Aviation Investigation Final Report

Location:	Foley, Alabama	**Accident Number:**	ERA19LA264
Date & Time:	September 1, 2019, 15:20 Local	**Registration:**	N878SR
Aircraft:	Cirrus SR22	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	4 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The private pilot was climbing the airplane to cruise altitude when the engine lost total power. His attempts to restore power were unsuccessful, and about 1,200 ft above ground level, the passenger activated the airplane's parachute system. The airplane descended under parachute and landed upright in a field, resulting in substantial damage to the fuselage. The pilot and passengers were not injured. Postaccident examination of the engine revealed that 11 of the teeth on the camshaft gear were fractured, with 3 of the teeth exhibiting fracture features consistent with fatigue.

The accident airplane was manufactured in 2007, and in 2015, its engine was replaced with an older, overhauled engine. At the time the replacement engine was overhauled, a manufacturer service bulletin was in effect that specified that the camshaft gear should be replaced by an improved camshaft gear. During the engine overhaul, the older, thinner camshaft gear was re-installed with an enhanced inspection performed by the inspection overhaul facility instead of replacing it with the improved gear.

In March 2017, in anticipation of an FAA airworthiness directive, the engine manufacturer elevated the service bulletin to a mandatory service bulletin (MSB) whose purpose was "to eliminate possibility of gear tooth fracture." The MSB called for camshaft gear replacement "within 100-hours of operation, at the next engine overhaul (not to exceed 12 years engine time in service), or whenever camshaft gear is accessible, whichever occurs first."

In April 2017, the engine overhaul facility distributed a service letter indicating that the MSB did not apply to engines overhauled at their facility if engine logbook inspection revealed a logbook entry referencing the alternate means of compliance with the MSB. Review of the accident airplane logbook included this entry at overhaul.

In July 2017, the engine manufacturer downgraded the MSB to a critical service bulletin (CSB). The CSB recommended recurring inspections of all unimproved camshaft gears at annual or 100-hour intervals until the unimproved gears had been replaced with improved gears. Between the time this service bulletin was issued and the accident, the airplane had undergone two annual inspections, and the airplane's maintenance logs contained no entries noting that this inspection had been completed or that the unimproved camshaft gear had been replaced. The airplane's most recent annual inspection was completed about 3 days before the accident.

Following the accident, the maintenance facility clarified that they did not perform the inspection detailed by the CSB because they assumed that the airplane, due to its date of manufacture, would not have been equipped with a camshaft gear subject to the CSB. They also stated that the manufacturer's CSB requiring recurring inspection was not applicable to older, thinner configuration camshaft gears that they had previously inspected and installed during overhaul per their approved alternate means of compliance with the CSB.

Probable Cause and Findings

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

Total loss of engine power due to a fatigue failure of the camshaft gear.

Findings

Aircraft	Recip engine power section - Failure
Aircraft	(general) - Fatigue/wear/corrosion

Factual Information

History of Flight

Enroute	Loss of engine power (total) (Defining event)
Emergency descent	Collision with terr/obj (non-CFIT)

On September 1, 2019, about 1520 central daylight time, a Cirrus Design Corporation SR22, N878SR, was substantially damaged when it was involved in an accident near Foley, Alabama. The pilot and three passengers were not injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

The pilot stated that he completed the preflight inspection, engine run-up, and before-takeoff checks with no anomalies noted. About 10 minutes after departure, while climbing to cruise altitude, he felt the engine "buffet" then noted a loss in engine rpm. He turned the airplane back toward the airport, after which the engine lost total power and the propeller stopped rotating. He declared an emergency to air traffic control and moved the throttle to idle then full forward; however, the engine did not respond. The airplane owner, who was seated in the front left seat, activated the airframe parachute system when the airplane reached 1,200 ft above ground level. The airplane descended via parachute and touched down upright in a field.

Examination of the wreckage revealed that the fuselage aft of the firewall exhibited buckling and cracking, and the bottom portion of the rudder exhibited a crack about 7-8 inches in length. Borescope examination of the engine's cylinders revealed valve strikes on each of the piston faces. The propeller governor screen contained no metal and the engine accessory drive gear for the governor would not rotate during crankshaft rotation. Upon removal of the alternator, there was no evidence of camshaft rotation when the propeller was rotated manually. The oil filter was removed and opened; metal particles were found inside the filter element.

The engine was removed from the airframe and sent to the manufacturer's facility for further examination. Metal particles were found in the oil sump after removal. The camshaft was removed from the engine crankcase. The camshaft was intact; however, several of the camshaft gear (part number 631845) teeth were smeared or missing.

Detailed metallurgical examination of the camshaft gear teeth revealed that the first three fractured teeth, located about 180° from the timing mark, exhibited evidence of fatigue failure. The fracture faces of gear teeth 4 through 11 exhibited severe mechanical damage that obliterated the fracture features.

On August 9, 2005, the engine manufacturer issued a service bulletin (SB05-8), which was later superseded by SB05-8A in August 2009 (this was the revision of the bulletin in effect at the time the accident airplane's engine was overhauled in 2015), to introduce into service an

improved camshaft gear applicable to the accident engine. The improved camshaft gear was nominally 0.060 inches wider than the previous camshaft configurations. The service bulletin recommended that the new camshaft gear be incorporated at the next engine overhaul or whenever replacement of the camshaft gear was required. In November 2009, the engine manufacturer issued a revised service bulletin to identify parts to be replaced during maintenance, preventative maintenance, and overhaul (SB 97-6B), which included the camshaft gear (part number 631845) as a mandatory replacement item at overhaul.

According to Federal Aviation Administration (FAA) airworthiness records, the airplane was manufactured in 2007, and was equipped with a Continental Motors IO-550-N engine. According to Continental Motors, at the time the engine was manufactured, it was equipped with the improved and thicker camshaft gear per SB05-8. To accommodate the thicker camshaft gear, the crankcase was modified with a clearance cut. Review of the airplane's maintenance logs revealed that in October 2015, the airplane's engine was replaced with an engine that had been overhauled by RAM Aircraft the preceding month. The logbook entry documenting the engine overhaul contained an entry noting that the (camshaft) gear had been inspected by the engine overhaul facility in accordance with, "RAM Gear Inspection Specification No. 1818, Rev. L dated 12/26/2013." The logbook entry did not include the part number of the camshaft gear in the overhauled engine and did not note that the camshaft gear had been replaced during the overhaul, nor did any entries following the overhaul.

In March 2017, in anticipation of an FAA Airworthiness Directive, the engine manufacturer elevated service bulletin SB 05-8B from a Category 3 to a Category 1 mandatory service bulletin (MSB05-8B), which called for the camshaft gear to be replaced "within 100-hours of operation, at the next engine overhaul (not to exceed 12 years engine time in service), or whenever camshaft gear is accessible, whichever occurs first."

In April 2017, the engine overhaul facility distributed a service letter indicating that MSB05-8B did not apply to engines overhauled at their facility if engine logbook inspection revealed a logbook entry referencing the alternate means of compliance with the MSB05-8B. Review of the accident airplane logbook included this entry at overhaul.

In July 2017, the engine manufacturer downgraded MSB05-8B to a Category 2 critical service bulletin (CSB05-8C) that recommended annual or 100-hour interval inspections of camshaft gears to eliminate the "the possibility of camshaft gear tooth fracture, resulting in power loss or in-flight shutdown…" until it was replaced with the improved camshaft gear. There were no logbook entries following the engine overhaul noting inspection of the camshaft gear in accordance with CSB05-8C or its subsequent revision (CSB05-8D, issued August 2018).

According to the owner of the maintenance facility who completed the accident airplane's most recent annual inspection (on August 29, 2019), the inspection was his facility's first annual inspection of that airplane. It was the facility's typical practice that when they first encounter an airplane for inspection, they research the airplane's complete history, including researching information relevant to the engine model and serial number. They did not believe that CSB05-8D applied since the airplane was manufactured after the service bulletin was issued and should have had the improved camshaft gear installed, even though the logbook showed that the original engine was replaced by an older refurbished engine.

In April 2020, the FAA issued a Special Airworthiness Information Bulletin (SAIB NE-20-05), which included a recommendation that repair stations, owners, operators, and maintenance personnel perform inspections of previously-manufactured camshaft gears (including 631845) in accordance with CSB05-8D until installation of the improved superseding camshaft gear.

Pilot Information

Certificate:	Private	**Age:**	44,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Right
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:**	May 23, 2019
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	December 19, 2018
Flight Time:	390 hours (Total, all aircraft), 102 hours (Total, this make and model), 344 hours (Pilot In Command, all aircraft), 28 hours (Last 90 days, all aircraft), 11 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Passenger Information

Certificate:		**Age:**	49,Male
Airplane Rating(s):		**Seat Occupied:**	Left
Other Aircraft Rating(s):		**Restraint Used:**	4-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:			

Passenger Information

Certificate:		**Age:**	44,Female
Airplane Rating(s):		**Seat Occupied:**	Rear
Other Aircraft Rating(s):		**Restraint Used:**	4-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:			

Passenger Information

Certificate:		**Age:**	29,Female
Airplane Rating(s):		**Seat Occupied:**	Rear
Other Aircraft Rating(s):		**Restraint Used:**	None
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:			

Aircraft and Owner/Operator Information

Aircraft Make:	Cirrus	**Registration:**	N878SR
Model/Series:	SR22 NO SERIES	**Aircraft Category:**	Airplane
Year of Manufacture:	2007	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	2778
Landing Gear Type:	Tricycle	**Seats:**	4
Date/Type of Last Inspection:	August 29, 2019 Annual	**Certified Max Gross Wt.:**	3400 lbs
Time Since Last Inspection:	11 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	3442.8 Hrs as of last inspection	**Engine Manufacturer:**	Continental
ELT:	C126 installed, activated, did not aid in locating accident	**Engine Model/Series:**	IO-550-N27B
Registered Owner:	On file	**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:	JKA,17 ft msl	**Distance from Accident Site:**	3 Nautical Miles
Observation Time:	15:35 Local	**Direction from Accident Site:**	350°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots /	**Turbulence Type Forecast/Actual:**	Unknown / Unknown
Wind Direction:	140°	**Turbulence Severity Forecast/Actual:**	Unknown / Unknown
Altimeter Setting:	29.97 inches Hg	**Temperature/Dew Point:**	29°C / 25°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Gulf Shores, AL (JKA)	**Type of Flight Plan Filed:**	None
Destination:	Vidalia, LA (0R4)	**Type of Clearance:**	None
Departure Time:	15:11 Local	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	3 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	4 None	**Latitude, Longitude:**	30.36861,-87.687774(est)

Administrative Information

Investigator In Charge (IIC):	Spencer, Lynn
Additional Participating Persons:	Nina A McBride; FAA/FSDO; Birmingham, AL Kurt A Gibson; Continental Aerospace Technologies; Mobile, AL Brad Miller; Cirrus Aircraft; Duluth, MN Rick Roper; Ram Aircraft; Waco, TX
Original Publish Date:	March 23, 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=100180