Aviation Investigation Final Report

Location:	Duncan, Oklahoma	**Accident Number:**	DEN08LA163
Date & Time:	September 28, 2008, 15:25 Local	**Registration:**	N6714E
Aircraft:	Beech C23	**Aircraft Damage:**	Substantial
Defining Event:	Powerplant sys/comp malf/fail	**Injuries:**	2 Minor
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

During the local flight, the airplane's engine began to violently shake and the pilot elected to shut down the engine and perform an emergency landing to a field. The airplane impacted a fence and terrain, which resulted in a bent firewall and left wing. A review of the maintenance records showed that, approximately 23 hours prior, the engine had experienced a loss of engine oil due to faulty maintenance during an annual inspection. The engine underwent maintenance and the airplane was returned to service. Examination and disassembly of the engine revealed that the crankshaft had fractured into 3 sections and that improper maintenance had been performed on several engine components. Metallurgical examination of the crankshaft revealed that the crankshaft had been improperly reworked which resulted in fatigue and crankshaft failure. The crankshaft rework and engine reassembly did not follow the manufacturer's overhaul manual.

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 due to the fatigue failure of the engine crankshaft. Contributing to the accident were the improper maintenance to the engine crankshaft, improper reassembly of the engine, and failure to follow the engine manufacturer's overhaul manual.

Findings

Aircraft	Recip engine power section - Failure
Aircraft	Recip engine power section - Fatigue/wear/corrosion
Personnel issues	Repair - Maintenance personnel
Aircraft	Recip engine power section - Incorrect service/maintenance
Personnel issues	Use of manual - Maintenance personnel

Factual Information

History of Flight

Maneuvering	Powerplant sys/comp malf/fail (Defining event)
Emergency descent	Loss of engine power (total)

On September 28, 2008, at 1525 central daylight time, a Beech C23 single-engine airplane, N6714E, sustained substantial damage when it impacted terrain following a loss of engine power while maneuvering near Duncan, Oklahoma. The private pilot, who was the registered owner, and passenger sustained minor injuries. Visual meteorological conditions prevailed for the Title 14 Code of Federal Regulations Part 91 personal flight. The local flight departed Duncan approximately 1500.

The pilot, who purchased the airplane in February 2008, flew the airplane from Guthrie, Oklahoma, to Duncan on a 1.3 hour flight with no problems noted. The passenger boarded the airplane in Duncan, and the pilot performed a run-up prior to the local flight. At an altitude of 2,500 mean sea level (msl), the engine RPM dropped, and the engine "shook violently." The pilot attempted to troubleshoot the engine problem; however, the engine vibration continued. The pilot elected to shut down the engine and execute a forced landing to a field. During the forced landing, the airplane impacted a fence and terrain. Examination of the airplane revealed the firewall and left wing were bent and buckled. The tachometer showed 1,688 hours at the time of the accident.

A review of the Lycoming O-360-A4K (s/n: L26749-36A) engine maintenance records revealed the engine underwent its most recent "annual" inspection on December 20, 2007, at a tachometer time of 1,661.8 hours. During the inspection, the engine oil cooler lines were replaced and no additional anomalies were noted. On January 21, 2008, at a tachometer time of 1,664.8 hours, the engine underwent maintenance due to an engine oil leak caused by a crack oil cooler elbow fitting. Included in that maintenance was the disassembly of the engine and replacement of the rod bearings, main crankshaft bearings, and piston rings. The engine was test run and leak checked with no anomalies noted. The engine maintenance records stated that the maintenance was done in accordance with the Lycoming Overhaul Manual.

On October 21, 2008, the engine was examined and disassembled at the facilities of Air Salvage of Dallas, Lancaster, Texas, under the supervision of a NTSB investigator, and three Federal Aviation Administration (FAA) inspectors. According to a FAA inspector's report, examination of the engine revealed the wrong gasket was installed on the oil filter adapter assembly, the oil filter contained metal debris, the piston rings were worn and did not exhibit etched part numbers, and the oil rings were different between the 4 pistons. Internal examination of the engine revealed the crankshaft was fractured into 3 sections, 2 of the 8 tappets exhibited pitting, the aft main bearings and rod bearing part numbers matched the

January 2008 engine maintenance record entry, however, the front main bearings did not match the part number indicated in the record. The fractured crankshaft was retained for metallurgical examination.

The fractured crankshaft was examined by the NTSB materials laboratory. Examination of the crankshaft revealed the crankshaft was fractured in two places; one fracture occurred forward of the number 2 crankshaft journal and one fracture occurred aft of the number 3 crankshaft journal. The features on both fracture surfaces were consistent with fatigue crack propagation with crack initiation at the journal radii. Circumferential crack arrest lines were observed on both fracture surfaces and ratchet marks were visible on the forward fracture surface, consistent with fatigue crack growth. The crack arrest lines and ratchet marks pointed towards the journal radius as the initiation site for both fatigue cracks.

Size measurements of the crankshaft journals were consistent with material removal from some of the journals. Three of the four crankshaft journals were undersized. Journal numbers 2 and 4 were undersized by 0.003 inch, and number 3 was undersized by 0.005 inch. According to the Lycoming Overhaul Manual, the crankshaft journal diameters may be reduced by 0.003 inch by polishing without renitriding the crankshaft. In that event, it is advised that all journals be polished to the same size. Grinding is not advised as it may penetrate the nitride layer at the journal radius leaving the crankshaft prone to fatigue failure. If a journal is polished to undersize, the code "M03P" should be stamped as a suffix to the part number on the flange. There was no code suffix found on the flange. If a journal is reduced by more than 0.003 inch, the journals should be ground to undersize, the shaft renitrided and the code "RN" stamped as a suffix to the serial number on the flange. There was no code suffix found on the flange. In addition, there was no documentation noted in the maintenance records that the shaft had been renitrided.

Pilot Information

Certificate:	Private	**Age:**	53,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 Without waivers/limitations	**Last FAA Medical Exam:**	September 12, 2007
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	June 4, 2007
Flight Time:	113 hours (Total, all aircraft), 27 hours (Total, this make and model), 52 hours (Pilot In Command, all aircraft), 11 hours (Last 90 days, all aircraft), 3 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Beech	**Registration:**	N6714E
Model/Series:	C23	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	M-2200
Landing Gear Type:	Tricycle	**Seats:**	4
Date/Type of Last Inspection:	December 20, 2007 Annual	**Certified Max Gross Wt.:**	2450 lbs
Time Since Last Inspection:	26 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	1688 Hrs at time of accident	**Engine Manufacturer:**	Lycoming
ELT:	Installed, not activated	**Engine Model/Series:**	O-360-A4K
Registered Owner:	Donald G. Holloway	**Rated Power:**	180 Horsepower
Operator:	Donald G. Holloway	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	DUC	**Distance from Accident Site:**	
Observation Time:	15:00 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	4 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	100°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.12 inches Hg	**Temperature/Dew Point:**	27°C
Precipitation and Obscuration:			
Departure Point:	Duncan, OK (DUC)	**Type of Flight Plan Filed:**	None
Destination:	Duncan, OK (DUC)	**Type of Clearance:**	None
Departure Time:	15:00 Local	**Type of Airspace:**	Unknown

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Minor	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Minor	**Latitude, Longitude:**	34.470832,-97.959724(est)

Administrative Information

Investigator In Charge (IIC):	Sauer, Aaron
Additional Participating Persons:	Lana West; Federal Aviation Administration; Oklahoma City, OK
Original Publish Date:	June 11, 2009
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=69223