Aviation Investigation Final Report

Location:	Billings, Montana	**Accident Number:**	WPR17LA056
Date & Time:	January 19, 2017, 11:48 Local	**Registration:**	N326CA
Aircraft:	Beech 99	**Aircraft Damage:**	Substantial
Defining Event:	Sys/Comp malf/fail (non-power)	**Injuries:**	1 None
Flight Conducted Under:	Part 135: Air taxi & commuter - Non-scheduled		

Analysis

The commercial pilot reported that, after departing for the cross-country, cargo flight, he retracted the landing gear and heard a "thud" sound. Subsequently, the main landing gear (MLG) "unsafe" light illuminated, and the left MLG light remained illuminated green, indicating that it was still extended despite the landing gear handle being in the retracted position. The pilot returned to the departure airport, and during touchdown, the right MLG collapsed, which resulted in substantial damage to the right aileron and right wing spar.

During the postaccident examination of the landing gear, the left MLG actuator's piston rod was found fractured. Metallurgical examination of the piston rod revealed that the rod had failed in its threaded section due to fatigue cracking over about 60% of the cross-section. Contact wear was observed on the faying surface of the retaining nut and piston head and the shoulder of the piston rod. These signatures were consistent with the nut not being tight enough to mitigate sliding of the piston head relative to the piston rod and retaining nut. It could not be determined if the manufacturer required a specific torque to be applied to the nut during assembly. Based on the evidence, it is likely that inadequate torque on the nut reduced the preload on the threaded section of the piston rod and contributed to premature fatigue crack propagation in the rod and its eventual failure. The failure of the piston rod allowed hydraulic fluid to pass freely from the down-side to the up-side of the piston, which prevented the hydraulic system from producing pressure to control the MLG's position.

Probable Cause and Findings

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

The fatigue failure of the left main landing gear (MLG) actuator piston rod, which prevented the hydraulic system from producing pressure to control the MLG's position and led to the right MLG collapsing during landing.

Findings

Aircraft	Landing gear actuator - Failure
Aircraft	Landing gear actuator - Fatigue/wear/corrosion

Factual Information

History of Flight

Initial climb	Sys/Comp malf/fail (non-power) (Defining event)
Landing-landing roll	Landing gear collapse

On January 19, 2017 about 1148 mountain standard time, a Beech 99A airplane, N326CA, experienced a landing gear collapse while landing at the Billings Logan International Airport, Billings, Montana. The commercial pilot was not injured; the airplane sustained substantial damage. The airplane was registered to and operated by Alpine Aviation Inc., d.b.a. Alpine Air, as a Title 14 *Code of Federal Regulations* Part 135 cargo transport flight. Visual meteorological conditions prevailed, and an instrument flight rules flight plan had been filed but was not activated. The flight departed from Dawson Community Airport, Glendive, Montana about 0945, with a planned destination of Sidney-Richland Municipal Airport, Sidney, Montana.

The pilot reported that after departure, he retracted the landing gear and heard a "thud" sound. The landing gear "unsafe" light was illuminated, and the left landing gear light remained illuminated green, an indication that it was still extended despite the landing gear handle being in the retracted position. When reaching his initial destination of Sidney, the pilot performed a low pass over the runway to enable maintenance personnel on the ground to do a visual assessment. A mechanic reported to the pilot that the nose gear was in trail. The pilot diverted to Billings and the air traffic control personnel confirmed observing the nose gear extended at a 45^0 angle.

The pilot further stated that he aligned with runway 28R and just prior to touch down, he feathered the propellers and decreased the airspeed. During touchdown, the right main landing gear collapsed, and the airplane came to rest on the centerline. As a result of the impact, the right aileron and right-wing spar was substantially damaged.

Pilot Information

Certificate:	Commercial	**Age:**	25,Male
Airplane Rating(s):	Single-engine land; Single-engine sea; 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):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	October 20, 2016
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	September 17, 2016
Flight Time:	1419 hours (Total, all aircraft), 270 hours (Total, this make and model), 1308 hours (Pilot In Command, all aircraft), 196 hours (Last 90 days, all aircraft), 57 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Beech	**Registration:**	N326CA
Model/Series:	99 A	**Aircraft Category:**	Airplane
Year of Manufacture:	1970	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	U-135
Landing Gear Type:	Retractable - Tricycle	**Seats:**	2
Date/Type of Last Inspection:	December 14, 2016 AAIP	**Certified Max Gross Wt.:**	10900 lbs
Time Since Last Inspection:	96 Hrs	**Engines:**	2 Turbo prop
Airframe Total Time:	46422 Hrs at time of accident	**Engine Manufacturer:**	Pratt and Whitney
ELT:	C126 installed, not activated	**Engine Model/Series:**	PT6A-28
Registered Owner:	Alpine Aviation Inc	**Rated Power:**	750 Horsepower
Operator:	Alpine Aviation Inc	**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:	Alpine Air	**Operator Designator Code:**	TIMA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	BIL	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	18:53 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	Broken / 10000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	12 knots / None	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	230°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	29.48 inches Hg	**Temperature/Dew Point:**	4°C / -6°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	GLENDIVE, MT (GDV)	**Type of Flight Plan Filed:**	IFR
Destination:	SIDNEY, MT (SDY)	**Type of Clearance:**	None
Departure Time:	09:45 Local	**Type of Airspace:**	

Airport Information

Airport:	BILLINGS LOGAN INTL BIL	**Runway Surface Type:**	Asphalt
Airport Elevation:	3651 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	28R	**IFR Approach:**	None
Runway Length/Width:	10518 ft / 150 ft	**VFR Approach/Landing:**	Traffic pattern

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 None	**Latitude, Longitude:**	45.807777,-108.542778

Tests and Research

Post-accident examination of the left landing gear actuator, part number (p/n) 99-388-008-1, revealed that it appeared to be fractured allowing the hydraulic fluid to pass freely from the downside to the upside, prohibiting pressure to control the landing gear's hydraulic system. Based on the pilots' statements about the landing, the fractured left landing gear was shipped to Textron Aviation, the airframe manufacturer, for examination. The piston rod, p/n 4A125C4, was separated into two pieces through several threads. According to the report, the damaged threads displayed crack propagation by fatigue. The final fracture was by overload and resulted in deformation of the damaged threads.

The National Transportation Safety Board Materials Laboratory reviewed the Textron Aviation Materials report and pictures. The lab specialist reported that the fractography indicated that the piston rod failed in the threaded region by fatigue cracking over about 60% of the cross section due primarily to axial tension force. Contact wear was observed on the faying surface of the retaining nut, the shoulder of the piston rod, and on the faying surfaces of the piston head. These signatures were consistent with the nut not being tight enough to mitigate relative sliding of the piston head relative to the piston rod shoulder and the retaining nut. It could not be determined if the manufacturer required a specific torque to be applied to the nut during assembly.

The airplane operator reported that the airplane had amassed 46,416.3 hours of total time in service. According to the maintenance records, the left actuator was last overhauled in November 2001, at which time the piston rod was replaced. The operator further reported that the part had acquired 7,445.2 hours equating to 8,267 cycles. The Beechcraft Model 99 Series Maintenance Manual stated that the landing gear hydraulic actuators should be overhauled or replaced every 10,000 hours.

Administrative Information

Investigator In Charge (IIC):	Keliher, Zoe
Additional Participating Persons:	Rickey Koffman; Federal Aviation Administration; Helena, MT
Original Publish Date:	April 13, 2020
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=94631