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

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

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.

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

Pilot Information

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)		

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:**	O-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 Precipitation		
Departure Point:	Merrill, WI	**Type of Flight Plan Filed:**	None
Destination:	Merrill, WI	**Type of Clearance:**	None
Departure Time:		**Type of Airspace:**	Unknown

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

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