Aviation Investigation Final Report

Location:	Hoagland, Indiana	**Accident Number:**	CEN19LA320
Date & Time:	September 13, 2019, 15:45 Local	**Registration:**	N578SP
Aircraft:	Cirrus SR22	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	2 Minor
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The private pilot was conducting an instrument flight rules cross-country flight. While en route, the engine began to lose oil pressure, and the pilot diverted to a nearby airport. An inspection after landing revealed that the engine contained adequate oil and there was no evidence of oil leaking. The oil pressure and temperature indicated normally during a subsequent engine test run, and the pilot continued the flight to his destination. After about 40 minutes of flight, the engine abruptly lost total power and the pilot activated the airframe parachute system upon realizing that the airplane was not within gliding distance of an airport. The airplane came to rest upright in a field. The forward fuselage, two engine mounts, and both wings sustained substantial damage.

The accident occurred about 2 months and 17 flight hours after the airplane's most recent annual inspection, during which the engine oil filter was cut open and no abnormalities were noted. The engine oil was subsequently changed about 1 month and 8.5 flight hours before the accident. The mechanic who performed the oil change reported that the engine was not equipped with a magnetic engine oil drain plug and that he did not cut open and examine the oil filter element, although the maintenance manual stated that oil screens and filter elements should be examined for contaminants at each oil change. The accident engine was equipped with a magnetic drain plug; however, postaccident examination revealed that the quick drain coupling and the magnetic oil drain plug were switched from their respective locations. Because of the switch, on removal of the plug to drain the oil, the mechanic most-likely wouldn't have seen any indication of bushing material.

Additionally, the manufacturer had issued a service bulletin advising that the magnetic drain plug be examined for recovered bushing material.

A postaccident examination of the engine revealed that the No. 1 connecting rod separated from its piston and crankshaft and was found in the oil sump. Its bushing was not present;

however, its piston pin was found in place. The No. 1 connecting rod bearing end components and sections of its bearing were found within the sump. Ferrous material was found on the magnetic oil drain plug and debris was found on the oil filter material.

The piston pin bushings in the Nos. 2, 3, 4, and 6 connecting rods were displaced. The Nos. 2, 3, and 4 connecting rod bushings were chipped. The split lines for the Nos. 2, 3, and 4 bushings were found not clocked in accordance with manufacturer specifications. Although the reason for the piston pin migration could not be determined, it is likely that the impending migration and connecting rod failure may have been detected during the most recent oil change if the mechanic had followed the manufacturer's guidance to inspect the oil filter element and magnetic drain plug.

Following the accident, the engine manufacturer issued a maintenance manual revision and a critical service bulletin that directed enhanced screening of oil and removing the non-magnetic oil plug or quick drain coupling and installing a magnetic drain plug in the oil sump to attract and collect ferrous wear particulate and larger particles.

Probable Cause and Findings

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

A catastrophic engine failure and forced landing due to the separation of the No. 1 connecting rod as a result of migration of the connecting rod piston pin bushing. Contributing to the accident was the mechanic’s failure to follow manufacturer guidance during the most recent oil change, which likely would have detected bushing material lost from the rod piston pin, which would have indicated impending migration and connecting rod failure.

Findings

Aircraft	Recip engine power section - Failure
Personnel issues	Lack of action - Maintenance personnel

Factual Information

History of Flight

Other	Aircraft maintenance event
Enroute	Loss of engine power (total) (Defining event)
Emergency descent	Miscellaneous/other

On September 13, 2019, about 1545 eastern daylight time, a Cirrus SR22 airplane, N578SP, sustained substantial damage when it was involved in an accident near Hoagland, Indiana. The private pilot and passenger sustained minor injuries. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

The pilot stated that he added 3/4 quart of oil before departing on the cross-country instrument flight rules flight. The oil pressure was about 41 to 42 pounds per square inch (psi) for the early part of the flight, then began to decrease into the 30 psi range. After the oil pressure dropped below 30 psi and the low oil pressure light came on, the pilot notified air traffic control that he would be diverting to a nearby airport. As the airplane descended from 10,000 ft and the pilot decreased engine power, the oil pressure increased above 30 psi and into the normal operating range by the time the airplane landed at the diversion airport. Flight information from the airplane's recoverable data module showed a recorded decrease in oil pressure and subsequent increase in oil pressure during the diversion, consistent with the pilot's statement.

A post-flight check revealed that the engine contained about 6 quarts of oil, and two mechanics inspected the engine and checked for leaks. After confirming there were no signs of any oil leaks, they adjusted the sensor and turned the pressure relief valve one-quarter turn to tighten it. The engine was run at 1,600 rpm and the oil pressure read as high as 50 psi, with normal oil temperature indications. The recorded oil pressure during the engine ground run was consistent with the pilot's statement. The pilot and passenger boarded the airplane, and the pilot conducted an engine run-up at 1,700 rpm. The oil pressure and temperature were "good," and the pilot and passenger departed to continue the flight.

The pilot watched the oil pressure closely and stated that it indicated 45 psi for about the first 20 minutes of flight. Shortly thereafter, the engine lost all power, the red oil pressure light came on, and a few gauges on the avionics display showed large red Xs. The pilot immediately declared an emergency and asked for vectors to Fort Wayne International Airport (FWA), Fort Wayne, Indiana.

The pilot initiated the engine restart checklist while navigating to FWA; however, upon realizing that he would not reach the airport, he chose to activate the Cirrus Airframe Parachute System (CAPS). After the airplane came to rest in a plowed field, the pilot egressed and helped the passenger out.

The data from the accident flight revealed that the oil pressure was between 40 and 50 psi during the flight until about 39 minutes into the flight. At that point, the data showed that oil pressure, fuel flow,

and engine rpm decreased to 0. There were subsequent changes in fuel flow consistent with the pilot's attempts to restart the engine.

Pilot Information

Certificate:	Private	**Age:**	56,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 3 Without waivers/limitations	**Last FAA Medical Exam:**	August 4, 2018
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	March 28, 2019
Flight Time:	641.2 hours (Total, all aircraft), 553.7 hours (Total, this make and model), 560.9 hours (Pilot In Command, all aircraft), 22 hours (Last 90 days, all aircraft), 2 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Cirrus	**Registration:**	N578SP
Model/Series:	SR22 Undesignat	**Aircraft Category:**	Airplane
Year of Manufacture:	2009	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	3578
Landing Gear Type:	Tricycle	**Seats:**	4
Date/Type of Last Inspection:	July 26, 2019 Annual	**Certified Max Gross Wt.:**	3400 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	3248 Hrs as of last inspection	**Engine Manufacturer:**	Continental
ELT:	C126 installed, activated, did not aid in locating accident	**Engine Model/Series:**	IO-550-N
Registered Owner:	On file	**Rated Power:**	310 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

At the time of the annual inspection, the Hobbs meter indicated 3,891.5 hours, and the engine had accumulated 1,199.5 hours total time since new. The logbook entry for the annual inspection stated that

the oil and filter were changed and that the filter was cut open and no abnormalities were noted. Additionally, the engine oil was analyzed routinely during oil changes. According to an oil analysis report dated May 29, 2019, the sample indicated the best “wear-rate” results from the engine; the amount of iron detected was a “bit” more than average for the type of engine, but “not far enough out of line to call a problem.”

According to the engine manufacturer’s maintenance manual directions current at the time of the accident, the minimum requirement is to change the oil and filter every 50 hours and/or 4 months on engines with full flow oil filters and on engines with a large or small replaceable oil filter cartridge. Manufacturer guidance stated that oil screens and filter elements should be inspected at each oil change, and that oil analysis may be used in addition to the oil screen or filter element inspection, but not as a replacement for inspection.

According to the engine’s illustrated parts catalogue, the accident engine type was equipped with a magnetic drain plug in the bottom drain hole of the oil sump pan and a quick drain coupling in a side port. Examination of the accident sump pan revealed that the magnetic drain plug was safety wired and mounted in the side port on the sump near the No. 1 cylinder and a quick drain coupling was mounted in the bottom drain hole.

A logbook entry showed that the engine oil was changed on August 4, 2019, at a Hobbs meter time of 3,900.4 hours. When asked if the magnetic drain plug or the oil filter were examined as part of the oil change, the mechanic who performed the oil change indicated that the accident airplane's engine was not equipped with a magnetic drain plug and that he did not examine the oil filter, since it had only been a few hours since the annual inspection.

The accident engine’s cylinders had not been removed since the engine was installed. An engine cylinder assembly includes a piston, piston pin, and connecting rod. The connecting rod components include a piston pin bushing and a connecting rod bearing. The steel-backed bronze piston pin bushing, part number 530658, is designed to have a split line, is pressed into the connecting rod, and its split line is clocked in a specified 45° arc.

Service Bulletin (SB)07-1, issued on March 19, 2007, current at the time of the accident, identified this arc. The purpose of this SB was “to provide inspection instructions for the connecting rod piston pin bushing,” and was directed “at each cylinder removal or anytime piston pin bushing material is identified during routine maintenance” procedures. The SB stated: “If piston pin bushing material is recovered from an engine, all of the cylinders, pistons, and piston pins must be removed to allow access for inspection of the connecting rods piston pin bushings.” The SB referenced a figure that showed a magnetic drain plug with an attracted bushing fragment as a typical indication of recovered bushing material.

The engine manufacturer issued Critical Service Bulletin (CSB) 07-1A and a maintenance manual Usua;lrevision after the accident. The CSB, revised September 2, 2020, updated SB07-1’s inspection instructions for the connecting rod piston pin bushing procedures and stated, “COMPLIANCE NECESSARY TO MAINTAIN SAFETY.” The CSB stated that during an oil change, a pre-cleaned catch basin should be placed beneath the oil sump drain and a 1000 micron or less (approximately 0.040” or less) mesh screen placed in the basin to strain the oil sump contents. The strainer, drain plug, and/or quick drain coupling should be examined for abnormal/excessive wear material, metal fragments, and debris to assess the engine condition. Metal fragments on the magnetic drain plug may indicate excessive wear or part damage.

The CSB contained a note that, in part, stated:

The quick drain coupling orifice may trap debris and sediment material. To prevent entrapped material and allow collection of ferrous particles, Continental strongly recommends removing the non-magnetic oil plug (Part No. 532432) or quick drain coupling (Part Nos. 656122, 656995, or 658764) and installing a magnetic drain plug (Part No. 636376 or 656169) in the oil sump to attract and collect ferrous (iron) wear particulate and larger particles that could contaminate the lubrication system. The presence and collection of material on the magnetic drain plug can: 1) indicate an issue with certain engine components; 2) prevent damage to the oil pump and; 3) capture particles that could become lodged in the oil pressure relief-valve and result in a low oil pressure event. Not all engines are equipped with quick drain couplings or magnetic drain plugs - check engine illustrated parts catalog for applicability.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument (IMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	FWA,828 ft msl	**Distance from Accident Site:**	9 Nautical Miles
Observation Time:	15:37 Local	**Direction from Accident Site:**	288°
Lowest Cloud Condition:	Scattered / 4300 ft AGL	**Visibility**	0.75 miles
Lowest Ceiling:	Broken / 7000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	17 knots / 28 knots	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	240°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.02 inches Hg	**Temperature/Dew Point:**	26°C / 23°C
Precipitation and Obscuration:	Heavy - Thunderstorm - Rain		
Departure Point:	Findlay, OH (KFDY)	**Type of Flight Plan Filed:**	IFR
Destination:	South Bend, IN (KSBN)	**Type of Clearance:**	IFR
Departure Time:	15:15 Local	**Type of Airspace:**	

Airport Information

Airport:	FORT WAYNE INTL FWA	**Runway Surface Type:**	
Airport Elevation:	814 ft msl	**Runway Surface Condition:**	Unknown
Runway Used:		**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Minor	**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	2 Minor	**Latitude, Longitude:**	40.924446,-85.017219(est)

The airplane descended under the CAPS canopy and came to rest upright. On impact with the ground, the airplane sustained substantial damage to the forward fuselage, two engine mounts, and both wings. The engine exhibited a hole near the base of the No. 1 cylinder, holes on the top of the crankcase near the Nos. 1 and 2 cylinders, and displacement of both magnetos from their base. The Hobbs meter indicated 3,908.9 hours.

A disassembly examination of the engine revealed that the No. 1 connecting rod was separated from its crankshaft location. The connecting rod was found in a hole torn into the sump near the No. 6 cylinder, and its piston pin end and its bushing were not present. The No. 1 connecting rod bearing end components and sections of its bearing were found within the sump. One connecting rod bolt was displaced from its nut and the other bolt was separated near its nut. The camshaft was deformed near the No. 1 crankshaft connecting rod location. The skirt end of the No. 1 piston was deformed and damaged; however, its piston pin was found in place. The No. 2 connecting rod was found in place; one side of the piston and its skirt end were damaged. The sump contained debris consistent with damaged and liberated internal engine components.

The spark plugs exhibited normal wear and coloration. The piston pin bushings in the Nos. 2, 3, 4, and 6 connecting rods were displaced. The Nos. 2, 3, and 4 connecting rod bushings were chipped. The split lines for the Nos. 2, 3, and 4 bushings were found not clocked in accordance with SB07-1.

The connecting rods with displaced bushings were measured and their bushings were extracted using a pressure gauge. The measurements did not reveal any findings that could explain the bushing migration.

The magnetic oil drain plug was removed and examined, and ferrous material was found attached to its magnet. The oil filter was cut open and particles were found on its pleated filter material.

An oil sample taken from the oil filter during the examination was sent to a laboratory for testing. The results revealed that the sample’s viscosity met the specifications of the required oil.

Additional Information

An operator that used engines with similar connecting rods provided information in reference to piston pin bushing migration. The information, in part, included conditions of piston pin bushing damage that were discovered while examining connecting rod components during cylinder replacement, with a low oil pressure event from bushing material trapped underneath the oil pump pressure relief valve seat, and during engine core disassembly for major overhaul.

The bushing damage observed included retained bushing sections that were cracked in the area of the split line clinch. The sections were fragmented and bushing material was missing. And there was migrated bushing which was fragmented and bushing material missing. The maximum bushing material fragmented and missing was observed to be approximately 20%.

The first occurrence was identified in a core return engine in early to mid-2014. This was a factory engine that had reached its overhaul interval of about 2,700 hours. Five of the six bushings exhibited abnormal operational signatures.

From 2014 through 2019, the company identified about 25 instances of bushing damage. The majority of these instances were connecting rods with bushing part number SA530658. The average engine (bushing) operational hours at time of discovery was about 2,000 hours.

Administrative Information

Investigator In Charge (IIC):	Malinowski, Edward
Additional Participating Persons:	David Shaul; Federal Aviation Administration; Indianapolis, IN Chris Lang; Continental Motors; Mobile, AL Brannon D Mayer; Cirrus; Duluth, MN Kurt Gibson; Continental Motors; Mobile, AL
Original Publish Date:	May 6, 2021
Last Revision Date:	
Investigation Class:	Class 2
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=100263