Aviation Investigation Final Report

Location:	Tappahannock, Virginia	**Accident Number:**	ERA13LA328
Date & Time:	July 20, 2013, 20:03 Local	**Registration:**	N223SS
Aircraft:	CIRRUS DESIGN CORP SR22	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	4 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot reported that the airplane was in cruise flight when he heard a "loud noise" come from the engine, followed by a loss of engine power. The pilot established the airplane's best glide speed and declared an emergency with air traffic control, and an air traffic controller then provided vectors toward the nearest airport. While approaching the airport, the pilot heard another loud noise come from the engine, and oil then covered the windscreen. The pilot chose to deploy the airplane's parachute system, and the airplane descended under the canopy until it came to rest among trees.

Examination of the engine revealed that the crankshaft top rear trailing forward counterweight retaining plate was fractured; the counterweight pin and portions of the plate were found in the crankcase and oil sump. The No. 2 connecting rod was fractured, and the crankcase exhibited significant damage concentrated at the No. 2 cylinder. A material analysis of the fractured counterweight pin revealed failure signatures consistent with overload. The hardness of the plate met manufacturer specifications, and microstructure analysis of the plate appeared normal.

About 4 years before the accident, the engine manufacturer issued a critical service bulletin (SB) "to inform operators of the possible long term effects of low engine RPM in cruise conditions." Models affected included the accident engine make and model. The SB described two instances of sudden engine stoppage as a result of a crankshaft counterweight release. These instances were found to have been associated with engine operation at a sustained cruise rpm of less than 2,300 rpm. As a result, the manufacturer recommended that engine cruise rpm settings be no lower than 2,300 rpm. Although the engine operating manual cautioned that the minimum cruise rpm setting was 2,300 rpm, the airplane manufacturer did not include this information in the Pilot's Operating Handbook. A review of recorded data from the accident airplane revealed that nine flights were flown in the 6 months before the accident and that, during these flights, the accident airplane was operated at or below 2,300 rpm for 20 minutes or longer. However, the investigation could not determine if the top rear trailing forward counterweight retaining plate failed due to these operations.

Probable Cause and Findings

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

A failure of the engine crankshaft top rear trailing forward counterweight retaining plate, which resulted in a total loss of engine power. The reason for the retaining plate's failure could not be determined during postaccident examination.

Findings

Aircraft	Recip engine power section - Failure
Not determined	(general) - Unknown/Not determined

Factual Information

History of Flight

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

On July 20, 2013, at 2003 eastern daylight time, a Cirrus SR22, N223SS, was substantially damaged during impact with trees and terrain after the pilot deployed the airplane's airframe parachute following a total loss of engine power near Tappahannock, Virginia. The private pilot and three passengers were not injured. The personal flight departed from Salisbury-Ocean City Wicomico Regional Airport (SBY), Salisbury, Maryland, about 1930, and was destined for Hanover County Municipal Airport (OFP), Hanover, Virginia. Visual meteorological conditions prevailed, and an instrument flight rules flight plan was filed for the flight, which was conducted under the provisions of Title 14 Code of Federal Regulations Part 91.

The pilot reported that the airplane was in cruise flight at 6,000 feet about 4 miles from Tappahannock-Essex County Airport (XSA), when he heard a "loud noise" from the engine, followed by a loss of engine power. The pilot established the airplane's best glide speed and declared an emergency with air traffic control, who provided vectors toward XSA. Approaching the airport, the pilot heard another loud noise from the engine, and the windscreen became covered with oil. The pilot stated that at this time, the airplane's glide capability "seemed to be significantly reduced," and his visibility through the windscreen was worsening. At an altitude of about 1,000 feet, the pilot elected to deploy the Cirrus Airframe Parachute System (CAPS). The CAPS deployed successfully and the airplane descended under canopy until it came to rest among trees. The pilot and passengers egressed the airplane and were subsequently met by first responders.

Examination of the airplane revealed substantial damage to both wings. The engine cowling was removed, and oil was found throughout the engine compartment. The engine oil dipstick was in place and secure, and when removed, revealed that 3 quarts of oil remained in the crankcase. A visual examination of the engine revealed that the #2 connecting rod had breached the crankcase, and was located on top of the engine along with the piston pin and pieces of the crankcase. The engine was sent to the manufacturer for further examination.

The 2015 recorded weather at XSA, located about 2 miles north of the accident site, included wind from 170 degrees at 5 knots, 10 miles visibility, sky clear, temperature 28 degrees C, dew point 24 degrees C, and a barometric altimeter setting of 29.87 inches of mercury.

Pilot Information

Certificate:	Private	**Age:**	54
Airplane Rating(s):	Single-engine land	**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:**	October 5, 2011
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	March 7, 2013
Flight Time:	2130 hours (Total, all aircraft), 1270 hours (Total, this make and model), 2068 hours (Pilot In Command, all aircraft), 3 hours (Last 90 days, all aircraft), 1 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

The pilot held a private pilot certificate with ratings for airplane single engine land and instrument airplane. His most recent Federal Aviation Administration (FAA) third class medical certificate was issued on October 5, 2011. The pilot reported a total of 2,130 total hours of flight experience, of which 1,270 hours were in the accident airplane make and model.

Aircraft and Owner/Operator Information

Aircraft Make:	CIRRUS DESIGN CORP	**Registration:**	N223SS
Model/Series:	SR22	**Aircraft Category:**	Airplane
Year of Manufacture:	2006	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	1819
Landing Gear Type:	Tricycle	**Seats:**	4
Date/Type of Last Inspection:	March 4, 2013 Annual	**Certified Max Gross Wt.:**	3600 lbs
Time Since Last Inspection:	66 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	1664.3 Hrs at time of accident	**Engine Manufacturer:**	CONT MOTOR
ELT:	C91A installed, activated, did not aid in locating accident	**Engine Model/Series:**	IO-550-N
Registered Owner:	APPENDIX R SOLUTIONS INC	**Rated Power:**	310 Horsepower
Operator:	APPENDIX R SOLUTIONS INC	**Operating Certificate(s) Held:**	None

The airplane was manufactured in 2006, and was powered by a Continental Motors Inc., IO-550-N, 310-horsepower reciprocating engine. The airplane's most recent annual inspection was completed on March 4, 2013, at a total airframe and engine time in service of 1,598 hours. At the time of the accident, the airframe and engine had both accumulated 1,664.3 total hours in service. The engine manufacturer's

recommended time between overhaul was 2,000 hours.

The airplane was equipped with Avidyne primary flight display (PFD) and multifunction flight display (MFD) units. The MFD unit displayed the aircraft checklist, terrain/map information, approach chart information, and comprehensive engine monitoring and performance data. Data was logged and stored on a compact flash (CF) memory card located in a slot on the side of the unit. The memory card was removed and sent to the NTSB Vehicle Recorders Laboratory for download.

The PFD unit included a solid-state air data and attitude heading reference system (ADAHRS) and displayed aircraft flight data including altitude, airspeed, attitude, vertical speed, and heading. The PFD unit had external pitot and static port inputs for altitude, airspeed, and vertical speed information. Each PFD contained two flash memory devices mounted on a riser card. The flash memory stored information used by the unit to generate the various PFD displays. Additionally, the PFD had a data logging function which is used by the manufacturer for maintenance and diagnostics. The PFD unit was removed from the airplane and sent to the NTSB Vehicle Recorders Laboratory for download.

Electronic Devices

The PFD contained recorded events from June 19, 2013 to July 20, 2013. The accident flight was identified by the recorded date and time stamp from July 20 at 23:15:36 UTC (19:15:36 EDT) to 00:04:06 UTC the next day (20:04:06 EDT) over the span of 480 data points. The MFD memory card contained 69 recorded events from December 5, 2012 to July 20, 2013. The accident event was identified by the recorded date and time stamp from July 20 at 23:15:36 UTC to 00:04:06 UTC of the next day over the span of 480 data points.

The data showed the airplane taking off at 19:28:00 and climbing to an average pressure altitude of 8,000 feet. The airplane continued in cruise flight with a fuel flow of about 13 gallons per hour until 19:59:46, when the engine rpm and exhaust gas temperature (EGT) indications dropped to zero. During this time, oil pressure indications dropped from 40 to 33 psi. The airplane subsequently began experiencing increasingly divergent dynamic oscillation in its lateral axis until the end of the flight. At 20:02:00, the airplane's navigational waypoint was changed to XSA. At 20:03:41 and about 500 feet pressure altitude, the airplane pitched nose-down and rolled right, consistent with a CAPS deployment. At 20:03:49, the airplane's accelerations simultaneously spiked, consistent with impact.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	XSA,135 ft msl	**Distance from Accident Site:**	2 Nautical Miles
Observation Time:	20:15 Local	**Direction from Accident Site:**	360°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots / None	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	170°	**Turbulence Severity Forecast/Actual:**	/ N/A
Altimeter Setting:	29.87 inches Hg	**Temperature/Dew Point:**	28°C / 24°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Salisbury, MD (SBY)	**Type of Flight Plan Filed:**	IFR
Destination:	Hanover, VA (OFP)	**Type of Clearance:**	IFR
Departure Time:	19:30 Local	**Type of Airspace:**	Unknown

Airport Information

Airport:	Tappahannock-Essex County XSA	**Runway Surface Type:**	
Airport Elevation:	135 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 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	3 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	4 None	**Latitude, Longitude:**	37.88639,-76.879447(est)

Additional Information

Engine Examination

The engine was examined at the manufacturer's facility on February 20, 2014. Examination of the cylinders revealed normal operating signatures and combustions deposits. The intake and exhaust valve faces and seats exhibited full seat contact signatures, and the intake and exhaust valve guides exhibited normal wear and operating signatures. The intake and exhaust rocker arms and shafts also exhibited normal operating signatures. All piston heads exhibited normal combustion deposits. The #1, 2, 3, and 4 piston skirts exhibited mechanical damage.

The crankshaft and counterweight assembly was mechanically damaged. The connecting rod journals, main journals, and thrust surfaces were mechanically damaged and showed no signs of abnormal wear or inadequate lubrication. The crankshaft counterweight pins, plates, and snap-rings were intact with the exception of the top rear trailing forward side counterweight plate, which was broken, with the pin and portions of the plate located in the oil sump and crankcase. The rear counterweights were mechanically damaged. The front set of counterweights were undamaged and had free and unrestricted movement on the hanger blades. The gear bolts were tight, safetied, and the gear teeth were undamaged.

The #2 connecting rod exhibited significant mechanical damage and was fractured through at the base of the I-beam. Fragments of the connecting rod cap exhibited mechanical damage, and fragments of connecting rod bolts and nuts were fractured through and exhibited mechanical damage and overload signatures.

The crankcase exhibited exterior damage concentrated at the #2 cylinder. Cylinder bays #1, 2, 3, and 4 were mechanically damaged, with portions of the crankcase missing above the #2 cylinder. The main bearing support mating surfaces were intact and exhibited no signs of fretting or bearing tank lock-slot elongation. The main bearing support diameters were intact and exhibited no signs of bearing movement or rotation. The oil galleys and passages in the left and right crankcase halves were intact, clear, and unrestricted.

A material analysis of the fractured counterweight pin revealed failure signatures consistent with overload. The hardness of the plate met manufacturer specifications, and microstructure analysis of the plate appeared normal.

Service Bulletin Information

On September 25, 2009, the engine manufacturer issued critical service bulletin CSB09-11, Minimum Cruise RPM Limits, "to inform operators of the possible long term effects of low engine RPM in cruise conditions." Models affected included the accident engine make and model. The service bulletin described two instances of sudden engine stoppage as a result of a crankshaft counterweight release. These instances were found to have been associated with engine operation at sustained cruise rpm of less than 2,300 rpm. As a result, the manufacturer recommended that engine cruise rpm settings be no lower than 2,300 rpm. The engine manufacturer's installation and operation manual also stated, "CAUTION: Minimum cruise RPM for this engine series is 2300 RPM."

Review of the recorded PFD and MFD data revealed 9 local area maneuvering flights in the 6 months prior to the accident, during which the accident airplane was operated at or below 2,300 rpm for durations of 20 minutes or longer.

Administrative Information

Investigator In Charge (IIC):	Neylon, John
Additional Participating Persons:	Kenny Bain; FAA/FSDO; Richmond, VA Brad Miller; Cirrus Aircraft; Duluth, MN Mike Council; Continental Motors; Mobile, AL
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