



Aviation Investigation Final Report

Location:	Homerville, Georgia	Accident Number:	ERA17LA176
Date & Time:	May 9, 2017, 15:25 Local	Registration:	N714DW
Aircraft:	Cessna 150M	Aircraft Damage:	Substantial
Defining Event:	Loss of engine power (total)	Injuries:	1 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot was conducting a cross-country flight when, during cruise at 3,000 ft mean sea level, he heard an unusual sound from the engine and engine power decreased to 1,500 rpm. The pilot unsuccessfully attempted to restore engine power, then light smoke began to enter the cockpit. The pilot subsequently declared an emergency with air traffic control and selected a forced landing site. During touchdown on a soft field, the airplane nosed over and came to rest inverted, resulting in substantial damage.

Examination revealed that the engine's No. 4 cylinder had separated about halfway along the cylinder barrel from a fatigue crack that initiated at a cooling fin valley on the exterior surface. The fatigue crack grew around the circumference of the cylinder through approximately 30% of the cross section, and the remaining cross section succumbed to overstress. Once the cylinder fractured, the other components, such as the piston and connecting rod, sustained subsequent damage. Metallographic cross section of the cylinder at and near the fracture revealed the presence of corrosion pits under the remaining paint and primer.

While the alloy used in the engine's cylinders was not necessarily susceptive to pitting, other issues, such as crevice corrosion near an unpainted area or use in salt environments, can lead to similar corrosion features. Corrosion pits can be a common cause of fatigue cracking. Although the accident engine had accrued about 2,249 hours since its most recent major overhaul about 21 years before the accident which exceeded the engine manufacturer's overhaul recommendations of 2,000 operating hours or 12 years in service, whichever occurred first, the No. 4 cylinder had been installed new about 9 years before the accident. However, the presence of pitting corrosion to the extent that it resulted in failure of a cylinder is consistent with inadequate inspection and maintenance of the engine.

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 inadequate maintenance and inspection of the engine, which resulted in a fatigue crack and subsequent failure of the No. 4 cylinder.

Findings	
Aircraft	Recip eng cyl section - Not inspected
Aircraft	Recip eng cyl section - Fatigue/wear/corrosion
Aircraft	Recip eng cyl section - Failure
Personnel issues	Scheduled/routine inspection - Maintenance personnel

Factual Information

History of Flight Enroute-cruise Loss of engine power (partial) Enroute-cruise Loss of engine power (total) (Defining event) Emergency descent Loss of engine power (total) Landing Off-field or emergency landing Landing roll Nose over/nose down

On May 9, 2017, about 1525 eastern daylight time, a Cessna 150M, N716DW, was substantially damaged when it was involved in an accident near Homerville, Georgia. The pilot was uninjured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

The pilot reported that he was in cruise flight at 3,000 ft mean sea level when he heard an unusual sound come from the engine and the engine power began to decrease to 1,500 rpm. The pilot turned the carburetor heat on, but power was not restored. He then checked the positions of the fuel selector and the engine primer. Light smoke began to enter the cockpit, and at the same time, a small piece of debris struck the windshield. The pilot declared an emergency with air traffic control, established the airplane at its best glide airspeed, and began looking for a suitable forced landing area.

As he descended the airplane toward the forced landing site, the pilot turned off electrical power. The main landing gear touched down first; however, the surface of the field was soft and rough, and the airplane nosed over and came to rest inverted.

Examination of the engine revealed that the barrel of the No. 4 cylinder separated at a point halfway along the length of the barrel and the No. 4 piston displayed heavy impact damage. The No. 4 connecting rod was bent, and the No. 4 piston pin was missing.

Examination of the components of the No. 4 cylinder by the NTSB Materials Laboratory revealed that the connecting rod, cap, and bolts were all intact, with no fractures; however, the connecting rod body was

deflected along the web near the piston pin bore. The sides of the rod exhibited scraping or gou ging damage, and the pin bore of the connecting rod was deformed, consistent with elongation along the length of the rod.

The crankshaft bearing surfaces were intact and exhibited minimal wear. Much of the piston exhibited severe deformation and material loss. The fracture surfaces on the underside of the piston were heavily damaged due to post-fracture impact and corrosion damage. The visible fracture features were consistent with overstress, with the fracture originating about the pin

hole bore of the piston. The cylinder had fractured about the compression wall at the 10th cooling fin valley when counted from the larger main body cooling fins of the cylinder head. Several of the fin flange surfaces exhibited small circular features consistent with pitting.

The fracture located on the head side and the piston, or open, side of the cylinder halves were relatively flat and exhibited a reflective luster. Much of the fracture surface was damaged or entirely obliterated by post-fracture smearing or contact.

Closer examination of the head side fracture surface revealed that a portion exhibited crack arrest marks consistent with fatigue cracking. The crack arrest features were present along approximately 30% of the fracture surface circumference and propagated around the cylinder cross section from a singular point. The crack initiation site was located on the exterior surface of the cylinder fin valley. An initial thumbnail crack was present adjacent to the crack initiation site, with radial marks and crack arrest marks propagating outward.

The cylinder fracture surfaces were examined using a scanning electron microscope. An area of undamaged fracture surfaces near the end of the progressive cracking area displayed crack arrest marks and radial lines consistent with the crack propagation direction. Inside this region, fatigue striations were present, consistent with fatigue crack propagation. Outside the fatigue crack, dimple rupture was observed, consistent with subsequent overstress fracture.

Multiple corrosion pits were present at the fatigue crack initiation site. The pits contained nonconductive (non-metallic) compounds consistent with an iron oxide, containing detectable levels of sodium, magnesium, phosphorus, potassium, sulfur, and calcium. These elements were not present in the bulk of the materials. The chemical composition was consistent with an alloy steel.

A portion of the cylinder and fins near the fracture surface was sectioned, mounted, and polished for metallographic examination. Of note were features present along the adjacent cooling fin valleys where corrosion pits were present on the surface, with non-metallic compounds contained within. These corrosion pits were found on much of the surfaces examined in the cross-section. The composition of these compounds, as examined using energy dispersive x-ray spectroscopy, was consistent with that of the iron oxide compounds observed on the corrosion pits at the fatigue crack initiation site on the fracture surface.

Surface corrosion was present at all the examined fin valleys. The chemical composition of these compounds was consistent with that of the corrosion pit compounds, and further examination revealed that the surface corrosion compounds were cracked and discontinuous. The underlying interface with the base metal was also tortuous in morphology, consistent with widespread pitting corrosion.

Continental Motors Service Information Letter 98-9C stated that the time between overhaul (TBO) for the O-200-A engine was 2,000 hours of operation or 12-years (whichever occurred first), and that an engine's published TBO does not mean that every engine will operate the number of hours or years listed without requiring component replacements and/or unscheduled maintenance events. Noncompliance with instructions for continued

airworthiness, operational and/or environmental factors may necessitate repair or replacement of the engine, engine components and accessories earlier than the published TBO.

According to FAA and maintenance records, the engine was manufactured on April 22, 1970. The engine received a complete overhaul on August 9, 1996. The engine was "top overhauled" with four new ECI cylinders on May 15, 2008.

The airplane's most recent annual inspection was completed on May 3, 2017. At the time of the accident, the airplane had accrued about 7,341.7 total hours of operation, and the engine had accrued about 2,249.3 total hours since the 1996 overhaul.

A nearly identical cylinder failure was documented in 2016 (NTSB Case No. CEN16LA306). Examination of that engine revealed that the No. 2 cylinder was completely separated between the flange and the head as the result of a fatigue crack that initiated at a cooling fin valley on the exterior surface. The fatigue crack grew around 40% of the circumference of the cylinder, and overstress led to the eventual cylinder fracture. A metallographic cross-section of the cylinder revealed corrosion pits under the paint and primer.

Pilot Information

Certificate:	Private	Age:	28,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 1 With waivers/limitations	Last FAA Medical Exam:	January 17, 2017
Occupational Pilot:	No	Last Flight Review or Equivalent:	April 25, 2017
Flight Time:	198 hours (Total, all aircraft), 194 ho	urs (Total, this make and model), 167	hours (Pilot In

198 hours (Total, all aircraft), 194 hours (Total, this make and model), 167 hours (Pilot In Command, all aircraft), 142 hours (Last 90 days, all aircraft), 57 hours (Last 30 days, all aircraft)

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	Registration:	N714DW
Model/Series:	150M	Aircraft Category:	Airplane
Year of Manufacture:	1976	Amateur Built:	
Airworthiness Certificate:	Normal; Utility	Serial Number:	15079105
Landing Gear Type:	Tricycle	Seats:	2
Date/Type of Last Inspection:	May 3, 2017 100 hour	Certified Max Gross Wt.:	1601 lbs
Time Since Last Inspection:	32 Hrs	Engines:	1 Reciprocating
Airframe Total Time:	7309.6 Hrs as of last inspection	Engine Manufacturer:	CONT MOTOR
ELT:	Installed	Engine Model/Series:	0-200-A48
Registered Owner:	On file	Rated Power:	100 Horsepower
Operator:	Tailwheels Etc.	Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	KHOE,188 ft msl	Distance from Accident Site:	0 Nautical Miles
Observation Time:	15:35 Local	Direction from Accident Site:	53°
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:	/ N/A
Altimeter Setting:	30.04 inches Hg	Temperature/Dew Point:	32°C / 11°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	LAKE CITY, FL (LCQ)	Type of Flight Plan Filed:	None
Destination:	EASTMAN, GA (EZM)	Type of Clearance:	VFR flight following
Departure Time:	14:40 Local	Type of Airspace:	Class G

Wreckage and Impact Information

Crew Injuries:	1 None	Aircraft Damage:	Substantial
Passenger Injuries:		Aircraft Fire:	None
Ground Injuries:		Aircraft Explosion:	None
Total Injuries:	1 None	Latitude, Longitude:	31.053333,-82.77111(est)

Administrative Information

Investigator In Charge (IIC):	Gunther, Todd
Additional Participating Persons:	Kenneth Reed; FAA/FSDO; College Park, GA John Kent; Continental Motors Inc.; Mobile, AL
Original Publish Date:	May 20, 2021
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=95145

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The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, "accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person" (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB's statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available <u>here</u>.