



AVIATION



HIGHWAY



MARINE



RAILROAD



PIPELINE

Aviation Investigation Final Report

Location:	Tat Momoli, Arizona	Accident Number:	WPR18LA248
Date & Time:	August 28, 2018, 18:40 Local	Registration:	N4139A
Aircraft:	Piper PA28	Aircraft Damage:	Substantial
Defining Event:	Powerplant sys/comp malf/fail	Injuries:	2 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot reported that during the cross-country flight, the engine experienced a total loss of power. The pilot initiated a forced landing to a nearby road where, during the landing roll, the airplane impacted a barbed wire fence, resulting in substantial damage to the right wing.

Postaccident examination revealed a large hole in the engine case at the No. 4 cylinder that exposed the crankshaft and connecting rod. The No. 4 cylinder was seized, and the connecting rod was fractured at the piston end. Further examination revealed that the connecting rod fractured from a fatigue crack in the bore on the piston end, which likely initiated at an internal corner of the bore. The fatigue crack progressed through most of the pin bore cross-section. Following the fracture of the connecting rod, the continued movement of the broken part led to subsequent overstress fractures and damage to nearby components, which resulted in catastrophic engine failure and a complete seizure of the engine.

The cause of the fatigue crack initiation could not be determined, as both the initiation site (or sites) and the termination of the fatigue crack were destroyed by postfracture impact damage. The general location of the initiation, the internal corner of the pin bore, suggested the presence of concentrated stress in that location, which could have been the result of a material defect, such as a pore, inclusion, or corrosion pit that may have occurred when the connecting rod was rebushed. A crack initiation could also have been the result of improper sizing of the internal bushing, improper installation of the connecting rod, or use of the wrong parts. The engine was overhauled 42 flight hours before the accident.

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 a fatigue crack in the connecting rod bushing end.

Findings

Aircraft	Recip eng cyl section - Fatigue/wear/corrosion
Aircraft	(general) - Failure

Factual Information

History of Flight

Enroute-cruise	Powerplant sys/comp malf/fail (Defining event)
Enroute-cruise	Loss of engine power (total)
Landing-landing roll	Collision during takeoff/land

On August 29, 2018, about 1840 mountain standard time, a Piper PA-28-181, N4139A, was substantially damaged when it was involved in an accident in Tat Momoli, Arizona. The private pilot and pilot-rated passenger were not injured. The airplane was operated by the pilot-rated passenger as a Title 14 Code of Federal Regulations Part 91 personal flight.

The pilot reported that they departed Nogales International Airport (OLS), Nogales, Arizona about 1710, with full fuel after completing an engine run-up. About 25 minutes into the flight, and about 100 nautical miles (nm) northwest of OLS, the engine started shaking violently and sputtering. Neither pilot observed an illumination of any annunciator lights. The pilot turned the ignition to the OFF position and retarded the mixture control to the idle setting. The pilot selected a road and made a turn to execute an emergency landing, when the engine exploded, and oil began to leak from the top of the cowl. The airplane touched down uneventfully, but during the landing roll, the right wing impacted a barbed wire fence before it departed the right side of the road and came to rest. According to the pilot, the airplane's flight control capabilities were uninhibited during the accident flight.

Postaccident photos furnished by local law enforcement revealed an approximate 3 ft long depression to the outboard right wing. Additionally, the top of the engine cowl was breached and displayed a streak of oil that terminated at the windshield.

According to Federal Aviation Administration (FAA) records, the airplane was manufactured in 1998 and was powered by a Lycoming O-360-A4M, 225-horsepower, air cooled, reciprocating engine. A review of the airplane's maintenance records revealed that the most recent 100-hour inspection was performed on March 1, 2018, at 5,510 hours total time in service about 42 flight hours prior to the accident. At the time of the inspection, the engine had accumulated a total of about 1,564 flight hours. An engine overhaul was completed on January 20, 2018, about 42 flight hours prior to the accident. Maintenance records indicated that the engine was disassembled, cleaned and inspected per "Overhaul Manual 60294-70", a publication by Lycoming Engines, and re-assembled after numerous items were repaired, inspected or replaced.

Among the items that were overhauled were the connecting rods and lifters. A work order showed that the connecting rods were sent to a facility where they were magnafluxed, rebushed, inspected, and balanced in accordance with the overhaul manual. They were then returned to the overhaul facility and installed on the engine.

The engine was examined at a facility in Phoenix, Arizona by a certified airframe and powerplant mechanic, with oversight provided by a representative of the FAA. Photographs taken after the accident revealed a large hole in the top of the engine case at the cylinder no. 4 position, and a large tear at the top of the cylinder. Each of the accessories were in good visual condition and did not exhibit any abnormal wear when inspected; however, propeller to accessory gear continuity could not be achieved as the engine was seized.

The crankshaft showed no signs of heating, oil starvation or scoring outside of minor fretting shown in the cylinder no. 4 journal. A large amount of metallic debris was observed in the oil sump that had originated from the no. 4 cylinder, which displayed abnormal wear. The other cylinders, associated rods and pistons did not exhibit any abnormal wear. The piston to cylinder no. 4 was locked in the upper half of the cylinder and displayed a tear in the barrel from the connecting rod. Further, the piston was displaced from the connecting rod and piston pin, which had separated. The connecting rod was twisted, and the bushing, which was found in the engine case, was deformed. The no. 4 exhaust valve keeper was missing, and the cylinder had a piece of the piston ring in the exhaust and intake valve ports.

A metallurgical examination of the no. 4 piston, connecting rod, and associated hardware was performed by the NTSB materials laboratory. The crankshaft side of the connecting rod assembly was generally intact, while the pin side of the rod had broken into multiple pieces, and the neck of the rod was bent. The piston pin bore surface remnant section of the connecting rod (opposite the crankshaft side) displayed a bend in the surface. Further examination showed that the bore surface facing the pin and internal bushing was heavily gouged, battered, and scraped, consistent with post-fracture impact damage with some of the adjacent parts.

A close-up view of one of the fractured sides of the pin bore showed gouging in multiple directions, batter of the fractured corner, and material flow from heavy deformation of the pin bore face. It was noted that any fracture features that may have been present were obliterated by post-fracture impact with the adjacent parts.

One of the undamaged fracture surfaces of the connecting rod pin bore walls exhibited crack arrest marks that were examined using a scanning electron microscope. The fracture displayed fatigue striations that were consistent with fatigue crack propagation. These striations exhibited varied spacing consistent with spectrum loading in high cycle applications, typical of reciprocating engines. The initiation area of the pin bore wall remnant included visual features and fatigue striations consistent with propagation from the inner face of the pin bore corner of the connecting rod.

The bore remnant was sectioned about 0.25 inches away from and oriented parallel to the fatigue fracture surface. The connecting rod microstructure exhibited a structure consistent with tempered martensite with an area that had not been tempered. Energy dispersive x-ray spectroscopy and x-ray fluorescence were used to examine the part chemistry of the connecting rod composition, which was consistent with alloy steel. It was noted that the tempered martensite microstructure is common for this type of steel alloy.

The bushing remnant that was present in the connecting rod pin bore exhibited severe plastic deformation along with gouges and impact marks. This damage was consistent with repeated impact with adjacent components.

Pilot Information

Certificate:	Private	Age:	33,Male
Airplane Rating(s):	Single-engine land	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	3-point
Instrument Rating(s):	None	Second Pilot Present:	Yes
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Class 3 Without waivers/limitations	Last FAA Medical Exam:	July 30, 2015
Occupational Pilot:	No	Last Flight Review or Equivalent:	October 28, 2016
Flight Time:	307 hours (Total, all aircraft), 0 hours (Total, this make and model)		

Aircraft and Owner/Operator Information

Aircraft Make:	Piper	Registration:	N4139A
Model/Series:	PA28 181	Aircraft Category:	Airplane
Year of Manufacture:	1998	Amateur Built:	
Airworthiness Certificate:	Normal	Serial Number:	2843115
Landing Gear Type:	Tricycle	Seats:	4
Date/Type of Last Inspection:	March 1, 2018 100 hour	Certified Max Gross Wt.:	2558 lbs
Time Since Last Inspection:	42 Hrs	Engines:	1 Reciprocating
Airframe Total Time:	5510.3 Hrs	Engine Manufacturer:	Lycoming Engines
ELT:	Installed	Engine Model/Series:	O-360-A4M
Registered Owner:		Rated Power:	180 Horsepower
Operator:	On file	Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	1464 ft msl	Distance from Accident Site:	14 Nautical Miles
Observation Time:	18:56 Local	Direction from Accident Site:	360°
Lowest Cloud Condition:	Clear	Visibility	10 miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	5 knots /	Turbulence Type Forecast/Actual:	/
Wind Direction:	360°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	29.84 inches Hg	Temperature/Dew Point:	37°C / 11°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Nogales, AZ (OLS)	Type of Flight Plan Filed:	None
Destination:	Van Nuys, CA (VNY)	Type of Clearance:	VFR
Departure Time:	17:10 Local	Type of Airspace:	Class E

Wreckage and Impact Information

Crew Injuries:	1 None	Aircraft Damage:	Substantial
Passenger Injuries:	1 None	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	2 None	Latitude, Longitude:	32.644721,-111.868057

Administrative Information

Investigator In Charge (IIC):	Stein, Stephen		
Additional Participating Persons:	Kenton Fenning; Federal Aviation Administration; Scottsdale, AZ Kathryn Whitaker; Piper Aircraft Company; Vero Beach, FL		
Original Publish Date:	November 19, 2020	Investigation Class:	3
Note:	The NTSB did not travel to the scene of this accident.		
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=98208		

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The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available [here](#).