Aviation Investigation Final Report

Location:	Kenansville, North Carolina	**Accident Number:**	ERA20LA064
Date & Time:	January 2, 2020, 10:25 Local	**Registration:**	N323SR
Aircraft:	Cirrus SR22	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (partial)	**Injuries:**	2 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot reported that, during a cross-country flight, he heard a pop from the engine, and it subsequently stopped producing power; however, the engine continued to run, and the propeller continued to rotate. The pilot attempted to troubleshoot the loss of power; however, power was not restored. Subsequently, the pilot activated the airplane's parachute system and the airplane impacted trees and terrain, resulting in substantial damage to the airframe.

Postacccident examination of the engine revealed that the camshaft fractured at one of its four oil transfer holes. As a result, camshaft continuity was lost, and the engine was partially unable to produce power. Forensic examination of the fracture surface revealed that the fracture occurred due to fatigue that initiated from a burr at the corner of an oil transfer hole. The extent of fatigue crack growth through the cross-section suggested the overall torsion load on the camshaft was relatively low as the crack grew. However, a burr at the edge of a hole is a feature that is known to reduce component fatigue life. The burr was deformed and coated, consistent with forming during a peening operation and before the manganese phosphate coating had been applied. A similar burr was also observed on the adjacent oil transfer hole in the camshaft. The presence of a burr suggests the corner of the hole was not properly broken before the part was peened during manufacturing, leading to deformation of a sharp corner during the peening operation.

Probable Cause and Findings

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

A fatigue failure of the camshaft due to a manufacturing defect, which resulted in a partial loss of engine power.

Findings

Aircraft	Recip engine power section - Failure

Factual Information

History of Flight

Enroute	Loss of engine power (partial) (Defining event)

On January 2, 2020, about 1015 eastern standard time, a Cirrus Design Corp. SR-22, N323SR, was substantially damaged when it was involved in an accident near Kenansville, North Carolina. The commercial pilot and passenger were not injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

The pilot reported that the departure and enroute phase of flight were normal for about 3.5 hours. While cruising at 6,500 ft mean sea level (msl), about 50 nautical miles from Curtis L Brown Jr. Field Airport (EYF), Elizabethtown, North Carolina, the airplane experienced three events nearly simultaneously. He first heard a "pop" that "wasn't huge," but caught his attention, then the autopilot disconnect aural alert sounded, and the airplane began "decelerating." He stated that the airplane just began to "slow down" and the engine "wasn't producing forward thrust." However, the propeller continued to rotate, and when he viewed the engine instruments, the engine RPM continued to read 1,600 RPM, all exhaust gas temperature (EGT) gauges read 0° F, but no other engine instrument was red.

He reported that he adjusted the throttle lever after the loss of engine power; when it moved, the lever felt normal, but had no effect on the engine power. He also switched the fuel tank selector, but the engine condition did not change. He maintained 88 knots indicated airspeed as the airplane descended, and about 2,000 ft msl while approaching an open field ahead, he activated the Cirrus Airframe Parachute System (CAPS). Subsequently, the CAPS deployed and the airplane "stopped and fell near vertically." The airplane impacted trees, where it became partially suspended in branches, with its right-wing impacting terrain below. The airplane's fuselage and wings sustained substantial damage.

The National Transportation Safety Board (NTSB) Vehicle Recorders Division performed a download of the primary and multi-function displays. The data were largely consistent with what the pilot reported. The airplane's flight and engine parameters were normal until a rapid drop in exhaust gas temperature (EGT) and oil pressure was observed in the final few minutes of data. Fuel flow remained consistent throughout the data, engine cylinder head temperatures were normal, and the engine rpm showed a slow decrease toward about 1,500 after the rapid drop in EGT was observed.

Examination of the engine revealed that it sustained minor impact damage. When the engine was rotated by hand, the No. 1 and 2-cylinder intake and exhaust valves moved normally, however, the remaining four cylinder's valves displayed no movement. With the engine partially disassembled, the engine was rotated by hand and the camshaft gear was observed to rotate normally with no observable wear on any of its associated gear teeth. The engine was

further disassembled and the camshaft was found fractured. The camshaft, part number 654084, revision P, was examined further by the NTSB Materials Laboratory.

According to the NTSB Materials Laboratory factual report, the camshaft had fractured between lobes associated with the No. 2 and 3 cylinders, intersecting oil transfer holes as shown in figure 1. The fracture plane was angled relative to the transverse plane consistent with fatigue fracture under torsion loading.

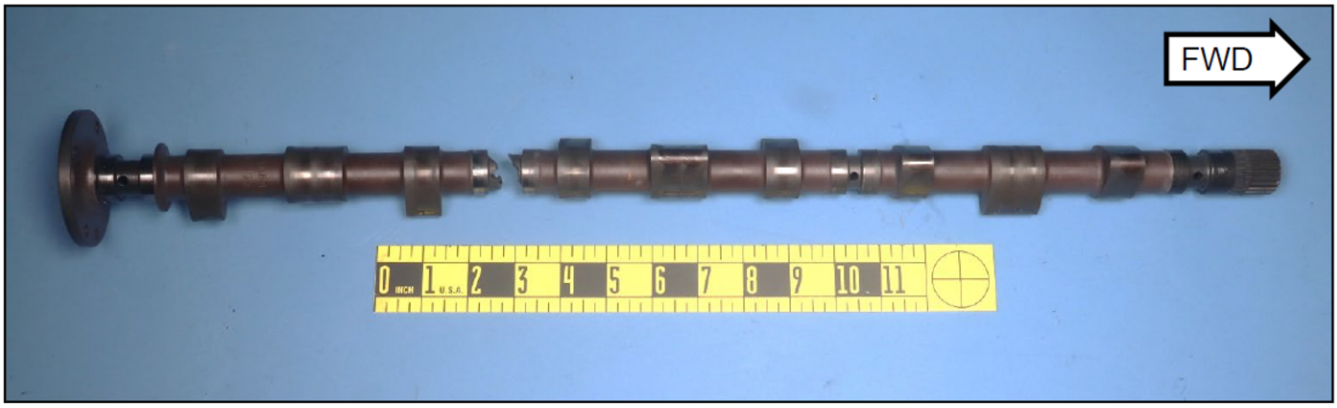

Figure 1. Overall view of the submitted camshaft.

The fracture surface was further forensically examined, which revealed relatively smooth fracture features with curving crack arrest lines, features consistent with fatigue. Crack arrest lines emanated from origins at the corner of the oil transfer hole where it intersected the camshaft exterior surface. Fatigue features were observed around most of the fracture surface, intersecting the oil transfer hole at the opposite side of the camshaft. A portion of the fracture had post-fracture rub damage that obliterated the fracture features. The exterior surface of the camshaft had a dimpled appearance, consistent with a shot-peened surface treatment. The corner of the oil transfer hole was deformed inward, forming a burr. Dimple features were also observed on the surface of the burr consistent with peening deformation.

The oil transfer hole between lobes associated with the No. 4 and 5 cylinders also displayed a burr at the corner of the hole, but no crack was observed. Further forensic examination and cuts to the oil transfer hole found an elongated texture consistent with surface deformation associated with the burr formation.

Maintenance records revealed that the engine was newly manufactured by Continental on July 15, 2017, and was installed on the airplane by Cornerstone Aviation on August 5, 2017. The airplane was inspected under annual/100-hour and Cirrus Progressive inspection protocols from the engine install date, with the most recent inspection competed on September 22, 2019. Review of the maintenance endorsements from July 2017 through the most recent inspection revealed no work that would have involved major disassembly of the engine. The engine had accumulated a total of 707 hours.

Review of NTSB accident report ERA11LA130, January 27, 2011, involving a Cirrus SR22, Continental Motors IO-550-N, Camshaft Part Number 654084, revision D, revealed that the

camshaft in that engine also fractured in-flight. The NTSB Materials Laboratory found that a fracture due to fatigue occurred at the most aft oil transfer hole. The report found that the engine had been overhauled about 393 hours prior to the incident. During the overhaul the original camshaft was replaced with a “repaired” camshaft and it was not determined whether any of the fatigue cracks were of detectible size at the time of installation.

Pilot Information

Certificate:	Commercial	**Age:**	66,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	August 10, 2019
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	September 25, 2019
Flight Time:	4000 hours (Total, all aircraft), 2738 hours (Total, this make and model), 30 hours (Last 90 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Cirrus	**Registration:**	N323SR
Model/Series:	SR22 NO SERIES	**Aircraft Category:**	Airplane
Year of Manufacture:	2006	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	2271
Landing Gear Type:	Tricycle	**Seats:**	4
Date/Type of Last Inspection:	September 22, 2019 Continuous airworthiness	**Certified Max Gross Wt.:**	3600 lbs
Time Since Last Inspection:	21 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	3774.1 Hrs as of last inspection	**Engine Manufacturer:**	Continental
ELT:	Installed	**Engine Model/Series:**	IO-550-N
Registered Owner:	Cornerstone Aviation LLC.	**Rated Power:**	310 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	ISO,94 ft msl	**Distance from Accident Site:**	20 Nautical Miles
Observation Time:	10:56 Local	**Direction from Accident Site:**	40°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	8 knots / None	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	200°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	30.11 inches Hg	**Temperature/Dew Point:**	14°C / 2°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Worcester, MA (ORH)	**Type of Flight Plan Filed:**	None
Destination:	Elizabethtown, NC (EYF)	**Type of Clearance:**	VFR flight following
Departure Time:	06:45 Local	**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:		**Aircraft Explosion:**	None
Total Injuries:	2 None	**Latitude, Longitude:**	35.084999,-77.895278(est)

Administrative Information

Investigator In Charge (IIC):	Gerhardt, Adam
Additional Participating Persons:	Bradley McCauley; FAA/ FSDO; Greensboro, NC Phillip Grice; Continental Motors; Mobile, AL Brannon Mayer; Cirrus Aircraft; Duluth, MN
Original Publish Date:	April 6, 2022
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=100764

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