Aviation Investigation Final Report

Location:	Pittsfield, Maine	**Accident Number:**	ERA18LA228
Date & Time:	August 22, 2018, 23:00 Local	**Registration:**	N35442
Aircraft:	Cessna T206	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	1 Serious, 1 Minor
Flight Conducted Under:	Public aircraft		

Analysis

The pilot stated that he was returning after a mission flight when he heard a "bang." The engine then lost power. He declared an emergency with air traffic control and received radar vectors to a nearby airport, but the airplane impacted a heavily wooded marsh about 3/4 mile from the runway, which resulted in serious injury to the pilot and substantial damage to the airplane. Postaccident examination revealed that the No. 4 cylinder exhaust hydraulic roller tappet was fractured and had separated. Further examination of the engine revealed that the No. 4 exhaust camshaft lobe and the corresponding roller tappet were severely worn and damaged. Additionally, the No. 4 exhaust roller tappet body ears, which supported the roller shaft and bearing, were also damaged, and one of the ears had fractured in fatigue. Metallurgical examination showed that the engine components conformed to the manufacturer's specifications. It is likely that the severe wear between the roller and camshaft led to nonstandard loading conditions, the fatigue failure of the roller tappet body ear, the subsequent liberation of the roller and its components, and the total loss of engine power.

Probable Cause and Findings

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

Wear of the No. 4 cylinder exhaust camshaft lobe and roller tappet, which resulted in the failure of the tappet and the subsequent total loss of engine power.

Findings

Aircraft	Recip engine power section - Failure

Factual Information

History of Flight

Enroute	Loss of engine power (total) (Defining event)

On August 22, 2018, about 2300 eastern daylight time, a Cessna T206H, N35442, operated by the US Department of Homeland Security, was substantially damaged during a forced landing after a loss of engine power near Pittsfield Municipal Airport (2B7), Pittsfield, Maine. The commercial pilot was seriously injured and passenger sustained minor injuries. Visual meteorological conditions prevailed, and an instrument flight rules flight plan was filed for the public use flight that originated from Bangor International Airport (BGR), Bangor, Maine.

According to the pilot, while returning from a mission flight at an altitude of 8,000 ft, he requested a lower altitude from air traffic control. The air traffic controller then cleared the pilot to descend to 7,000 ft, and during the decent, he heard a "bang," and felt a vibration. The pilot checked the engine monitoring instruments and noted that the No. 4 cylinder was "lost." The engine lost power completely shortly thereafter. The pilot declared an emergency and was provided with radar vectors to the closest airport, which was 2B7. While on an extended final approach to runway 36, the pilot determined that he would not be able to reach the runway. The pilot then tried to land in an open area of forest about 4,500 ft south of runway 36 but impacted a heavily wooded area of the marsh.

Postaccident examination of the wreckage revealed that the airplane sustained damage to the elevator and fuselage. Cursory examination of the engine revealed that the No. 4 cylinder exhaust hydraulic roller tappet was fractured and had separated.

The engine's No. 4 exhaust roller tappet assembly, camshaft, crankcase, and oil filter were sent to the engine manufacturer's metallurgy laboratory for evaluation The engine crankcase generally displayed internal contact damage in the form of various gouging/contact marks. Components of the roller tappet assembly were found and recovered from the oil sump. The crankcase bore holding the No. 4 exhaust roller tappet was found in good condition with no abnormal scoring or wear. Below the No. 4 exhaust tappet bore, witness marks were observed on the crankcase consistent with contact with the No. 4 exhaust roller tappet. Dimensional inspection of the crankcase roller tappet bore, which secured the roller tappet assembly with respect to the case, was performed using go/no-go gages on all six exhaust roller tappet bores, and all were found conforming.

The No. 4 exhaust camshaft lobe displayed severe wear, spalling, and galling. Minor damage was observed along the length of the camshaft, appearing as secondary contact marks. While the No. 4 exhaust camshaft lobe was too damaged to be metallographically examined, examination of the No. 5 exhaust camshaft lobe revealed that it had a conforming case and core microstructure.

The No. 4 exhaust roller tappet was fractured with the roller, needle bearings, and shaft no longer retained by the tappet body. Both ears of the roller body that retained the shaft were fractured. The engine's 11 other roller tappet assemblies were found in overall good condition, and each of their respective shafts remained staked. The No. 4 exhaust roller body ear fracture surfaces were examined

using stereomicroscopy, digital microscopy, and scanning electron microscopy. Spalling of the case was observed around the shaft bores on the body along with witness marks from the roller and needle bearings on the inside of the body ears. The witness marks from the roller appeared deeper on one ear compared to the other. Fatigue was observed on one of the body ear fragment fracture surfaces. The roller had separated into multiple fragments that showed evidence of brittle fracture originating at the outside diameter in a severely spalled region. Another fragment of the roller showed evidence of fracture origin at the inside diameter. The roller displayed signs of significant wear and spalling on the outer diameter, consistent with the severe wear observed on the corresponding camshaft lobe. Some areas of the inner diameter were galled and/or spalled. The needle bearings were in overall good condition and the shaft was damaged mostly on the two ends and some areas of the midsection. The No. 4 exhaust roller tappet components were evaluated for conformance, including selected key dimensions, material chemistry, hardness, case hardness, case depths, and microstructure as applicable to the individual components. Each of the evaluated components was conforming to engineering requirements.

The oil filter was examined and found to contain fine metallic chips. A representative selection of approximately 18 chips were cleaned and examined using energy dispersive x-ray spectroscopy. Three chips were composed of steel consistent with the type used in the roller tappet assembly roller or shaft; two were composed of copper plating chips consistent with material from the camshaft, valve guides, rocker arms, or connecting rod bolts; five aluminum alloy chips likely from pistons or accessory housing; and eight aluminum alloy chips likely from the crankcase.

Pilot Information

Certificate:	Airline transport; Commercial; Flight instructor	**Age:**	43,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	December 13, 2017
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	June 22, 2017
Flight Time:	(Estimated) 6100 hours (Total, all aircraft), 327 hours (Total, this make and model), 5500 hours (Pilot In Command, all aircraft), 140 hours (Last 90 days, all aircraft), 40 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	**Registration:**	N35442
Model/Series:	T206 H	**Aircraft Category:**	Airplane
Year of Manufacture:	2002	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	T20608328
Landing Gear Type:	Tricycle	**Seats:**	3
Date/Type of Last Inspection:	August 14, 2018 100 hour	**Certified Max Gross Wt.:**	
Time Since Last Inspection:	2 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	5805 Hrs at time of accident	**Engine Manufacturer:**	Lycoming
ELT:	C91 installed, activated, did not aid in locating accident	**Engine Model/Series:**	TIO540-AJ1A
Registered Owner:		**Rated Power:**	310 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night
Observation Facility, Elevation:	KWVL,310 ft msl	**Distance from Accident Site:**	19 Nautical Miles
Observation Time:	02:56 Local	**Direction from Accident Site:**	223°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	4 knots /	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	260°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	29.64 inches Hg	**Temperature/Dew Point:**	18°C / 17°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Bangor, ME (BGR)	**Type of Flight Plan Filed:**	IFR
Destination:	Bangor, ME (BGR)	**Type of Clearance:**	IFR
Departure Time:	21:00 Local	**Type of Airspace:**	Class E

Airport Information

Airport:	Pittsfield Muni 2B7	**Runway Surface Type:**	Asphalt
Airport Elevation:	197 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	18	**IFR Approach:**	None
Runway Length/Width:	4003 ft / 100 ft	**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 Serious	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Minor	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Serious, 1 Minor	**Latitude, Longitude:**	44.758609,-69.370002(est)

Administrative Information

Investigator In Charge (IIC):	Boggs, Daniel
Additional Participating Persons:	J.C. Mills; FAA/FSDO; Portland, ME Henry Soderlund; Textron Aviation; Kansas City, KS David Harsanyi; Lycoming Engines; Williamsport, PA Paul McDaniel; U.S. Customs and Boarder Protection; Washington, DC
Original Publish Date:	September 14, 2020
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=98138