable tricycle type landing gear. It was powered by an air cooled, 6-cylinder, horizontally opposed, 285 horsepower Continental IO-520-BB engine driving a McCauley 3-bladed, variable pitch, constant speed propeller.

According to FAA and maintenance records, the airplane was manufactured in 1979. The airplane's most recent annual inspection was completed on December 17, 2014. At the time of the inspection, the airplane had accrued 6,796.6 total hours of operation.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	POU,164 ft msl	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	10:47 Local	**Direction from Accident Site:**	235°
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:	30.01 inches Hg	**Temperature/Dew Point:**	25°C / 13°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Poughkeepsie, NY (POU)	**Type of Flight Plan Filed:**	IFR
Destination:	BURLINGTON, VT (BTV)	**Type of Clearance:**	IFR
Departure Time:	10:42 Local	**Type of Airspace:**	Class D

The recorded weather at POU, at 1047, about 7 minutes after the accident, included: calm winds, 10 miles visibility, clear skies, temperature 25° C, dew point 13° C, and an altimeter setting of 30.01 inches of mercury.

Airport Information

Airport:	Dutchess County Airport POU	**Runway Surface Type:**	Asphalt
Airport Elevation:	164 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	24	**IFR Approach:**	None
Runway Length/Width:	5001 ft / 100 ft	**VFR Approach/Landing:**	Forced landing;Straight-in

POU was owned by Dutchess County and was a public use, tower-controlled airport. It was located four miles south of Poughkeepsie, New York. The airport elevation was 165 feet above mean sea level.

There were two runways oriented in an 6/24 and 15/33 configuration.

Runway 24, had a left-hand traffic pattern, was asphalt, grooved, and in excellent condition. The total length was 5,001 feet-long and 100 feet-wide.

It was marked with precision markings in good condition and equipped with high intensity runway edge lights.

Obstructions were present off the departure end of the runway in the form of 18 ft trees, located 380 ft from the runway, 300 ft right of centerline which took a 10:1 slope to clear.

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Minor, 1 None	**Latitude, Longitude:**	41.626667,-73.884162(est)

Examination of the accident site revealed that the airplane had initially touched down on its belly in a grassy area, then traveled over the top of a large rock and came to rest.

Examination of the airplane revealed that it had touched down with the landing gear in the up (stowed) position. All major parts of the airplane were on site, and the airplane had been substantially damaged when it struck and traveled over the rock.

The outboard sections of all three blades of the propeller had been bent backwards, the right side nose wheel door had separated at the hinge line, the aft portion of the lower cowling had been buckled and crushed, the upper cowling had partially opened on impact.

The nose landing gear wheel well had been crushed upward, and both right side engine mounts were fractured. The throttle body had one of the mount lugs fractured and two of the fuel fittings were fractured.

The lower portion of the firewall was buckled, and the fuselage had buckled just aft of the firewall. The wing flaps were in the 15°position, and the inboard portion of the left wing flap was bent. Fuel was observable in both the left, and right, wing tanks.

Additional Information

According to the auxiliary pump manufacturer, fittings and O-rings can be a source of leakage. Care should be taken to ensure that fittings are inspected for cracks, scratches and cross threaded threads. New O-Rings should be installed at the time of fuel pump replacement and if the O-Rings have been on the fittings more than 10 years.

Tests and Research

Review of Maintenance Records

Review of maintenance records and the Pilot/Operator Accident/Incident Report submitted by the pilot, indicated that the factory rebuilt engine was installed on the airplane on February 23, 2012, at a recorded tachometer time of 6,103.9 hours.

On June 14, 2013, at 279.1 hours after engine installation, maintenance personnel replaced the airplane's auxiliary fuel pump (fuel boost pump).

On February 6, 2014, (tachometer and engine time not specified), maintenance personnel located in Fort Pierce, Florida, "bled fuel line, checked fuel strainer, cleaned injectors due to rough running engine." The engine was test run and returned to service.

On February 7, 2014, at an unspecified tachometer and engine time, maintenance personnel located in Stuart, Florida, "removed all spark plugs, cleaned, gapped, and rotated upon reinstallation, removed all fuel injectors cleaned inspected and reinstalled, [and performed] aircraft operational and functional check" with no discrepancies noted.

On December 17, 2014, at a recorded tachometer time of 6,796.6 hours, the engine underwent an annual inspection. On December 18, 2014 (same tachometer reading as annual inspection), the spark plugs were removed, cleaned, and reinstalled, and the ignition leads, and magnetos were checked with no anomalies noted.

On May 11, 2015, at a tachometer time of 6,881 hours, the engine underwent an oil and oil filter change.

According to the pilot, the engine had accumulated 790 hours at the time of the accident.

Engine Test Run

On November 2, 2015, in order to help determine why in the maintenance records the engine had been reported to have been running rough and why the loss of engine power had occurred, an engine test run was performed.

Prior to the test run several airframe related items were removed in preparation for operation in the test cell. The removed items included:

- Both fractured Engine mounts (right front and right rear)
- Fuel fittings (the throttle body outlet and mixture return)
- Cooling Baffles
- Propeller Governor

The following substitute or repaired parts were then installed for engine operation:

- Engine Mount legs
- Fuel fittings

The magneto-to-engine timing which was specified to be 22° before top dead center (BTDC) was then checked, with the following results:

- Left Magneto (21°BTDC)
- Right Magneto (20°BTDC)

The engine was not disassembled prior to the engine run. The crankshaft end-play was measured 0.010" and the run-out was 0.001".

The engine was prepared for operation by installing the appropriate thermocouples, pressure lines and test pads for monitoring purposes. The engine was then moved to a test cell, mounted for operation, and then fitted with a club type propeller for testing.

The engine experienced a normal start on the first attempt without hesitation or stumbling in observed RPM. The engine RPM was advanced in steps for warm-up in preparation for full power operation. The engine throttle was advanced to 1200 RPM and held for five (5) minutes to stabilize. The engine throttle was advanced to 1600 RPM and held for five (5) minutes to stabilize. The engine throttle was advanced to 2450 RPM and held for five (5) minutes to stabilize. The engine throttle was advanced to the fully open position and held for five (5) minutes to stabilize. The engine throttle was rapidly advanced from idle to full throttle five times where it performed normally without any hesitation, stumbling or interruption in power.

Throughout the test phase, the engine accelerated normally without any hesitation, stumbling or interruption in power and demonstrated the ability to produce rated horsepower.

After the test run with the engine still hot, a cylinder leakage test was performed in accordance with the latest revision of CMI Service Bulletin SB03-3 with the following results (master orifice reading – 43 PSI):

- Cylinder No. 1 - 17/80 PSI (rings)
- Cylinder No. 3 - 56/80 PSI (rings)
- Cylinder No. 5 - 60/80 PSI (rings)
- Cylinder No. 2 - 72/80 PSI (rings)
- Cylinder No. 4 - 36/80 PSI (rings)
- Cylinder No. 6 - 60/80 PSI (rings)

(*) – Leakage Source

Airplane Fuel System

Airplane fuel systems are designed to provide an uninterrupted flow of clean fuel from the fuel tanks to the engine. The fuel must be available to the engine under all conditions of engine power, altitude, attitude, and during all approved flight maneuvers. Two common classifications apply to fuel systems: gravity-feed and fuel-pump systems.

Low- and mid-wing single reciprocating engine airplanes cannot utilize gravity-feed fuel systems because the fuel tanks are not located above the engine. Instead, one or more pumps are used to move the fuel from the tanks to the engine.

In a low wing airplane, with a fuel injection system such as the Continental system, fuel pressurized by an engine-driven pump is metered as a function of engine rpm. It is first delivered from the fuel tanks (one for each wing), To a three-way selector valve (LEFT, RIGHT, or OFF). The selector valve also acts simultaneously as a diverter of air that has been separated out of the fuel in the engine-driven fuel pump and returned to the valve. It routes the air to the vent space above the fuel in the selected tank.

An electric auxiliary fuel pump draws fuel through the selector valve. It forces the fuel through the strainer, making it available for the engine-driven fuel pump. The electric auxiliary pump also supplies fuel pressure while starting, is used to prevent vapor lock, and is also used as a backup should the engine-driven pump fail and does not need to be operating to allow the engine-driven fuel pump access to the fuel.

The engine driven pump supplies a higher-than needed volume of fuel under pressure to the fuel control. Excess fuel is returned to the pump, which pumps it through the selector valve into the appropriate tank. Fuel vapor is also returned to tanks by the pump. The fuel control unit meters the fuel according to engine rpm and mixture control inputs from the cockpit and then supplies it to the fuel manifold and injectors, which spray fuel without any air mixed in directly into the cylinders, to provide a measured, continuous spray and smooth engine operation.

Auxiliary Fuel Pump

The auxiliary fuel pump was controlled by an ON-OFF toggle switch on the control console. It provided pressure for starting and emergency operation. Immediately after starting, the auxiliary fuel pump could be used to purge the system of vapor caused by extremally high ambient temperature or start with the engine hot. The auxiliary fuel pump provided for near maximum engine performance should the engine driven pump fail.

On May 4, 2016, the auxiliary fuel pump was tested.

It was noted that the fuel pump was intact and had not been disassembled from the time of manufacture.

During the testing, it took 5-7 seconds for the pump to self-prime and to start pumping.

Fuel pump requirements were a minimum of 42 gph at 16 psi, with a maximum amperage draw of 3 amps at 28 volts dc.

The pump during testing produced 53 gph at 16 psi, and amperage draw was 2.1 amps at 28 volts dc. indicating that the pump was operating within specifications.

During the testing however, it was discovered that the discharge fitting was leaking. Disassembly of the discharge fitting revealed that it appeared that it had had been installed to the proper torque, but it was observed that there were deep scratches on the O-Ring boss on the pump side of the fitting, and a piece of metal was found imbedded in the O-Ring.

The fittings were then removed, and the pump was then retested with another set of fittings. No leaks

were found with the pump and /or the replacement fittings.

Administrative Information

Investigator In Charge (IIC):	Gunther, Todd
Additional Participating Persons:	Dramaine James; FAA FSDO; Teterboro, NJ Nicole Charnon; Continental Motors Inc.; Mobile, AL
Original Publish Date:	September 14, 2020
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=91652