



Aviation Investigation Final Report

Location:	Salem, Oregon	Accident Number:	WPR20LA252
Date & Time:	June 4, 2020, 18:21 Local	Registration:	N8244Y
Aircraft:	Piper PA 30	Aircraft Damage:	Substantial
Defining Event:	Landing gear collapse	Injuries:	2 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot reported that, after departure, he raised the landing gear and heard an unusual "clunk"; however, he did not observe any anomalies at the time and continued the flight. As the airplane neared the destination airport, the pilot extended the landing gear, but the landing gear did not fully extend. After troubleshooting, including attempting the emergency extension procedure, the pilot landed the airplane with the gear partially extended, during which the airplane sustained substantial damage to the keel beam and the right-wing spar.

Postaccident examination revealed that the right main landing gear trunnion was fractured as the result of two fatigue cracks that had developed at a welded gusset joined to a protruding boss. Once these fatigue cracks had propagated far enough into the boss cross-section, the remainder of the part fractured by overstress, likely during the last landing. The presence of two opposite-facing fatigue cracks was consistent with reverse bending fatigue. The fatigue cracks initiated at a tapered neck-shaped area, where the gusset and trunnion were joined. The cross-sectional thickness at this location was half the thickness of the gusset and a quarter of the diameter of the boss. This configuration would introduce a stress concentration at the locations of the fatigue cracking.

The trunnion boss was consistent with a heat-treated aluminum alloy. The hardness approaching the welded joint decreased, consistent with softening from the heat input. The reduced hardness would increase susceptibility to fatigue crack initiation at the areas of stress concentration.

It is likely that, over time, the fatigue cracks propagated as the joint flexed or bent back and forth, and the stress concentrations at the neck-shaped region were exacerbated by the reduced mechanical properties of that region. The fracture surfaces were damaged after the accident, and, due to the amount of post-fracture damage, no reliable fatigue analysis could be performed.

Probable Cause and Findings

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

A fatigue failure of the right main landing gear trunnion.

Findings

Aircraft	Gear extension and retract sys - Fatigue/wear/corrosion
Aircraft	Gear extension and retract sys - Failure

Factual Information

History of Flight

Landing	Landing gear collapse (Defining event)
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On June 4, 2020, at 1821 Pacific daylight time, a Piper PA30 airplane, N8244Y, was substantially damaged when it was involved in an accident at Salem, Oregon. The pilot and passenger were not injured. The airplane was operated as a Title 14 *Code of Federal Regulations (CFR)* Part 91 personal flight.

The pilot reported that after departure, he raised the landing gear and heard an unusual "clunk," but the landing gear retraction light illuminated normally and the mirror on the left engine nacelle indicated that the nose gear was retracted. The pilot continued the flight, and as the airplane neared the destination airport, he lowered the landing gear. The green "down and locked" light did not illuminate, and the nose landing gear door was open, but the nose landing gear was not extended. The pilot climbed the airplane and began to troubleshoot the issue, including performing the emergency gear extension procedure; however, "the system was totally jammed." The pilot diverted to a nearby airport, where he performed a flyby, and ground personnel indicated that the main landing gear was partially extended, and the nose landing gear was not extended. The pilot landed the airplane and he and the passenger egressed without injury. The airplane sustained substantial damage to the keel beam and the right-wing spar.

Postaccident examination revealed that the right main landing gear trunnion was fractured. The trunnion was removed from the airplane and sent to the NTSB Materials Laboratory for analysis. The fracture surfaces had been forced together and taped before receipt by the laboratory, which inhibited examination. Most of the undamaged portions of the fracture surfaces exhibited a rough, fibrous texture with a dull luster. The inner mating fracture surface was less damaged and was sectioned below the fracture surface to facilitate further examination.

The sectioned portion was examined with a scanning electron microscope. Most of the surface exhibited features consistent with overstress fracture; however, there were two opposite facing areas exhibiting flatter, darker features. These areas were located at a tapered area where the trunnion and gusset were joined and showed evidence of fatigue striations that were consistent with having propagated from the outside surface inward. Due to post-fracture damage, only one crack initiation site was able to be observed, and this site exhibited an inward concave geometry inconsistent with a corrosion pit or pore.

The cross-sectional thickness of the tapered area in which the evidence of fatigue was found was measured as 0.4 inches. In contrast, the welded gusset was 0.8 inches thick, and the boss exhibited a diameter of 1.75 inches. This configuration would introduce a stress concentration at the locations of the fatigue cracking. The presence of two opposite-facing fatigue cracks was

consistent with reverse bending fatigue, suggestive of the gusset bending back and forth at the interface. Once these fatigue cracks had propagated far enough into the boss cross section, the remainder of the part fractured under overstress during the last landing.

The chemical composition of the sectioned trunnion was examined using x-ray fluorescence (XRF) and energy dispersive x-ray spectroscopy (EDS). From the data obtained using these techniques, the trunnion was found to be consistent with an AA 2014 aluminum alloy. The hardness and conductivity met specifications consistent with peak hardened temper for this alloy.

The welded gusset however, exhibited a different chemical composition. The composition was consistent with an aluminum casting or welding alloy. The electrical conductivity was higher, and the hardness was softer than the Rockwell B scale and was, therefore, not measured conclusively. The hardness of the boss material was found to decrease as it was probed closer to the weld. These data were consistent with the boss being locally softened due to the heat inputs from the welding process.

Pilot Information

Certificate:	Private	Age:	77, Male
Airplane Rating(s):	Single-engine land; Multi-engine land	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	3-point
Instrument Rating(s):	Airplane	Second Pilot Present:	No
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Class 3 With waivers/limitations	Last FAA Medical Exam:	December 11, 2019
Occupational Pilot:	No	Last Flight Review or Equivalent:	December 9, 2019
Flight Time:	(Estimated) 4562 hours (Total, all aircraft), 2533 hours (Total, this make and model), 4500 hours (Pilot In Command, all aircraft), 30 hours (Last 90 days, all aircraft)		

Passenger Information

Certificate:		Age:	Female
Airplane Rating(s):		Seat Occupied:	Right
Other Aircraft Rating(s):		Restraint Used:	3-point
Instrument Rating(s):		Second Pilot Present:	No
Instructor Rating(s):		Toxicology Performed:	
Medical Certification:		Last FAA Medical Exam:	
Occupational Pilot:	No	Last Flight Review or Equivalent:	
Flight Time:			

Aircraft and Owner/Operator Information

Aircraft Make:	Piper	Registration:	N8244Y
Model/Series:	PA 30 No Series	Aircraft Category:	Airplane
Year of Manufacture:	1965	Amateur Built:	
Airworthiness Certificate:	Normal	Serial Number:	30-917
Landing Gear Type:	Retractable - Tricycle	Seats:	4
Date/Type of Last Inspection:	March 10, 2020 Annual	Certified Max Gross Wt.:	3800 lbs
Time Since Last Inspection:	25.3 Hrs	Engines:	2 Reciprocating
Airframe Total Time:	4785 Hrs as of last inspection	Engine Manufacturer:	Lycoming
ELT:	Installed, not activated	Engine Model/Series:	IO-320-C1A
Registered Owner:	On file	Rated Power:	160 Horsepower
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:	KSLE,201 ft msl	Distance from Accident Site:	0 Nautical Miles
Observation Time:	18:20 Local	Direction from Accident Site:	167°
Lowest Cloud Condition:	Clear	Visibility	10 miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	6 knots / 18 knots	Turbulence Type Forecast/Actual:	None / None
Wind Direction:		Turbulence Severity Forecast/Actual:	N/A / N/A
Altimeter Setting:	29.9 inches Hg	Temperature/Dew Point:	22°C / 7°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Medford, OR (MFR)	Type of Flight Plan Filed:	IFR
Destination:	Salem, OR	Type of Clearance:	None
Departure Time:	15:00 Local	Type of Airspace:	Class D

Airport Information

Airport:	McNary Fld SLE	Runway Surface Type:	Asphalt
Airport Elevation:	213 ft msl	Runway Surface Condition:	Dry
Runway Used:	34	IFR Approach:	None
Runway Length/Width:	5146 ft / 100 ft	VFR Approach/Landing:	Precautionary landing

Wreckage and Impact Information

Crew Injuries:	1 None	Aircraft Damage:	Substantial
Passenger Injuries:	1 None	Aircraft Fire:	None
Ground Injuries:		Aircraft Explosion:	None
Total Injuries:	2 None	Latitude, Longitude:	44.909442,-123.0025(est)

Administrative Information

Investigator In Charge (IIC):	Cornejo, Tealeye
Additional Participating Persons:	Tony Moore; FAA FSDO; Portland, OR
Original Publish Date:	November 4, 2022
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=101734

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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](#).