

Aviation Investigation Final Report

Location: Merrill, Wisconsin Accident Number: CEN21LA213

Date & Time: May 11, 2021, 15:00 Local Registration: N793Y

Aircraft: Beech C23 Aircraft Damage: Substantial

Defining Event: Loss of engine power (partial) **Injuries:** 2 Minor

Flight Conducted Under: Part 91: General aviation - Personal

Analysis

The pilot reported that he was returning to the airport after a 1-hour flight when the engine started to run rough and gradually lost power. The pilot switched fuel tanks and cycled the magnetos, with no change in the power loss. He executed an off airport forced landing. The landing gear collapsed during the landing and the airplane slid to a stop coming to rest upright. The airplane sustained substantial damage to both wings and fuselage.

Examination of the engine found that the oil filter contained metallic particles that were determined to be consistent with tappet material. Further examination revealed 7 of the 8 tappets were destroyed. A metallurgical examination of the tappets revealed that the tappets fractured from overstress. The fracture started along the heads facing their corresponding camshaft lobes, which proceeded towards the back surface. While there were no indications of pre-existing cracks, such as from fatigue, there was evidence of pitting and surface wear on many of the tappet head faces that contact the camshaft. Of note was the No.2 exhaust tappet, the only tappet that underwent wear on the tappet face significant enough to change its geometry.

The engine was overhauled 19 years before the accident and had accumulated 838 hours since the overhaul. The engine manufacturer recommends overhaul of the engine at 2,000 hours, or 12 years in service, whichever comes first. No record of tappet replacement was found in the maintenance records.

Probable Cause and Findings

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

The loss of engine power due to tappet failure.

Findings

Aircraft

Recip eng cyl section - Failure

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Factual Information

History of Flight

Enroute-descent

Loss of engine power (partial) (Defining event)

On May 11, 2021, at 1500 central daylight time, a Beech C23, N793Y, was substantially damaged when it was involved in an accident near Merrill, Wisconsin. The pilot and passenger received minor injuries. The airplane was operated as a Title 14 Code of Federal Regulations Part 91 personal flight.

The pilot reported that he was returning to the airport after a 1-hour flight. When the airplane was about 5 miles from the airport and descending through about 1,300 ft above ground level, the engine started to run rough and gradually lost power. The pilot switched fuel tanks and cycled the magnetos, with no change in the engine power. He executed an off-airport forced landing. The airplane touched down, the landing gear collapsed, and the airplane slid to a stop coming to rest upright. The airplane sustained substantial damage to both wings and fuselage.

Examination of the engine found that the oil filter contained metallic particles consistent with tappet material. Further examination revealed 7 of the 8 tappets were destroyed. The tappets were removed for further examination.

Examination of the tappets by the National Transportation Safety Board Materials Laboratory revealed that the tappets fractured from overstress. The fracture started along the heads facing their corresponding camshaft lobes, which proceeded towards the back surface. While there were no indications of pre-existing cracks, such as from fatigue, there was evidence of pitting and surface wear on many of the tappet head faces that contact the camshaft. Of note was the No. 2 exhaust tappet, the only tappet that underwent wear on the tappet face significant enough to change its geometry.

Figure 1 shows the No. 2 exhaust tappet face, which was reflective and consistent with polishing from repeated contact with the mating camshaft lobe. The depression at the center of the tappet head corresponding to the stem exhibited circular wear marks. The fracture surface on the bottom of the figure was circular, conforming to the geometry of the stem radius. Figure 2 shows the widespread spalling of the remaining surface, demonstrating the degree of material loss on this part.

Review of the engine logbooks revealed that the engine was overhauled on February 19, 2002, and installed on the accident airplane on February 1, 2019. The last annual inspection was completed on February 24, 2021. At the time of the accident, the engine had about 838 hours of operation since overhaul. No record of tappet replacement was found in the maintenance

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records. The engine manufacturer recommends overhaul of the engine at 2,000 hours, or 12 years in service, whichever comes first.

An oil sample collected on May 11, 2021, before the accident flight, was sent in for analysis. The vendor who conducted the oil sample analysis provided an oil sample report. Nothing remarkable was found in the oil sample report.



Figure 1. View of the #2 exhaust tappet head.

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Figure 2. Worn areas of the #2 exhaust tappet head, showing spalling and pitting.

Pilot Information

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Certificate:	Private	Age:	60,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:	
Instructor Rating(s):	None	Toxicology Performed:	
Medical Certification:	Class 3 With waivers/limitations	Last FAA Medical Exam:	October 9, 2019
Occupational Pilot:		Last Flight Review or Equivalent:	April 15, 2021
Flight Time:	233 hours (Total, all aircraft), 136 hours (Total, this make and model), 77 hours (Pilot In Command, all aircraft), 25 hours (Last 90 days, all aircraft), 9 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

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Aircraft and Owner/Operator Information

Aircraft Make:	Beech	Registration:	N793Y
Model/Series:	C23	Aircraft Category:	Airplane
Year of Manufacture:	1979	Amateur Built:	
Airworthiness Certificate:	Normal	Serial Number:	M-2184
Landing Gear Type:	Tricycle	Seats:	4
Date/Type of Last Inspection:	February 24, 2021 100 hour	Certified Max Gross Wt.:	2450 lbs
Time Since Last Inspection:	55.7 Hrs	Engines:	1 Reciprocating
Airframe Total Time:	4419.3 Hrs at time of accident	Engine Manufacturer:	Lycoming
ELT:	C91A installed, not activated	Engine Model/Series:	0-360-A2G
Registered Owner:	Park City Flight Training	Rated Power:	
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:	RRL,1318 ft msl	Distance from Accident Site:	5 Nautical Miles
Observation Time:	14:55 Local	Direction from Accident Site:	237°
Lowest Cloud Condition:	Scattered / 7000 ft AGL	Visibility	10 miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	3 knots / 14 knots	Turbulence Type Forecast/Actual:	None / None
Wind Direction:	20°	Turbulence Severity Forecast/Actual:	N/A / N/A
Altimeter Setting:	30.31 inches Hg	Temperature/Dew Point:	13°C / -4°C
Precipitation and Obscuration:	No Obscuration; No Precipita	ation	
Departure Point:	Merrill, WI	Type of Flight Plan Filed:	None
Destination:	Merrill, WI	Type of Clearance:	None
Departure Time:		Type of Airspace:	Unknown

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Airport Information

Airport:	Merrill Municipal Airport RRL	Runway Surface Type:	
Airport Elevation:	1318 ft msl	Runway Surface Condition:	
Runway Used:		IFR Approach:	None
Runway Length/Width:		VFR Approach/Landing:	

Wreckage and Impact Information

Crew Injuries:	1 Minor	Aircraft Damage:	Substantial
Passenger Injuries:	1 Minor	Aircraft Fire:	None
Ground Injuries:		Aircraft Explosion:	None
Total Injuries:	2 Minor	Latitude, Longitude:	45.242042,-89.613289

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Administrative Information

Investigator In Charge (IIC):	Link, Samantha
Additional Participating Persons:	Michael Dziengel; Federal Aviation Administration; Milwaukee, WI Ryan Enders; Lycoming
Original Publish Date:	August 15, 2023
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=103071

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

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 here.

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