Aviation Investigation Final Report

Location:	Lolo Pass, Idaho	**Accident Number:**	WPR14FA316
Date & Time:	July 28, 2014, 08:53 Local	**Registration:**	N29MM
Aircraft:	Meyer LEGACY	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The commercial pilot was conducting a personal cross-country flight in an amateur-built, experimental airplane when he transmitted a distress call. Two pilots in other aircraft near the accident airplane's location relayed the pilot's "mayday" call to air traffic control and he was subsequently heard stating that he had low engine oil pressure and that oil was covering the windshield while he was flying over wooded mountainous terrain. The pilot attempted a forced landing, but the airplane struck trees and then impacted the terrain.

Postaccident examination of the engine revealed a hole in the top of the engine case near the No. 2 cylinder. An engine teardown revealed that the Nos. 1 and 2 cylinder connecting rods had fractured. The examination of the fracture surfaces determined that the No. 1 connecting rod fracture was initiated by a fatigue crack and was the catalyst for the engine failure. In addition, partial surface decarburization and surface corrosion pits were observed around the surface of the connecting rod shaft. It is likely that the decarburization and corrosion pits decreased the connecting rod's surface hardness, served as fatigue initiation sites, and led to the premature failure of the No. 1 connecting rod. Although some fatigue cracks were observed on the No. 2 connecting rod, most of the facture surfaces exhibited overstress failure; therefore, the No. 2 connecting rod likely failed after the No. 1 connecting rod fractured. Although the cause of the decarburization was not determined based on the available evidence, it typically results from a manufacturing deficiency.

Toxicology testing of the pilot detected metoprolol and rosuvastatin in his tissue samples, and he had a history of high blood pressure and cholesterol; however, it is unlikely that the pilot's medical conditions or the medications he was using to treat them impaired his ability to safely operate the airplane.

Probable Cause and Findings

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

The fatigue fracture of an engine connecting rod, which resulted in a catastrophic engine failure and a forced landing in unsuitable terrain.

Findings

Aircraft	Recip eng cyl section - Failure
Aircraft	Recip eng cyl section - Fatigue/wear/corrosion
Environmental issues	Mountainous/hilly terrain - Contributed to outcome

Factual Information

History of Flight

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

On July 28, 2014, about 0853 mountain daylight time, an amateur built, experimental, Meyer-Lancair, Legacy, N29MM, sustained substantial damage during a forced landing about 41 miles southwest of Missoula, Montana, in Lolo Pass following a reported loss of engine power during cruise flight. The airplane was registered to and operated by the pilot under the provisions of Title 14 Code of Federal Regulations Part 91. The commercial pilot was fatally injured. Visual meteorological conditions prevailed and a visual flight rules flight plan was filed for the cross country flight. The flight departed Richland Airport (RLD) Richland, Washington, about 0755 with a destination of Baker Municipal Airport (BHK), Baker, Montana.

Air Traffic Control (ATC) reported that they received information from two other aircraft that the accident pilot made a "mayday" radio call and stated that he had low engine oil pressure. The airplane struck terrain while the pilot was trying to land in a forested area.

GPS tracking of the flight revealed the airplane flew an easterly heading towards the planned destination. However, during the final minutes of flight, while flying over the Clearwater National Forest, in Idaho, a 90 degree left turn to a northerly heading was accomplished.

A Federal Aviation Administration (FAA) inspector examined the airplane at the accident site and revealed the airplane's fuselage and wings were substantially damaged. The wreckage was recovered to a secure location for further examination.

Pilot Information

Certificate:	Commercial	**Age:**	71,Male
Airplane Rating(s):	Single-engine land; Single-engine sea	**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:**	Yes
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	February 27, 2014
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	July 1, 2014
Flight Time:	(Estimated) 1414 hours (Total, all aircraft)		

The pilot, age 71, held a commercial pilot certificate with airplane single-engine land, single-engine sea, and airplane instrument ratings. He also held a flight instructor certificate for airplane single-engine. The pilot was issued a special issuance FAA third-class airman medical certificate on February 27, 2014, with the limitations that he must wear corrective lenses and the certificate was not valid for any class after January 28, 2015. The pilot reported on his most recent medical certificate application that he had accumulated 1,420 total flight hours, and 20 flight hours in the last 6 months.

Aircraft and Owner/Operator Information

Aircraft Make:	Meyer	**Registration:**	N29MM
Model/Series:	LEGACY	**Aircraft Category:**	Airplane
Year of Manufacture:	2009	**Amateur Built:**	Yes
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	L2K-197
Landing Gear Type:	Retractable - Tricycle	**Seats:**	2
Date/Type of Last Inspection:	September 8, 2013 Condition	**Certified Max Gross Wt.:**	2200 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	248.5 Hrs at time of accident	**Engine Manufacturer:**	CONT MOTOR/PERF ENG
ELT:	Installed, activated, aided in locating accident	**Engine Model/Series:**	IO-550 SERIES
Registered Owner:	On file	**Rated Power:**	370 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

The two seat, low-wing, retractable tricycle gear airplane, serial number (S/N) L2K-197, was manufactured in 2009. It was powered by an experimental Performance Aircraft Engines (originally Continental) IO-550-EXP engine, serial number (S/N) TC-5826, rated at 370 horsepower. The airplane was also equipped with a Hartzell model HC-J3YF-1RF/F7391D-3, serial number (S/N) JN 204B, controllable pitch propeller. A review of the maintenance logbooks revealed that the most recent conditional inspection was completed on September 8, 2013, at an airframe total time of 248.5 hours.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	MSO,3200 ft msl	**Distance from Accident Site:**	41 Nautical Miles
Observation Time:	09:53 Local	**Direction from Accident Site:**	240°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.23 inches Hg	**Temperature/Dew Point:**	19°C / 7°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	RICHLAND, WA (RLD)	**Type of Flight Plan Filed:**	VFR
Destination:	BAKER, MT (BHK)	**Type of Clearance:**	VFR
Departure Time:	07:55 Local	**Type of Airspace:**	Class G

The 0953 recorded data from the Missoula International Airport (MSO), Missoula, Montana, automated weather observation station, located about 41 miles southwest of the accident site, revealed conditions were wind calm, visibility 10 statute miles, clear sky, temperature 19 degrees Celsius, dew point 7 degrees Celsius, and an altimeter setting of 30.24 inches of mercury.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	43.649597,-116.430541(est)

Examination of the accident site by an FAA inspector revealed that the first identified point of contact (FIPC) was when the airplane's left wing impacted a tree about 40 feet above ground level. Shortly thereafter, the right wing impacted a tree. During the impact sequence, the airplane's wings separated as they struck the trees. The main fuselage continued to travel about 280 feet and then impacted the terrain. The wreckage came to rest on a mountain slope of about 30 degrees, in a wooded environment, and at an elevation of about 6,528 feet. The orientation of the fuselage was about 180 degrees magnetic and the orientation of the wreckage debris path was also 180 degrees magnetic, and about 400 feet in length. The main wreckage was located about 200 feet below County Road 581, in Clearwater National Forest, Idaho. All major structural components of the airplane were accounted for in the wreckage.

Flight control continuity was established to the rudder and elevators.

The landing gear was found in the extended position and oil smearing was observed on the windshield fragments. The engine was separated from the airplane except for one attached cable, and came to rest inverted about 10 feet in front of the fuselage. The propeller hub was separated from the engine and was located near the start of the debris trail.

Communications

The accident airplane was not in contact with ATC but two airplanes near the accident airplane's location relayed his Mayday distress call to ATC (Salt Lake Air Route Traffic Control Center [ZLC]). The distress call was also heard by ZLC on the frequency 121.5 at 0849. The pilot reported a loss of oil pressure and oil covering the windshield while flying over the Clearwater National Forest, west of Lolo Pass, and near the Montana/Idaho state line.

Medical and Pathological Information

The Clearwater County Coroner office conducted an autopsy on the pilot on August 7, 2014. The medical examiner determined that the cause of death was the effect of blunt force injures.

The FAA's Civil Aeromedical Institute (CAMI) in Oklahoma City, Oklahoma, performed toxicology tests on the pilot's tissue samples. According to CAMI's report, cyanide, volatiles, and drugs were tested. The report contained positive findings for the tested drugs Metoprolol and Rosuvastatin.

A review of the pilot's positive drug findings by the National Transportation Safety Board (NTSB) Chief Medical Officer revealed that the pilot treated his high blood pressure with the blood lowering medication Metoprolol and used the cholesterol lowering medication Rosuvastatin. Both of these medications had been reported to the FAA by the pilot.

Tests and Research

Further examination of the airframe and engine was accomplished by the NTSB investigator-in charge (IIC), an FAA inspector, and an investigator from Continental Motors Inc. The examination revealed that the airplane was disassembled at the accident site during the recovery process. The engine and empennage remained attached to the main fuselage only by cables.

The engine was originally a Continental Motors IO550N model that was converted to an IO550-EXP by Performance Aircraft Engines. The current engine data plate was provided by Performance Aircraft Engines and listed the serial number as TC-5826 and the horsepower as 370. Examination of the engine revealed that a large hole was present in the upper left portion of the crankcase, located above the number 2 cylinder. Visible through the hole, was a broken connecting rod for the number 1 cylinder. Further observation revealed that the connecting rod for number 2 cylinder was also broken.

A borescope inspection of each cylinder revealed that number 6 cylinder induction tube sustained damage. The number 1 and 2 cylinders could not be examined due to the location of the pistons in their respective cylinders, which blocked entry. Cylinders 3, 4, and 5, were observed and were unremarkable.

The engine was shipped to Continental Motors Inc. for further examination. Continental Motors Inc. personnel examined the engine under the supervision of the NTSB IIC at the factory in Mobile, Alabama, on February 18, and 19, 2015.

The engine was disassembled and all the associated accessories were examined.

Examination of the engine revealed that no measurable oil was observed in the engine. The oil pump and filter were removed and examined. A small amount of metal contamination was observed on the filter element folds. The oil sump was removed and metal debris including the fractured connecting rod bolts and nuts were observed at the bottom.

All the cylinder nut torques were checked and determined to be at the manufacturer's specification. The cylinders were removed and all cylinders were unremarkable with the exception of the number 1 and 2 cylinder skirts. The crankcase halves were then separated. The main bearings were intact and no anomalies were noted with them. No signature of oil starvation or loss of oil pressure was noted. All the rods and main journals had a normal appearance with no bluing or scoring observed.

Initial examination of the number 1 and 2 cylinder connecting rods revealed that both rods had fractured. The connecting rods were shipped to the NTSB Material Laboratory for a detailed examination.

The laboratory examination revealed that both connecting rods had fractured along the I-beam shafts (see the public docket for the detailed report). A portion of the number 2 connecting rod shaft was bent backwards about at a 45 degree angle. The fracture surfaces were examined using a scanning electron microscope (SEM) and revealed that on the number 1 connecting rod fracture surface, striations were observed that were consistent with fatigue crack propagation. The fatigue crack initiated at the surface. Corrosion pits were also observed on the surface of the shaft cross section. Further, the bolt holes were observed to be unremarkable and the bolt fracture was consistent with an overstress failure.

Observation of the number 2 connecting rod assembly fracture surface revealed signatures consistent with a progressive fracture. Although, the observation with a SEM revealed faint fatigue striations and multiple crack initiation sites; the areas were free of any material artifacts such as corrosion pits. The associated bolt was observed to have signatures consistent with tensile overstress failure.

The mounted and polished cross-sections of the number 1 connecting rod shaft were tested to determine

local material hardness. The hardness results indicated that the rod shaft exhibited lower hardness towards the surface of about 10%. Metallographic analysis indicated that the surface of the connecting rod had up to about 0.03-inch of decarburization. The lower hardness measurement was consistent with the partial surface decarburization of the connecting rod shaft. Decarburization occurs when carbon atoms at the steel surface interact with the furnace atmosphere of the engine and are removed from the steel as a gaseous phase, which results in lower surface hardness and strength, and can lead to shorter times to initiate fatigue cracks.

Additional Information

Several personal and airplane electronic devices were sent to the NTSB Vehicle Recorders Division for potential data download. Some of the devices had unrecoverable data. However, of the devices that had data present, the following had information pertinent to the investigation.

The Garmin GTX 327 Transponder indicated a last code selected of 7700. According to the Aeronautical Information Manual (AIM), the 7700 code will be used when a distress or emergency condition is encountered. The Garmin SL30 Nav/Com listed the last navigation frequency as 122.9 and the last communication frequency as 121.5 (which is an emergency frequency). The GRT EIS 6000 is a panel mounted engine monitor. The last flight time was 58 minutes and the accumulated engine time was 248.5 hours. An Apple iPad contained an active route from RLD to BHK on the ForeFlight application. At 08:44:54 PDT an image was captured and indicated a vertical speed of -925 feet per minute. Additional miscellaneous data was captured on the IPad during the previous 2 months.

Administrative Information

Investigator In Charge (IIC):	Nixon, Albert
Additional Participating Persons:	David Hartson; Federal Aviation Administration; Spokane, WA Mike Council; TMI Continential Motors; Mobile, AL Rhonda Barrett-Bewley; Barrett Precision Engines; Tulsa, OK
Original Publish Date:	September 22, 2016
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=89758