Aviation Investigation Final Report

Location:	Mountain Rest, South Carolina	**Accident Number:**	ERA19LA029
Date & Time:	October 28, 2018, 18:30 Local	**Registration:**	N653DC
Aircraft:	Diamond DA20	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (partial)	**Injuries:**	2 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

According to the pilot, the airplane was in cruise flight about 6,500 ft mean sea level when the engine lost partial power. The pilot stated that he selected a field for a forced landing because no airport was within gliding distance. During the descent, the pilot's remedial actions to restore engine power were unsuccessful, so he declared an emergency over the radio and secured the engine before the off-airport landing. The airframe sustained substantial damage to the wings, fuselage, and empennage during the landing.

After the accident, several engine starts were attempted on the airframe, but each was unsuccessful. The engine was removed and shipped to the manufacturer, where an engine start was attempted in a test cell. The engine ran roughly and would not run continuously. Troubleshooting was performed, and internal engine timing and ignition timing were confirmed. Ultimately, both magnetos and both ignition harnesses required replacement to achieve a successful engine run. Disassembly of the right magneto revealed excessive wear, which rendered it inoperative. The left magneto required cleaning of the points to operate, and both ignition harnesses displayed damage due to overtightening of restraint clamps, which resulted in ignition "leaks" and intermittent spark at the spark plugs. It is likely that the combination of all of the discrepancies of the ignition system ultimately resulted in the engine's partial loss of power during the accident flight.

Probable Cause and Findings

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

A partial loss of engine power due to multiple discrepancies of the engine's ignition system.

Findings

Aircraft	Magneto/distributor - Fatigue/wear/corrosion
Aircraft	Dist (ignition harness) - Damaged/degraded

Factual Information

History of Flight

Enroute-cruise	Loss of engine power (partial) (Defining event)
Enroute-cruise	Attempted remediation/recovery
Emergency descent	Off-field or emergency landing

On October 28, 2018, at 1830 eastern daylight time, a Diamond DA-20, N653DC, was substantially damaged during collision with terrain during a forced landing in Mountain Rest, South Carolina. The forced landing followed a loss of engine power while in cruise flight about 6,500 feet mean sea level (msl). The pilot and his passenger were not injured. Visual meteorological conditions prevailed, and no flight plan was filed for the personal flight which was conducted under the provisions of 14 Code of Federal Regulations Part 91.

According to the pilot, the airplane was in cruise flight approximately 6,500 feet msl when the engine experienced a partial loss of engine power. The engine speed slowed to 1,000 rpm and the pilot adjusted the flight controls to achieve the airplane's best glide performance.

The pilot stated that he selected a field for the forced landing because no airport was within gliding distance. During the descent, the pilot's remedial actions to restore engine power were unsuccessful, so he declared an emergency over the radio and secured the engine prior to the off-airport landing. After the landing, the occupants egressed the airplane uninjured and without assistance.

The pilot held a commercial pilot and flight instructor certificates with ratings for airplane single engine land, multiengine land, and instrument airplane. His Federal Aviation Administration (FAA) first class medical certificate was issued February 1, 2018, and he reported 1,477 total hours of flight experience.

According to FAA records, the airplane was manufactured in 2001. Its most recent 100-hour inspection was completed October 24, 2018 at 7,730 total aircraft hours.

At 1835, the weather recorded at Toccoa Letourneau Airport (TOC), 18 miles southwest of the site, included clear skies and winds from 240 degrees at 6 knots. The temperature was 19°C, and the dew point was 10°C. The altimeter setting was 29.94 inches of mercury.

Examination of photographs revealed that the wings, fuselage, and empennage all sustained substantial impact damage. The tail was fractured but remained attached by cables. The horizontal stabilizer and the elevator were separated from the tail section.

An FAA aviation safety inspector confirmed flight continuity from the cockpit, through breaks and fractures, to all flight control surfaces. All breaks and fractures exhibited signatures consistent with overload failure. Several gallons of fuel were drained from the airplane, and samples from the fuel were absent of water and debris.

The airplane was retained for further examination.

On November 27, 2018, an engine run was attempted using an external battery and the airplane's own fuel system. Several starts were attempted, but each was unsuccessful. The testing was suspended, and the engine was removed and shipped to the manufacturer for further testing.

On December 4, 2018, the engine was examined in Mobile, Alabama. Ignition timing on the right magneto could not be verified. Timing was initially confirmed on the left magneto. The engine was placed in a test cell, and a start was attempted. The engine ran roughly and would not run continuously. Troubleshooting was performed, and internal engine timing and ignition timing were confirmed. Ultimately, both magnetos and both ignition harnesses required replacement to achieve a successful engine run.

The right magneto was tested using a magneto synchronizer, which revealed the points would not close, and the magneto would not produce spark. The right magneto was disassembled, and examination revealed the distributor gear bushing showed extreme wear. Debris (dust) consistent with the bushing material and the distributor gear block coated the internal magneto components. The distributor gear and distributor drive gear were loose in their mounts. The distributor gear block displayed excessive wear on the bushing, the bushing race, and the clearance cut-out adjacent to the drive gear.

The left magneto timing was verified on the engine, but then would not function in the test cell. The magneto was removed, the points were cleaned, the magneto was then bench tested again and functioned as designed.

The ignition harnesses were bench tested. The right-side harness showed continuity through all terminal leads, but the high-energy spark "leaked" through damaged areas in the #2 and #4 leads. The damage was consistent with over-tightening at the terminal harness b-nuts and clamp sites, as well as chafing at the clamp sites. Some impact-related damage was also noted.

The left-side harness showed continuity through all terminal leads. The high-energy spark "leaked" through damaged areas throughout. The damage was consistent with that of the right-side harness.

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	26,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Unknown
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	February 1, 2018
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	1477 hours (Total, all aircraft), 1021 hours (Total, this make and model), 127 hours (Last 90 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Diamond	**Registration:**	N653DC
Model/Series:	DA20 C1	**Aircraft Category:**	Airplane
Year of Manufacture:	2001	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	C0153
Landing Gear Type:	Tricycle	**Seats:**	
Date/Type of Last Inspection:	October 24, 2018 100 hour	**Certified Max Gross Wt.:**	
Time Since Last Inspection:		**Engines:**	Reciprocating
Airframe Total Time:	7744.7 Hrs at time of accident	**Engine Manufacturer:**	Continental
ELT:	Installed	**Engine Model/Series:**	IO-240-B
Registered Owner:		**Rated Power:**	
Operator:		**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KTOC,995 ft msl	**Distance from Accident Site:**	18 Nautical Miles
Observation Time:	18:35 Local	**Direction from Accident Site:**	203°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	6 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	240°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.94 inches Hg	**Temperature/Dew Point:**	19°C / 10°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Sylva, NC (24A)	**Type of Flight Plan Filed:**	None
Destination:	Athens, GA (AHN)	**Type of Clearance:**	None
Departure Time:		**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 None	**Latitude, Longitude:**	34.865001,-83.157218(est)

Administrative Information

Investigator In Charge (IIC):	Rayner, Brian
Additional Participating Persons:	Bruce Vestal; FAA/FSDO; Columbia, SC John Kent; CMI; Mobile, AL
Original Publish Date:	June 29, 2020
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=98561