Aviation Investigation Final Report

Location:	Cross City, Florida	**Accident Number:**	ERA11LA130
Date & Time:	January 27, 2011, 19:19 Local	**Registration:**	N8135B
Aircraft:	CIRRUS DESIGN CORP SR22	**Aircraft Damage:**	Substantial
Defining Event:	Powerplant sys/comp malf/fail	**Injuries:**	1 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The airplane's engine lost power during cruise flight at 9,000 feet, and the pilot declared an emergency. Air traffic control (ATC) personnel initially provided the pilot with headings to a nearby airport. However, when the pilot realized that he would not reach the intended airport, he deployed the airplane's parachute, and the airplane came to rest upright in a field.

Postaccident examination of the engine revealed that the camshaft was completely fractured due to fatigue cracks near the flange at the oiling holes. Further examination showed that the fatigue cracks initiated at the edge of the oiling holes and were caused by burrs left when the camshaft was originally manufactured. The burrs folded over during subsequent shot-peening operations, which formed laps at the corners of the holes; the laps acted to concentrate stresses at the edges of the holes and also shielded the underlying material during shot peening. The laps prevented formation of the beneficial compressive stresses that result from shot peening. This allowed subsequent formation of fatigue cracks.

The accident camshaft was determined to have been the 19th camshaft of its type manufactured. Because the camshaft was not a serialized part, specific manufacturing records could not be located. However, the quality control inspection procedures that were in place at the time the camshaft was manufactured required an inspection of the oil holes for proper de-burring. A search of FAA database revealed no similar camshaft fracture failure between 1995, and February 2012, excluding the accident event.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: A total loss of engine power resulting from the failure of the camshaft due to fatigue cracks. Contributing to the accident was the inadequate quality inspection of the camshaft after initial manufacture.

Findings

Aircraft	Recip engine power section - Fatigue/wear/corrosion
Personnel issues	(general) - Not specified

Factual Information

History of Flight

Enroute-cruise	Powerplant sys/comp malf/fail (Defining event)
Enroute-cruise	Loss of engine power (total)
Emergency descent	Off-field or emergency landing
Emergency descent	Miscellaneous/other
Landing	Hard landing

HISTORY OF FLIGHT

On January 27, 2011, about 1919 eastern standard time, a Cirrus Design Corp. SR22, N8135B, registered to Deep South Express LLC, and operated by a commercial pilot, experienced a loss of engine power during cruise flight in the vicinity of Cross City, Florida. The pilot deployed the airframe ballistic recovery system parachute and the airplane descended into a field near Cross City. Visual meteorological conditions prevailed at the time and an instrument flight rules flight plan was filed for the 14 Code of Federal Regulations (CFR) Part 91 personal flight, from Weedon Field Airport (EUF), Eufaula, Alabama, to Leesburg International Airport (LEE), Leesburg, Florida. The airplane sustained substantial damage, and the pilot, the sole occupant, was not injured. The flight originated from EUF about 1819.

The pilot stated that earlier that day he and the student/airplane owner flew the airplane from LEE to EUF, where the student was dropped off. After landing, the fuel tanks were filled. After fueling, he checked the wing tanks and fuel strainer for contamination; no contaminants were found. He also performed a preflight inspection of the airplane before departure; no discrepancies were reported. He received an IFR clearance while on the ground at Eufaula for an IFR flight direct to Leesburg.

The flight departed and climbed to 7,000 feet, then later climbed to 9,000 feet. Approximately 1 hour into the flight, while north-northwest of Cross City, with the engine operating between 2,500 and 2,600 rpm and 23 inches manifold pressure, the pilot reported the engine surged then lost power. Utilizing the emergency procedures checklist, he activated the engine alternate air control, switched the fuel selector, moved the magneto switch to left and right positions, and turned on the auxiliary fuel pump in efforts to restore engine power but was unsuccessful.

According to a transcription of communications with the Taylor Radar Control Position of the Jacksonville Air Route Traffic Control Center (Jacksonville ARTCC), at 1913:02, the pilot advised the controller that he may be having "…some engine problems here", to which the controller asked the pilot to repeat that transmission. The pilot repeated his transmission about an engine problem and alerted the controller that he might need to divert. The controller

immediately advised the pilot of the distance and direction to the Cross City Airport (CTY), and asked the pilot if he was declaring an emergency, to which he replied yes. The controller advised the pilot to descend and maintain 3,000 feet, which he read back. The pilot advised that he proceeded towards CTY using the on-board global positioning system (GPS) receiver, and began descending at best glide airspeed.

Air traffic control communications were transferred to another sector at the Jacksonville ARTCC, and that controller provided the pilot with weather for Gainesville, and instructed him to report the Cross City Airport in sight. The controller asked the pilot the nature of the emergency and at 1916:23, the pilot advised the controller that the engine was only operating at 1,500 rpm. The flight continued, and at 1918:24, the pilot informed the controller that he would be unable to land at CTY. The controller asked the pilot to state his intentions, and the pilot informed the controller that he intended on landing the airplane in a field, but reported it was dark in that area. The controller asked the pilot of another airplane if he was familiar with the area and the pilot of that airplane replied that there were open fields near the VOR near the CTY airport.

The controller vectored the flight towards the VOR, and at 1919:21, the controller asked the pilot what type of airplane he was flying to which the pilot replied the make and model. The controller asked the pilot, "…obvious question you do not have the parachute recovery system" to which the pilot immediately replied, "I do I'm deploying right now." The pilot reported that he felt deceleration as a result of the parachute deployment, then while descending did not feel anything else because of the dark area he was over. He was wearing the 4-point harness which was cinched tight, and reported the ground contact as being, "harder than a hard landing."

While on the ground using the airplane's VHF transceiver, he broadcast to another pilot nearby his latitude and longitude, who in turn relayed that to air traffic control (ATC). Personnel of the ATC facility relayed that to law enforcement personnel who proceeded to the scene. While on the ground he did not recall hearing the on-board emergency locater transmitter (ELT) activating or bleeding over onto the VHF frequency he was communicating on.

PERSONNEL INFORMATION

The pilot, age 28, holds private, commercial, and flight instructor certificates. At the commercial level, he was endorsed with airplane single engine land and instrument airplane ratings, and held a second class medical certificate with no medical restrictions or limitations issued October 5, 2009.

The NTSB Pilot/Operator Aircraft Accident/Incident Report submitted by the pilot indicates his total flight time was 470 hours, of which 442 hours were as pilot-in-command (PIC). Of the 442 hours as PIC, 30 were in the accident make and model airplane.

AIRCRAFT INFORMATION

The SR22 airplane was manufactured by Cirrus Design Corporation in 2003, and designated serial number 0669. It was certificated in the normal category, and powered by a 310 horsepower Teledyne Continental Motors IO-550-N engine and equipped with a constant speed Hartzell PHC-J3YF-1RF propeller with F7694 propeller blades.

Review of the maintenance records revealed the engine oil was documented as being changed last during a 100-Hour inspection of the engine which was signed off on August 11, 2010. While the entry by the repair station indicates that 8 quarts of Aeroshell 100R oil were added, the Chief Inspector for the repair station later indicated in fact that Aeroshell 100 Straight Mineral Oil were added and the "R" suffix was an internal code used for pricing and invoicing. The Chief Inspector for the repair station also indicated that they incorporated a change to their procedures for maintenance record entries to specify the exact grade and type of engine oil added per the container. The airplane total time at that time was recorded to be approximately 1,371 hours.

The airplane total time at the time of the accident was recorded to be approximately 1,414 hours, or an elapsed time of approximately 43 hours since the last oil change.

METEOROLOGICAL INFORMATION

A surface observation weather report taken at Cross City Airport (CTY) at 1853, or approximately 24 minutes before the accident indicates the wind was from 220 degrees at 4 knots, the temperature and dew point were 08 and 03 degrees Celsius respectively, and the altimeter setting was 30.09 inches of Mercury. The accident site was located approximately 11 nautical miles and 033 degrees from CTY.

COMMUNICATIONS

The pilot was in contact with the Tallahassee Radar Control Position of the Jacksonville Air Route Traffic Control Center. There were no reported communication difficulties. Following a loss of radio contact with the accident pilot, the controller had the pilot of a nearby airplane divert to the area who was able to relay information to and from the controller.

FLIGHT RECORDERS

The airplane was equipped with components that record and retain non-volatile memory associated with flight. The components that have non-volatile memory or retain data consist of a primary flight display (PFD) and multi-function display (MFD), both of which were manufactured by Avidyne. The PFD and data storage card from the MFD were retained and submitted to the NTSB's Vehicle Recorder Division for data extraction.

WRECKAGE AND IMPACT INFORMATION

Examination of the airframe by a representative of the airframe manufacturer with Federal

Aviation Administration (FAA) oversight revealed the lower aft lip of the spar cover was substantially damaged.

Examination of the Teledyne Continental IO-550-N (27) engine S/N 913919 was performed by a representative of the engine manufacturer with FAA oversight. The examination confirmed crankshaft continuity; however, hand rotation of the crankshaft did not produce valve train action at any cylinder. Approximately 16.9 pounds oil (including the weight of the plastic bucket) were drained from the engine. Disassembly inspection of the engine revealed that the camshaft, part number (P/N 654084 D), was completely fractured approximately 1 inch forward of the flange. A sample of oil drained from the engine was later submitted to a company for analysis revealing the oil brand was Shell, the oil type was AeroShell 100, and the SAE grade was 50. The testing report revealed that, “all values appeared normal.” An oil analysis report is contained in the NTSB public docket for this case. A detailed engine examination report with accompanying pictures is contained in the NTSB public docket for this case. The two pieces of the camshaft were retained for further examination by the NTSB’s Materials Laboratory located in Washington, D.C.

Examination of the fractured camshaft by the NTSB’s Materials Laboratory revealed a viborpeen marking “B15-00-19” on the aft face of the flange. The camshaft was fractured through the oiling holes for the aft bearing and connected three of the four holes. Fatigue regions were optically identified at four locations. In all instances crack arrest lines and fracture traces indicated fatigue initiations at or in the vicinity of the outside corners of the holes. Close examination revealed lapped and folded material at all of the origin corners. The lapped material and surrounding surfaces had a surface texture consistent with shot peening. While the engineering drawing depicts that the outer surface of the holes are to be chamfered with a maximum of .0020 inch, measurements indicated a chamfer greater than specified. The engineering drawing also depicts that chamfering should be accomplished before shot peening.

The Materials Laboratory Factual Report also indicated that surface hardness testing of the cam lobes and bearing surfaces measured 60 Rockwell C (HRC) specification is 58 to 62 HRC, and the core hardness of one area tested was 27.7 (specification is 25 to 45 HRC). Ferritic structure consistent with surface decarburization was uncovered at most surfaces of the camshaft intersected by the cross section. The typical decarburization layer measured between 0.002 and 0.004 inch in thickness, while CMI personnel report there are no limits set for decarburization in the carburization heat treatment and subsequent hardening operations. A detailed report with accompanying pictures is contained in the NTSB public docket for this case.

TEST AND RESEARCH

Personnel from Teledyne Continental Motors reported that camshaft P/N 654084 Revision D became effective on August 17, 1998. That P/N superseded camshaft P/N 654837. On October 21, 1999, Revision E to the P/N became effective which added marking each camshaft

with a serialized number on the flange. Continental Motors, Inc. (CMI), (formerly Teledyne Continental Motors) personnel reported that the serial number system pertaining to camshafts consists of a 9 alpha numeric sequence (such as Z08GA188), with the first character being “Z” for a camshaft. The second and third numbers correlate to the last 2 digits of year of manufacture. The fourth letter correlates to the month of manufacture, and the fifth thru seventh numbers represents sequential manufacturing letter and numbers. Personnel from CMI also reported that it takes about 1 year from the date a revision becomes effective to the date that revised components are manufactured.

Based on the vibropeen marking on the aft side of the camshaft flange“B15-00-19”, CMI personnel reported that marking was consistent with marking made during manufacturing indicating it was the 19th camshaft manufactured on February 15, 2000. Because the camshaft was not serialized, manufacturing records could not be located. CMI personnel reported that item 16 of their quality control inspection procedures titled, “General Condition” for the accident camshaft P/N specifies to verify proper de-burring, and their “Quality Audit Checklist: Camshaft Line” specifies to, “…verify all oil holes in all bearing grooves have been deburred.”

Review of the engine maintenance records revealed the engine serial number (S/N 913919) was last overhauled by a FAA certified repair station (CRS) in March 2008. During the inspection process, the camshaft was rejected and a reconditioned camshaft part number (P/N 654084 D) was obtained from an outside company and installed. The engine was approved for return to service on March 6, 2008, and returned for installation in the airplane; however, the airplane owner learned that re-ground lifters were installed and had the engine returned to the overhaul facility where new lifters were installed. The engine was returned to the airplane owner, and installed in the accident airplane on April 1, 2008. The airplane total time at the time of engine installation was recorded to be approximately 1,021 hours, and the airplane total time at the time of the accident was recorded to be 1,414 hours, or approximately 393 hours since overhaul.

According to the president of the facility that last overhauled the engine, he was not sure why the engine was sent to him for overhaul because it had only approximately 1,021 hours since new. He stated that with respect to the reconditioned camshaft, when it was received at their facility, they only performed a visual inspection of it; no other quality control checks or inspections were performed.

The paperwork associated with the re-conditioned camshaft reflected the work was performed by a FAA CRS named Rock Aviation, Inc., on April 26, 2006. The paperwork reflected P/N 654084; and the S/N was recorded as “N/A.” The paperwork indicated that it was, “Repaired per RAPS-1 [Inspected] per RAIP-1.”

According to FAA personnel, Rock Aviation, Inc.’s repair station certificate was revoked on October 3, 2008, for a Federal Aviation Regulation (FAR) violation dated May 30, 2007. The FAR violation was related to a requirement that each supervisor must be certificated under 14 CFR

Part 65.

Attempts by NTSB and FAA personnel to obtain records pertaining to the camshaft from former Rock Aviation, Inc., personnel were unsuccessful.

According to the NTSB's Cockpit Display(s)-Recorded Flight Data report prepared by the Vehicle Recorder Division, the PFD and data card from the MFD contained recorded data that was downloaded. Plot 1 of the report containing data downloaded from both components indicates the oil pressure remained nearly constant from the point takeoff power was applied to the point the engine rpm began decreasing from the steady state setting. A detailed report with plots and a Google Earth image depicting the flight path, along with the raw data are contained in the NTSB public docket for this case.

A search of the FAA database from 1995 to February 2, 2012, concerning camshaft P/N 654084 revealed a total of 4 entries. One of the 4 entries was from the accident event, and none of the other 3 entries involved fracture failure of the camshaft. A copy of the database search results is included in the public docket for this case

Pilot Information

Certificate:	Commercial; Flight instructor; Private	**Age:**	28,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane single-engine	**Toxicology Performed:**	No
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	October 5, 2009
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	September 13, 2010
Flight Time:	470 hours (Total, all aircraft), 30 hours (Total, this make and model), 442 hours (Pilot In Command, all aircraft), 95 hours (Last 90 days, all aircraft), 54 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	CIRRUS DESIGN CORP	**Registration:**	N8135B
Model/Series:	SR22	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	0669
Landing Gear Type:	Tricycle	**Seats:**	4
Date/Type of Last Inspection:	August 11, 2010 Annual	**Certified Max Gross Wt.:**	3400 lbs
Time Since Last Inspection:	43 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	1414 Hrs at time of accident	**Engine Manufacturer:**	CONT MOTOR
ELT:	Installed, not activated	**Engine Model/Series:**	IO-550-N
Registered Owner:	Deep South Express LLC	**Rated Power:**	310 Horsepower
Operator:	Deep South Express LLC	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	CTY,42 ft msl	**Distance from Accident Site:**	11 Nautical Miles
Observation Time:	18:53 Local	**Direction from Accident Site:**	213°
Lowest Cloud Condition:	Unknown	**Visibility**	
Lowest Ceiling:	Unknown	**Visibility (RVR):**	
Wind Speed/Gusts:	4 knots / None	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	220°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.09 inches Hg	**Temperature/Dew Point:**	8°C / 3°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Eufaula, AL (EUF)	**Type of Flight Plan Filed:**	IFR
Destination:	Leesburg, FL (LEE)	**Type of Clearance:**	IFR
Departure Time:	18:19 Local	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 None	**Latitude, Longitude:**	29.790832,-82.986946(est)

Administrative Information

Investigator In Charge (IIC):	Monville, Timothy
Additional Participating Persons:	Larry A Penland; FAA/FSDO; Orlando, FL Brannon Mayer; Cirrus Design Corp.; Duluth, MN Rodney Martinez; Teledyne Continental Motors; Mobile, AL
Original Publish Date:	August 7, 2012
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=78255