



# Aviation Investigation Final Report

<b>Location:</b>	Pellston, Michigan	<b>Accident Number:</b>	CEN23LA217
<b>Date &amp; Time:</b>	June 1, 2023, 13:30 Local	<b>Registration:</b>	N4376H
<b>Aircraft:</b>	Piper PA-28-181	<b>Aircraft Damage:</b>	Substantial
<b>Defining Event:</b>	Sys/Comp malf/fail (non-power)	<b>Injuries:</b>	2 None
<b>Flight Conducted Under:</b>	Part 91: General aviation - Instructional		

## Analysis

The flight instructor and student pilot had completed two touch and go landings. On takeoff after the second landing, they heard an unusual thumping sound or a bang. Due to the unusual noise, the flight instructor elected to perform a precautionary landing. During the approach for a precautionary landing, the airport manager observed that the left main landing gear wheel assembly was hanging from the landing gear strut by the brake line and advised the flight instructor via radio not to land. The flight instructor then diverted to another airport due to the availability of increased airport fire and rescue services. The airplane landed on the runway centerline with the partially separated left main landing gear assembly and sustained substantial damage to the left wing.

Postaccident examination revealed the landing gear strut housing and clevises were fractured at the upper torque link connection. Metallurgical examination revealed the strut and clevises fractured from fatigue cracks that had initiated along the radius of the clevis arms within the inner machined surface. These cracks initiated at multiple casting solidification voids and silicon-rich phases. The cracks propagated through the clevis cross-sections until the remaining cross-sections fractured from overstress.

## Probable Cause and Findings

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

The failure of the left main landing gear strut and clevises due to fatigue cracks that initiated at multiple casting solidification voids.

## Findings

**Aircraft**

Main gear strut/axle/truck - Fatigue/wear/corrosion

# Factual Information

## History of Flight

Landing	Sys/Comp malf/fail (non-power) (Defining event)
Landing-flare/touchdown	Abnormal runway contact

On June 1, 2023, about 1330 eastern daylight time, a Piper PA-28-181 airplane, N4376H, sustained substantial damage when it was involved in an accident near Pellston, Michigan. The flight instructor and student pilot were not injured. The airplane was being operated as a Title 14 *Code of Federal Regulations* Part 91 instructional flight.

The flight instructor reported he and the student pilot had completed two touch and go landings. On takeoff after the second landing, they heard an unusual thumping sound or bang. Initially they thought the noise was coming from the engine, so they planned for a precautionary landing back to the runway. During the approach, the airport manager observed that the left main landing gear wheel assembly was hanging by the brake line from the landing gear strut and advised the flight instructor via radio not to land. The flight instructor then diverted to another airport due to the availability of increased airport fire and rescue services.

The airplane landed on the runway centerline with the partially separated left main landing gear assembly and sustained substantial damage to the left wing. Postaccident examination revealed the landing gear strut housing clevis was fractured at the upper torque link connection (see figure 1). The wheel assembly remained attached via the brake line hose. The airplane and strut housing were retained for further examination.



*Figure 1. Fractured left main landing gear strut housing clevis (Source: Federal Aviation Administration).*

The National Transportation Safety Board's Materials Laboratory examined the remnants of the landing gear strut, which included a sectioned portion of the cylinder, and the torque link assembly arm attached to the broken cylinder clevis via the attachment bolt. The chemical composition of the fractured cylinder was consistent with A356 aluminum-silicon casting alloy. The cylinder side fracture surfaces exhibited crack arrest marks, consistent with progressive fracture, and ratchet marks, indicative of multiple crack initiation sites. The crack features were consistent with initiation along the interior surface between the clevises, which was machined smoother than the exterior surfaces. Outside of the cracks, the fracture surface exhibited dimpled rupture, consistent with subsequent overstress fracture.

Several initiation sites were examined along the radius with the machined surface. One initiation site exhibited a flat, faceted region from which river patterns and striations emanated. Closer examination revealed layered hackles typical of localized brittle fracture and consistent with a silicon-rich phase, typical in many aluminum-silicon castings.

A smooth surface feature adjacent to the fracture edge exhibited a spherical, dendritic morphology which consisted of a solidification void from the casting of the part. Fatigue striations were found propagating from the void rather than from the fracture edge. The features were consistent with crack initiation from the solidification void. Another solidification void, exhibiting smooth, rounded dendritic shapes along the fracture surface edge, contained a secondary crack running through the feature. Fatigue striations were found propagating parallel to the edge, consistent with initiation along the secondary crack from the solidification void.

The strut assembly fractured from fatigue cracks that had initiated along the radius of the clevis arms within the inner machined surface. These cracks initiated at multiple casting solidification voids and silicon-rich phases. The cracks propagated through the clevis cross-sections until the remaining cross-sections fractured from overstress.

## Flight instructor Information

<b>Certificate:</b>	Commercial; Flight instructor	<b>Age:</b>	67,Male
<b>Airplane Rating(s):</b>	Single-engine land	<b>Seat Occupied:</b>	Right
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	3-point
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	Airplane multi-engine; Airplane single-engine	<b>Toxicology Performed:</b>	
<b>Medical Certification:</b>	Class 2 With waivers/limitations	<b>Last FAA Medical Exam:</b>	December 10, 2022
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	March 19, 2023
<b>Flight Time:</b>	5545 hours (Total, all aircraft), 16 hours (Total, this make and model), 4597 hours (Pilot In Command, all aircraft), 21 hours (Last 90 days, all aircraft), 11 hours (Last 30 days, all aircraft)		

## Student pilot Information

<b>Certificate:</b>	Student	<b>Age:</b>	45,Male
<b>Airplane Rating(s):</b>	None	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	3-point
<b>Instrument Rating(s):</b>	None	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	None	<b>Toxicology Performed:</b>	
<b>Medical Certification:</b>	Class 1 Without waivers/limitations	<b>Last FAA Medical Exam:</b>	August 31, 2022
<b>Occupational Pilot:</b>	No	<b>Last Flight Review or Equivalent:</b>	
<b>Flight Time:</b>	42 hours (Total, all aircraft), 3 hours (Total, this make and model), 3 hours (Last 90 days, all aircraft), 3 hours (Last 30 days, all aircraft)		

## Aircraft and Owner/Operator Information

<b>Aircraft Make:</b>	Piper	<b>Registration:</b>	N4376H
<b>Model/Series:</b>	PA-28-181	<b>Aircraft Category:</b>	Airplane
<b>Year of Manufacture:</b>	1984	<b>Amateur Built:</b>	
<b>Airworthiness Certificate:</b>	Normal; Utility	<b>Serial Number:</b>	28-8490110
<b>Landing Gear Type:</b>	Tricycle	<b>Seats:</b>	4
<b>Date/Type of Last Inspection:</b>	April 2, 2023 Annual	<b>Certified Max Gross Wt.:</b>	2550 lbs
<b>Time Since Last Inspection:</b>		<b>Engines:</b>	1 Reciprocating
<b>Airframe Total Time:</b>	4452 Hrs as of last inspection	<b>Engine Manufacturer:</b>	LYCOMING
<b>ELT:</b>	Installed	<b>Engine Model/Series:</b>	O-360-A4M
<b>Registered Owner:</b>	On file	<b>Rated Power:</b>	180 Horsepower
<b>Operator:</b>	On file	<b>Operating Certificate(s) Held:</b>	None

## Meteorological Information and Flight Plan

<b>Conditions at Accident Site:</b>	Visual (VMC)	<b>Condition of Light:</b>	Day
<b>Observation Facility, Elevation:</b>	KPLN, 715 ft msl	<b>Distance from Accident Site:</b>	0 Nautical Miles
<b>Observation Time:</b>	11:54 Local	<b>Direction from Accident Site:</b>	144°
<b>Lowest Cloud Condition:</b>	Clear	<b>Visibility</b>	10 miles
<b>Lowest Ceiling:</b>	None	<b>Visibility (RVR):</b>	
<b>Wind Speed/Gusts:</b>	5 knots /	<b>Turbulence Type Forecast/Actual:</b>	/
<b>Wind Direction:</b>	130°	<b>Turbulence Severity Forecast/Actual:</b>	/
<b>Altimeter Setting:</b>	30.14 inches Hg	<b>Temperature/Dew Point:</b>	29°C / 16°C
<b>Precipitation and Obscuration:</b>	No Obscuration; No Precipitation		
<b>Departure Point:</b>	Harbor Springs, MI (MGN)	<b>Type of Flight Plan Filed:</b>	None
<b>Destination:</b>	Pellston, MI	<b>Type of Clearance:</b>	None
<b>Departure Time:</b>	11:23 Local	<b>Type of Airspace:</b>	Class G

## Airport Information

<b>Airport:</b>	PELLSTON RGNL/EMMET COUNTY PLN	<b>Runway Surface Type:</b>	Asphalt
<b>Airport Elevation:</b>	720 ft msl	<b>Runway Surface Condition:</b>	Dry
<b>Runway Used:</b>	14	<b>IFR Approach:</b>	None
<b>Runway Length/Width:</b>	6513 ft / 150 ft	<b>VFR Approach/Landing:</b>	Forced landing

## Wreckage and Impact Information

<b>Crew Injuries:</b>	2 None	<b>Aircraft Damage:</b>	Substantial
<b>Passenger Injuries:</b>	N/A	<b>Aircraft Fire:</b>	None
<b>Ground Injuries:</b>		<b>Aircraft Explosion:</b>	None
<b>Total Injuries:</b>	2 None	<b>Latitude, Longitude:</b>	45.570041,-84.79916(est)



## Administrative Information

Investigator In Charge (IIC):	Sauer, Aaron
Additional Participating Persons:	Joshua Osman; FAA; Grand Rapids, MI
Original Publish Date:	April 18, 2024
Last Revision Date:	
Investigation Class:	<a href="#">Class 3</a>
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	<a href="https://data.nts.gov/Docket?ProjectID=192285">https://data.nts.gov/Docket?ProjectID=192285</a>

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