Aviation Investigation Final Report

Location:	Burlington, Massachusetts	**Incident Number:**	ERA14IA301
Date & Time:	June 11, 2014, 13:31 Local	**Registration:**	N813JE
Aircraft:	CIRRUS DESIGN CORP SR22	**Aircraft Damage:**	Minor
Defining Event:	Loss of engine power (total)	**Injuries:**	2 None
Flight Conducted Under:	Part 91: General aviation - Instructional		

Analysis

The flight instructor reported that he and the pilot receiving instruction had completed a local instructional flight and were returning to the departure airport. While the airplane was about 1,700 ft mean sea level, the engine began running roughly and subsequently lost all power. The pilot receiving instruction immediately handed over the flight controls to the flight instructor. The flight instructor attempted to maneuver the airplane to a field for a forced landing but realized that the airplane would not be able to reach the field, so the pilots activated the ballistic parachute system. After the parachute deployed, the airplane touched down in an area of dense vegetation.

Postincident examination of the engine revealed that the crankshaft had fractured at the No. 2 main journal and that the camshaft had fractured between the Nos. 2 and 3 main bearing supports. The No. 2 main bearing had shifted, and fretting was present on the main bearing supports, consistent with a loss of clamping load on the crankcase, which resulted in movement of the No. 2 bearing and excessive loading on, and the ultimate failure of, the crankshaft. The nuts securing the No. 5 cylinder to its two crankcase through bolts had less torque than that specified by the engine manufacturer's installation guidance, and it is possible that the loss of clamping load on the crankcase was due to a loss of torque to the adjacent No. 5 cylinder crankcase through bolts. According to maintenance records, the No. 5 cylinder had been removed and replaced about 4 months, or 27 flight hours, before the accident. Although the logbook entry indicated that the through bolts were torqued "from each side to [the engine manufacturer's] specifications," it is likely that, while replacing the No. 5 cylinder, maintenance personnel did not properly torque the cylinder crankcase through bolts, which resulted in displacement of the No. 2 bearing and the catastrophic failure of the engine.

Probable Cause and Findings

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

A loss of clamping load of the No. 5 cylinder crankcase through bolts due to maintenance personnel's failure to properly torque the through bolts during recent maintenance, which resulted in displacement of the No. 2 bearing and the subsequent catastrophic engine failure.

Findings

Aircraft	Recip eng cyl section - Incorrect service/maintenance
Personnel issues	Installation - Maintenance personnel
Aircraft	(general) - Incorrect service/maintenance

Factual Information

History of Flight

Approach	Loss of engine power (total) (Defining event)
Emergency descent	Off-field or emergency landing
Emergency descent	Collision with terr/obj (non-CFIT)

On June 11, 2014, about 1331 eastern daylight time, a Cirrus Design Corp. SR22, N813JE, operated by East Coast Aero Club, incurred minor damage during a forced landing after the flight instructor activated the Cirrus Airframe Parachute System (CAPS) near Burlington, Massachusetts. Both airline transport pilots were uninjured. Visual meteorological conditions prevailed for the instructional flight conducted under Title 14 Code of Federal Regulations Part 91. The local flight originated from Laurence G. Hanscom Field (BED) Bedford, Massachusetts at 1245.

According to the flight instructor, the pilot seated in the right front seat was receiving instruction for an insurance checkout in the airplane. After completing several touch and go maneuvers at a nearby airport, the pilot flew the airplane to BED, which was located at a field elevation of 132 feet mean sea level (msl). About 5 miles from the airport they leveled the airplane at an altitude of 1,700 feet msl. The engine started running "very rough and shaking violently." The pilot immediately handed over the flight controls to the flight instructor, who flew the airplane while the pilot-rated passenger completed the emergency checklist. About 15 seconds later the propeller stopped.

The flight instructor pitched for best glide while they searched for a suitable landing site. They selected a field to their right and turned to initiate their approach. At 600 ft. msl the pilots decided they would not make the field and elected to activate the CAPS. They pulled the handle "according to the placard" and pulled the fuel mixture lever to the cutoff position. After the parachute deployed the occupants felt a "very strong backwards pull". The airplane then rocked back and forth. The pilots shut off the fuel selector, fuel pump, magnetos and switches while descending in a slight nose down attitude. The airplane came to rest in an area of high vegetation surrounded by trees.

The flight instructor and pilot each held airline transport certificates with ratings for instrument airplane, airplane single-engine land, and airplane multiengine land. They both also possessed flight instructor certificates with ratings for airplane single-engine, airplane multiengine, and instrument airplane. The flight instructor's most recent first class medical certificate was issued on February 27, 2014. She reported 6,983 hours of total flight experience, 328 of which were in the accident airplane make and model. The pilot reported 2,511 hours of total flight experience, 377 of which were in make and model of the accident airplane.

The airplane was manufactured in 2008 and equipped with a Continental IO-550-N engine. According to a maintenance work order, on June 9, 2011, a new cylinder, piston, piston ring, and lifter were installed at 539 flight hours, after a crack was discovered in the number 4 cylinder. When asked about the procedure used to mount the replacement cylinder, the director of maintenance responsible for this work

stated that the facility normally added oil to the bolt threads and torqued the through bolts from both sides of the crankcase. They also verified the proper torque from "both sides."

On February 5, 2014, at 1269.4 flight hours, the number 5 cylinder was removed due to low compression. According to the maintenance logbook entry, the through bolts were torqued "from each side to [the engine manufacturer's] specifications." The logbook entry stated that an engine ground run was completed, "in accordance with cylinder break in procedures," and no leaks or defects were noted.

An oil change was performed on February 18, 2014. According to the logbook entry, the oil filter was cut open and no metal was found. The most recent annual inspection was completed on April 4, 2014, at a tachometer time of 1293.2 hours. According to the logbook entry, the compression values at the time were: (1) 62/80, (2) 57/80, (3) 67/80, (4) 62/80, (5) 75/80, and (6) 73/80. No anomalies were noted during the inspection. The tachometer read 1320.6 hours at the time of the accident.

The airplane came to rest in a slightly nose low attitude and was not easily accessible as the area was covered by dense vegetation. The airplane was recovered from the site and examination of the airframe revealed some scratches and dents throughout the fuselage and wings that did not meet the criteria for substantial damage. The lower skin of the left wing displayed an orange-brown residue and the pitot tube was partially separated from its mount. The propeller blades exhibited some gouges and scratches, but did not display any bending.

Examination of the oil quantity indicator rod revealed approximately 5 quarts of oil in the engine, and the presence of metallic particles in the oil sump. Both the upper and lower spark plugs were removed and inspected, with oil deposits noted on the spark plugs for cylinders 3 and 6.

Recoverable Data Module (RDM) Examination

The airplane was equipped with a Recoverable Data Module (RDM) mounted in the empennage, which was intended to recover various flight and aircraft parameters. The device was retained after the accident, and forwarded to the NTSB Vehicle Recorders Laboratory, Washington, D.C., for data recovery.

According to the RDM data, the engine lost power at 1329:50, and immediately after, the airplane began descending from a GPS-derived altitude of 577 feet. In the 10 seconds that followed, the exhaust gas temperatures (EGT) for cylinder numbers 1, 3, and 5 increased from about 1,350 degrees F to about 9,700 degrees F and then decreased. The CAPS was activated at 1330:50, and the CAPS rocket deployed at the same time. After the parachute deployed, the EGT for cylinder number 1 was about 2,400 degrees F, and the EGTs for cylinder numbers 3 and 5 were about 5,000 degrees F for the remainder of the data recording, which ceased at 1331:15.

Engine Teardown Inspection

A teardown of the engine was completed at Continental Motors, Inc. in Mobile, Alabama under the supervision of the NTSB. Examination of the engine revealed the crankshaft fractured at the number 2 main journal and the camshaft fractured between the number 2 and 3 main bearing supports. The number 2 main bearing support exhibited evidence of bearing shift, in addition to varying degrees of fretting and lock-slot elongation on the main bearing supports.

A snap ring and plate were missing from the rear set of crankshaft counterweights that were later found in the oil sump. Metallurgical examination of the snap ring and plate revealed the radii at the base and

width of the groove were within the prescribed tolerance. The plate exhibited witness marks at the retainer ring ends and the snap ring was installed with the sharp edge out.

The through bolt breakaway torque values were all within the bolt torqueing limits prescribed by Continental Motors, Inc. Service Bulletin SB96-76C, with the exception of both bolts for cylinder number5, which were about 150 inch-pounds below the lower limits.

Flight instructor Information

Certificate:	Airline transport; Commercial; Flight instructor	**Age:**	59,Female
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	February 27, 2014
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	June 6, 2014
Flight Time:	6983 hours (Total, all aircraft), 328 hours (Total, this make and model), 6600 hours (Pilot In Command, all aircraft), 233 hours (Last 90 days, all aircraft), 102 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft)		

Pilot Information

Certificate:	Airline transport; Commercial; Flight instructor	**Age:**	26,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine	**Toxicology Performed:**	No
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	December 18, 2013
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	November 26, 2013
Flight Time:	(Estimated) 2511 hours (Total, all aircraft), 377 hours (Total, this make and model), 2443 hours (Pilot In Command, all aircraft), 105 hours (Last 90 days, all aircraft), 42 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	CIRRUS DESIGN CORP	**Registration:**	N813JE
Model/Series:	SR22	**Aircraft Category:**	Airplane
Year of Manufacture:	2008	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	3107
Landing Gear Type:	Tricycle	**Seats:**	4
Date/Type of Last Inspection:	June 4, 2014 Annual	**Certified Max Gross Wt.:**	3400 lbs
Time Since Last Inspection:	28 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	1320 Hrs at time of accident	**Engine Manufacturer:**	CONT MOTOR
ELT:	C126 installed, not activated	**Engine Model/Series:**	IO-550-N
Registered Owner:	BEE FLYERS LLC	**Rated Power:**	310 Horsepower
Operator:	East Coast Aeroclub, Inc.	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	BED,132 ft msl	**Distance from Accident Site:**	3 Nautical Miles
Observation Time:	13:30 Local	**Direction from Accident Site:**	245°
Lowest Cloud Condition:		**Visibility**	10 miles
Lowest Ceiling:	Overcast / 11000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	10 knots / None	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	110°	**Turbulence Severity Forecast/Actual:**	/ N/A
Altimeter Setting:	30.17 inches Hg	**Temperature/Dew Point:**	21°C / 9°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	BEDFORD, MA (BED)	**Type of Flight Plan Filed:**	None
Destination:	BEDFORD, MA (BED)	**Type of Clearance:**	Traffic advisory
Departure Time:	12:45 Local	**Type of Airspace:**	Class D

Airport Information

Airport:	LAURENCE G HANSCOM FLD BED	**Runway Surface Type:**	
Airport Elevation:	132 ft msl	**Runway Surface Condition:**	
Runway Used:		**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	2 None	**Aircraft Damage:**	Minor
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 None	**Latitude, Longitude:**	42.488609,-71.219718

Administrative Information

Investigator In Charge (IIC):	Stein, Stephen
Additional Participating Persons:	Craig Joliffe; FAA/FSDO; Boston, MA Richard Fulton; FAA/FSDO; Boston, MA Brad Miller; Cirrus Aicraft Corportation; Duluth, MN Mike Council; Continental Motors Inc.; Mobile, AL
Original Publish Date:	January 21, 2016
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB did not travel to the scene of this incident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=89476