Aviation Investigation Final Report

Location:	Pocahontas, Arkansas	**Accident Number:**	DFW06LA154
Date & Time:	June 6, 2006, 08:00 Local	**Registration:**	N181DM
Aircraft:	McClung Christian Eagle I	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	1 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The 18,700-hour pilot was piloting his single-engine experimental airplane at an altitude of 4,500 feet mean sea level (msl) when he started to feel a "slight vibration" or "light buzz" from the engine. The vibrations gradually became more severe until there was a loud bang and the engine seized. The pilot made a forced landing to a hay field. Metallurgical examination of the engine revealed the crankshaft had fractured through the crank cheek, between the #5 and #6 cylinder journals as a result of fatigue cracking. Further examination revealed that the crankshaft was susceptible to early subsurface fatigue failure due to the presence of "honeycomb" structure and microcracking. The mechanical damage was from contact of the connecting rod with the crankshaft thrust faces, and the "honeycomb" structure was most likely a result of overheating during the forging process. The crankshaft had been installed new in the engine in 2001,and two years later was modified with 11:1 compression ratio pistons. As a result of this and other modifications, engine power was increased by 30 percent. Due to the fact that these modifications altered the engine's original certification criteria; the engine was re-classified as an experimental. The serial number of the fractured crankshaft was listed in Lycoming's Mandatory Service Bulletin (SB) 569A, titled Crankshaft Retirement for Certain Lycoming Engines, which recommended the crankshafts be replaced at the first instance the engine crankcase was separated or no later than February 21, 2009. The SB was generated as a result of several subsurface fatigue failures of similar crankshafts used on higher horsepower engines (greater than 300 HP). Those crankshafts were subject to Airworthiness Directive (AD) 2002-04-51, which would have required them to be removed before the date of this accident. Since the engine was classified as experimental, the crankshaft did not have to be removed as a result of this guidance. The AD and SB were issued as a result of a slight change in the specified composition of the crankshaft material, which was a small vanadium addition intended to lower the tempering temperature and reduce warpage; however, this change increased the susceptibility to "honeycomb" and microcracking when slightly over-heated during the forging process. The "honeycomb" and microstructure significantly reduced fatigue properties. The loss of fatigue life was most pronounced in the

higher HP applications, and the experimental modifications made to this engine would have made the crankshaft more susceptible to fatigue fracture.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The loss of engine power as a result of a fractured crankshaft due to fatigue. A factor was the engine modifications to increase engine horsepower.

Findings

Occurrence #1: LOSS OF ENGINE POWER(TOTAL) - MECH FAILURE/MALF
Phase of Operation: CRUISE - NORMAL

Findings
1. (C) ENGINE ASSEMBLY,CRANKSHAFT - FAILURE,TOTAL
2. (F) MAINTENANCE,MODIFICATION - PERFORMED
3. (C) ENGINE ASSEMBLY,CRANKSHAFT - FATIGUE

Occurrence #2: FORCED LANDING
Phase of Operation: DESCENT - EMERGENCY

Factual Information

On June 6, 2006, approximately 0800 central daylight time, a homebuilt McClung Christian Eagle I single-engine airplane, N181DM, sustained substantial damage during a forced landing following a loss of engine power near Pocahontas, Arkansas. The airline transport rated pilot, the sole occupant of the airplane, was not injured. The airplane was registered to and operated by Red Eagle Aviation Incorporated, of Peachtree City, Georgia. A flight plan was not filed for the cross-country flight that originated from the Walker County Airport, near Jasper, Alabama, about 0638. Visual meteorological conditions prevailed for the personal flight conducted under 14 Code of Federal Regulations Part 91.

According to the 18,700-hour pilot, the airplane was in cruise flight at an altitude of 4,500 feet mean sea level (msl) when he started to feel a "slight vibration" or "light buzz" from the engine. He increased engine power by 50 RPM and monitored the engine via the JPI engine analyzer. All readings were "normal." The engine vibrations lasted for about 15-20 seconds before they became "sharper" and "more pronounced." The pilot attempted to navigate toward the nearest suitable airport; however, the engine vibrations increased and began to shake the airplane "violently." The pilot added that "some 45 seconds or so after the first indication of a problem, there was a loud bang of an explosion and oil covered my canopy, the engine seized (oil pressure confirmed at zero) and the propeller stopped completely."

The pilot executed a forced landing in a hay field covered by three-foot-high grass. The airplane rolled about 900 feet before a wheel pant caught a rock, which caused the airplane to skid about another 30 feet on its nose. According to the pilot, the accessory section of the engine had "blown off," and one of the engine mounts failed. There was also damage to the lower engine cowl, the 3-bladed propeller, the wheel pants, and the landing gear box.

Examination of the Lycoming AEIO-540-D4A5 engine revealed the crankshaft had fractured through the crank cheek, which contained the counterweights, between the #5 and #6 cylinder journals. The fractured sections of crankshaft were sent to the Safety Board's Materials Laboratory, in Washington, DC, for metallurgical examination. The examination revealed that a visual and magnified inspection of the fracture faces exhibited beach markings, which were indicative of fatigue cracking. The fatigue initiated in the vicinity of the aft radius of the #5 journal and propagated rearward through most of the crank cheek and balancer arms before separating the crankshaft. However, due to post-failure mechanical damage, the exact fatigue origins could not be determined and it could not be establish if the failures were initiated at the surface or subsurface. The crankshaft met the manufacturer's specified metallurgical requirements.

Further examination revealed that the crankshaft was susceptible to early subsurface fatigue failure due to the presence of "honeycomb" structure and microcracking. The mechanical

damage was from contact of the connecting rod with the crankshaft thrust faces, and the "honeycomb" structure was most likely a result of overheating during the forging process.

A review of the engine logbooks indicated that the crankshaft had been installed new in the engine in 2001, and had accumulated 263.5 hours at the time it failed. Between 2003 and 2004, Penn Yan Aero, Penn Yan, New York, modified the engine with 11:1 compression ratio pistons (certificated configuration was 8.5:1 compression ratio pistons). As a result, this modification (along with several other modifications) increased engine power from the certified 260 horsepower (HP) to 340 HP at full mixture setting, and 350 HP when leaned to best power, a 30 percent increase. Due to the fact that this modification altered the engine's original certification criteria; the engine was re-classified as an experimental.

The serial number of the fractured crankshaft was listed in Lycoming's Mandatory Service Bulletin (SB) 569A, titled Crankshaft Retirement for Certain Lycoming Engines, which was released April 11, 2006. The SB recommended that these crankshafts be replaced at the first instance the engine crankcase was separated or no later than February 21, 2009. The SB was generated as a result of several subsurface fatigue failures of similar crankshafts used on higher horsepower engines (greater than 300 HP). Those crankshafts were subject to Airworthiness Directive (AD) 2002-04-51, which would have required them to be removed before the date of this accident. Since the engine was classified as experimental, the crankshaft did not have to be removed as a result of this guidance.

The AD and SB were issued as a result of a slight change in the specified composition of the crankshaft material, which was a small vanadium addition intended to lower the tempering temperature and reduce warpage; however, this change increased the susceptibility to "honeycomb" and microcracking when slightly over-heated during the forging process. The "honeycomb" and microstructure significantly reduced fatigue properties. Lycoming has since returned to the previous composition. The loss of fatigue life was most pronounced in the higher HP applications, and the experimental modifications made to this engine would have made the crankshaft more susceptible to fatigue fracture.

Pilot Information

Certificate:	Airline transport; Flight engineer	**Age:**	Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Single
Other Aircraft Rating(s):		**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	June 1, 2005
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	June 1, 2005
Flight Time:	18700 hours (Total, all aircraft), 2000 hours (Total, this make and model), 12500 hours (Pilot In Command, all aircraft), 57 hours (Last 90 days, all aircraft), 20 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	McClung	**Registration:**	N181DM
Model/Series:	Christian Eagle I	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	Yes
Airworthiness Certificate:		**Serial Number:**	M002
Landing Gear Type:	Tailwheel	**Seats:**	1
Date/Type of Last Inspection:	March 1, 2006 Condition	**Certified Max Gross Wt.:**	1650 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	524.5 Hrs at time of accident	**Engine Manufacturer:**	Textron Lycoming
ELT:	Not installed	**Engine Model/Series:**	AEIO-540-D2A5
Registered Owner:	Red Eagle Aviation Incorporated	**Rated Power:**	260 Horsepower
Operator:		**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:		**Distance from Accident Site:**	
Observation Time:		**Direction from Accident Site:**	
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	10 knots / None	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	180°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30 inches Hg	**Temperature/Dew Point:**	19°C / 14°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Jasper, AL (JFX)	**Type of Flight Plan Filed:**	None
Destination:	Des Plains, MO (Y76)	**Type of Clearance:**	VFR
Departure Time:	06:38 Local	**Type of Airspace:**	

Airport Information

Airport:	None	**Runway Surface Type:**	
Airport Elevation:		**Runway Surface Condition:**	
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:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 None	**Latitude, Longitude:**	

Administrative Information

Investigator In Charge (IIC):	Yeager, Leah
Additional Participating Persons:	Tommy Arnold; FAA/ FSDO; Little Rock, AR Aaron Spotts; Textron Lycoming; Williamsport, PA
Original Publish Date:	November 29, 2006
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=63863