Aviation Investigation Final Report

Location:	Tahlequah, Oklahoma	**Accident Number:**	CEN17LA292
Date & Time:	July 30, 2017, 18:59 Local	**Registration:**	N786MD
Aircraft:	Piper PA 46 350P	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	4 Minor
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The private pilot reported that he was in cruise flight when the engine experienced a total loss of power. Oil covered the windshield and smoke filled the cockpit, making it difficult for him to see out of the airplane. He attempted to land at an airport but conducted a forced landing to a field about 300 ft short of the runway. The right wing separated from the fuselage when it hit a hay bale.

The examination of the engine revealed a large hole in the engine case near the No. 2 cylinder. The engine maintenance records indicated that when the engine had a major overhaul about 8 years before the accident, the engine crankcase was repaired at a facility specializing in crankcase repairs. The facility typically used glass bead media to clean engine crankcases instead of "mildly abrasive organic substances" as required by the engine manufacturer. About 1 year before the accident, about 825 hours since the major overhaul, all 6 cylinders were replaced. The engine failure occurred about 198 hours after the cylinders were replaced.

The metallurgical examination of the eight through bolts revealed that two of the through bolts and the No. 2 cylinder studs had fracture surfaces that were consistent with fatigue. The fatigue in the studs and through bolts likely resulted from insufficient clamping force due to insufficient torque applied to the attachment nuts during installation or could have developed in service as asperities on the clamping surfaces worked down over time, leading to a reduction in clamping force.

Probable Cause and Findings

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

The total loss of engine power, which resulted from fatigue failure of two engine through bolts and the No. 2 cylinder attachment studs due to the lack of sufficient clamping force.

Findings

Aircraft	(general) - Failure
Aircraft	(general) - Fatigue/wear/corrosion
Aircraft	(general) - Incorrect service/maintenance
Personnel issues	(general) - Maintenance personnel
Environmental issues	(general) - Contributed to outcome

Factual Information

History of Flight

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

On July 30, 2017, about 1859 central daylight time, a Piper PA-46-350P, N786MD, sustained substantial damage during a forced landing to a field near the Tahlequah Municipal Airport (TQH), Tahlequah Oklahoma, after a complete loss of engine power. The pilot and three passengers received minor injuries. The airplane was owned by ALP Air LLC and operated by the pilot as a 14 *Code of Federal Regulations* Part 91 personal flight. Visual meteorological conditions existed near the accident site at the time of the flight, and a visual flight rules (VFR) flight plan had been filed. The flight departed from the Joplin Regional Airport (JLN), Joplin, Missouri, about 1800, and was en route to Addison Airport (ADS), Addison, Texas.

The pilot reported he was receiving VFR flight following at 12,500 ft above mean sea level (msl) when the engine started to lose power. The pilot turned toward TQH since it was the nearest airport, and he flew about 6 to 8 nautical miles before the engine stopped producing power. Oil covered the windshield and smoke filled the cockpit, making it difficult to see out of the airplane. The pilot maintained communications with the Fort Worth Center as he glided toward TQH. Once over the airport, he made about 1 1/2 left circles as he prepared to land on the runway 35. However, the landing gear indicator lights indicated that the nose landing gear was not in the fully extended position during the landing approach. He attempted to manually lower the landing gear but without success. While attempting to lower the nose landing gear, he determined that there was insufficient altitude to make it to the runway, so he executed a forced landing to a field about 300 ft short of the runway. During the landing, the right wing struck a hay bale which separated the wing from the fuselage.

The engine was sent to an engine overhaul facility for an engine teardown and examination. The examination revealed that there was a large hole in the engine case near the No. 2 cylinder. The examination of the pistons, piston connecting rods and bearings, and main bearings revealed heat distress signatures consistent with a lack of lubrication. The cylinder attachment flange of the No. 2 cylinder to the engine case exhibited fretting and a metal ridge buildup on the surface of the flange. All 8 through bolts, including 2 through bolts which were fractured, and 2 pieces of the No. 2 cylinder attachment flange with 2 fractured cylinder attachment studs, were sent to the National Transportation Safety Board's (NTSB) Material Laboratory for examination.

The NTSB Materials Laboratory examination of the No. 2 cylinder attachment studs revealed that there were crack arrest lines and ratchet marks on the stud fracture surface, features consistent with fatigue. The fracture features in the fatigue regions had a relatively rough appearance consistent with relatively high cyclic stress.

The examination of the fracture surfaces of the through bolts revealed that there were relatively smooth areas-oriented transverse to the bolt axis observed on one side of the thread consistent with fatigue fracture. The fatigue regions transitioned to rougher matte gray features with a shear lip opposite from the fatigue region, features consistent with overstress fracture across the majority of the cross section.

The machined surfaces of the crank case pieces, including the cylinder attachment flange, the crank case split line, and the cam shaft bore surfaces, all had a gritty or frosted visual appearance. When viewed under an optical stereoscope, the surfaces were rough with generally semispherical pits or craters. Crater-like features were also observed on the cylinder flange stud threads. The thread of the through bolts were free of pit or crater-like features.

The Lycoming Engines Overhaul *Manual – Avco Lycoming Direct Drive Aircraft Engines*, Revision 14, (July 2011), in the section relating to the cleaning of the crankcase, states the following: "When grit-blasting parts[,] do not use sand or any metallic abrasives. It is recommended instead that mildly abrasive organic substances such as rice, baked wheat, plastic pellets, or crushed walnut shells be used. All machined surfaces must, of course, be adequately masked…"

The engine maintenance records indicated that the engine had been overhauled on June 5, 2009, and the logbook entry stated that the total engine time was 627.2 hours with 000.0 hours since major overhaul (SMOH). (The maintenance records did not indicate the reason why the engine was overhauled) The logbook entry indicated that the company who performed the engine overhaul had sent the crankcase to another company to be repaired. The company that repaired the crankcase indicated that the work order for the repair of the case halves was no longer available, but the receiving and shipping documents indicated that the billing was for inspection and dimension checks only, and that they had shipped the crankcase back to the customer in 2007. The facility indicated that it used glass bead media to grit blast engine cases.

The engine maintenance records indicated that following maintenance was performed on July 1, 2016: "Removed all 6 cylinders. Installed 6 new Lycoming cylinder kit assemblies P/N 05K21262. Checked all ring gaps and valve clearances. Reassembled with all new gaskets and seals…" The engine total time was 1,452.2 hours with 825 hours SMOH. The engine failure occurred about 198 hours after the cylinders were replaced.

Pilot Information

Certificate:	Private	**Age:**	50,Male
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 Without waivers/limitations	**Last FAA Medical Exam:**	August 10, 2016
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	559 hours (Total, all aircraft), 140 hours (Total, this make and model)		

Aircraft and Owner/Operator Information

Aircraft Make:	Piper	**Registration:**	N786MD
Model/Series:	PA 46 350P	**Aircraft Category:**	Airplane
Year of Manufacture:	1998	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	4636156
Landing Gear Type:	Retractable - Tricycle	**Seats:**	6
Date/Type of Last Inspection:	July 1, 2016 Annual	**Certified Max Gross Wt.:**	4299 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	4103 Hrs as of last inspection	**Engine Manufacturer:**	LYCOMING
ELT:	C91A installed, activated, did not aid in locating accident	**Engine Model/Series:**	TI0-540-AE2A
Registered Owner:	On file	**Rated Power:**	350 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Dusk
Observation Facility, Elevation:	TQH,874 ft msl	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	18:55 Local	**Direction from Accident Site:**	0°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	50°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.05 inches Hg	**Temperature/Dew Point:**	30°C / 15°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Joplin, MO (JLN)	**Type of Flight Plan Filed:**	VFR
Destination:	Dallas, TX (ADS)	**Type of Clearance:**	VFR flight following
Departure Time:	18:00 Local	**Type of Airspace:**	

Airport Information

Airport:	Tahlequah Municipal Airport TQH	**Runway Surface Type:**	Asphalt
Airport Elevation:	874 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	35	**IFR Approach:**	None
Runway Length/Width:	5001 ft / 75 ft	**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:	3 Minor	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	4 Minor	**Latitude, Longitude:**	35.930278,-95.004447(est)

Administrative Information

Investigator In Charge (IIC):	Silliman, James
Additional Participating Persons:	Tim Wells; FAA Oklahoma City FSDO; Oklahoma, OK Mike Caldera; Lycoming Engines; Williamsport, PA
Original Publish Date:	November 6, 2019
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=95701