



Aviation Investigation Final Report

Location:	Tacoma, Washington	Accident Number:	WPR23LA213
Date & Time:	May 30, 2023, 11:15 Local	Registration:	N9574X
Aircraft:	Cessna 210	Aircraft Damage:	Substantial
Defining Event:	Sys/Comp malf/fail (non-power)	Injuries:	2 None
Flight Conducted Under:	Part 91: General aviation - Instructional		

Analysis

While on the downwind leg of the traffic pattern, the flight instructor was unable to fully extend the landing gear. The landing gear appeared to be stuck in a transitional position, which the flight instructor attempted to resolve by moving the gear selector back to the gear-up position; however, she observed no movement. After about 1.5 hours of troubleshooting the landing gear, the flight instructor decided to land with the gear partially extended. The airplane touched down with the nose gear locked and the pilot was unable to attain directional control. The airplane veered off the runway, coming to rest in the grass.

Examination of the hydraulic system revealed that the left main landing gear hydraulic actuator barrel was fractured adjacent to the end cap. A fracture at the retainer clip groove exhibited striations consistent with fatigue crack propagation, and other fractures through the barrel exhibited signatures of overstress failure. It is likely that, once the fatigue crack grew to a significant depth, the housing cracked further from overstress and hydraulic fluid leaked out of the system, preventing the landing gear from extending properly.

The airplane manufacturer had previously issued instructions for modification of some landing gear hydraulic actuators installed on the accident airplane make and model, and an FAA airworthiness directive (AD) was subsequently issued to mandate the modifications. The maintenance records showed that the AD was performed on the accident airplane.

This is at least the fourth known failure of this model of actuator that resulted in an accident. The location, size, and physical features of the cracks were consistent among the accidents.

Probable Cause and Findings

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

A fatigue failure of the left main landing gear hydraulic actuator, which resulted in a loss of hydraulic fluid that prevented the pilot from lowering the landing gear to the fully extended position and maintaining directional control after landing.

Findings

Aircraft	Findings
	Landing gear actuator - Fatigue/wear/corrosion

Factual Information

History of Flight

Landing	Sys/Comp malf/fail (non-power) (Defining event)
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On May 30, 2023, about 1115 Pacific daylight time, a Cessna 210B, N9574X, was substantially damaged when it was involved in an accident near Tacoma, Washington. The flight instructor and student pilot were not injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 instructional flight.

The flight instructor stated that she intended to perform a practice landing at Boeing Field in Seattle, Washington. While on the downwind leg of the traffic pattern, she completed the landing checklist but encountered an issue with the landing gear. The landing gear did not fully extend and appeared to be stuck in a transitional position. The flight instructor attempted to resolve the situation by moving the gear selector back to the gear-up position but observed no landing gear movement. The gear selector was then returned to the gear-down position, but again no landing gear movement occurred. Suspecting a problem in the hydraulic system, the flight instructor attempted to extend the hydraulically actuated wing-flaps, which was unsuccessful.

The flight instructor requested to perform a low-approach over the runway so the air traffic controllers could visually verify the landing gear position. The controllers stated that the landing gear appeared to be stuck in transition, and the flight instructor opted to divert to a practice area to troubleshoot the landing gear. She used the emergency backup hand-pump, but her attempts were unsuccessful. She called a maintenance technician, and he attempted to troubleshoot the landing gear, but the situation did not change. The flight instructor then diverted to Tacoma Narrows Airport, Tacoma, Washington and performed several low passes over mechanics on the ground who assessed the condition of the airplane's landing gear.

After about 1.5 hours of troubleshooting, the flight instructor decided to land with the gear partially extended. The airplane touched down on the centerline of the runway with the nose gear locked in place, which allowed for limited turning ability. The airplane came to rest in the grass off the left side of the runway. The left horizontal stabilizer was damaged during the accident sequence (see Figure 1).



Figure 1: Airplane damaged at the accident site.

Flight instructor Information

Certificate:	Commercial; Flight instructor	Age:	34,Female
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land	Seat Occupied:	Right
Other Aircraft Rating(s):	None	Restraint Used:	4-point
Instrument Rating(s):	Airplane	Second Pilot Present:	No
Instructor Rating(s):	Airplane single-engine	Toxicology Performed:	
Medical Certification:	Class 1 Without waivers/limitations	Last FAA Medical Exam:	October 20, 2022
Occupational Pilot:	No	Last Flight Review or Equivalent:	April 26, 2023
Flight Time:	860 hours (Total, all aircraft), 8 hours (Total, this make and model), 720 hours (Pilot In Command, all aircraft), 50 hours (Last 90 days, all aircraft), 25 hours (Last 30 days, all aircraft), 6 hours (Last 24 hours, all aircraft)		

Student pilot Information

Certificate:	Student	Age:	35, Male
Airplane Rating(s):	None	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	4-point
Instrument Rating(s):	None	Second Pilot Present:	No
Instructor Rating(s):	None	Toxicology Performed:	
Medical Certification:	Class 3 Without waivers/limitations	Last FAA Medical Exam:	April 25, 2023
Occupational Pilot:	No	Last Flight Review or Equivalent:	
Flight Time:	(Estimated)		

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	Registration:	N9574X
Model/Series:	210 B	Aircraft Category:	Airplane
Year of Manufacture:	1962	Amateur Built:	
Airworthiness Certificate:	Normal	Serial Number:	21057874
Landing Gear Type:	Retractable - Tricycle	Seats:	4
Date/Type of Last Inspection:	May 8, 2023 Annual	Certified Max Gross Wt.:	3000 lbs
Time Since Last Inspection:	8 Hrs	Engines:	1 Reciprocating
Airframe Total Time:	4538 Hrs as of last inspection	Engine Manufacturer:	Teledyne Continental Motors
ELT:	Installed, not activated	Engine Model/Series:	IO-470-S2B
Registered Owner:	FLYING NOVA LLC	Rated Power:	280
Operator:	FLYING NOVA LLC	Operating Certificate(s) Held:	None

A comparison of the Airworthiness Directive (AD) compliance listing in the logbook against a list of AD's applicable to the airplane's serial number revealed that all those pertinent had been endorsed as complied with. This included 76-04-01, which was shown as complied with in August 1985.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	KTIW,290 ft msl	Distance from Accident Site:	0 Nautical Miles
Observation Time:	11:53 Local	Direction from Accident Site:	88°
Lowest Cloud Condition:	Clear	Visibility	10 miles
Lowest Ceiling:	Overcast / 2300 ft AGL	Visibility (RVR):	
Wind Speed/Gusts:	5 knots / None	Turbulence Type Forecast/Actual:	None / None
Wind Direction:	300°	Turbulence Severity Forecast/Actual:	N/A / N/A
Altimeter Setting:	30.06 inches Hg	Temperature/Dew Point:	12°C / 6°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Auburn, WA (S50)	Type of Flight Plan Filed:	None
Destination:	Seattle, WA (BFI)	Type of Clearance:	VFR
Departure Time:	09:35 Local	Type of Airspace:	Class D

Airport Information

Airport:	TACOMA NARROWS TIW	Runway Surface Type:	Asphalt
Airport Elevation:	294 ft msl	Runway Surface Condition:	Dry
Runway Used:	17	IFR Approach:	None
Runway Length/Width:	5002 ft / 100 ft	VFR Approach/Landing:	Forced landing;Full stop;Traffic pattern

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:	47.267944,-122.57811(est)

Tests and Research

A postaccident examination of the landing gear was performed by a certified airframe and powerplant mechanic. He stated that the landing gear doors were locked in the open position. Removing the panels revealed that the left main gear rotary actuator was cracked and was leaking hydraulic fluid (see Figure 2).

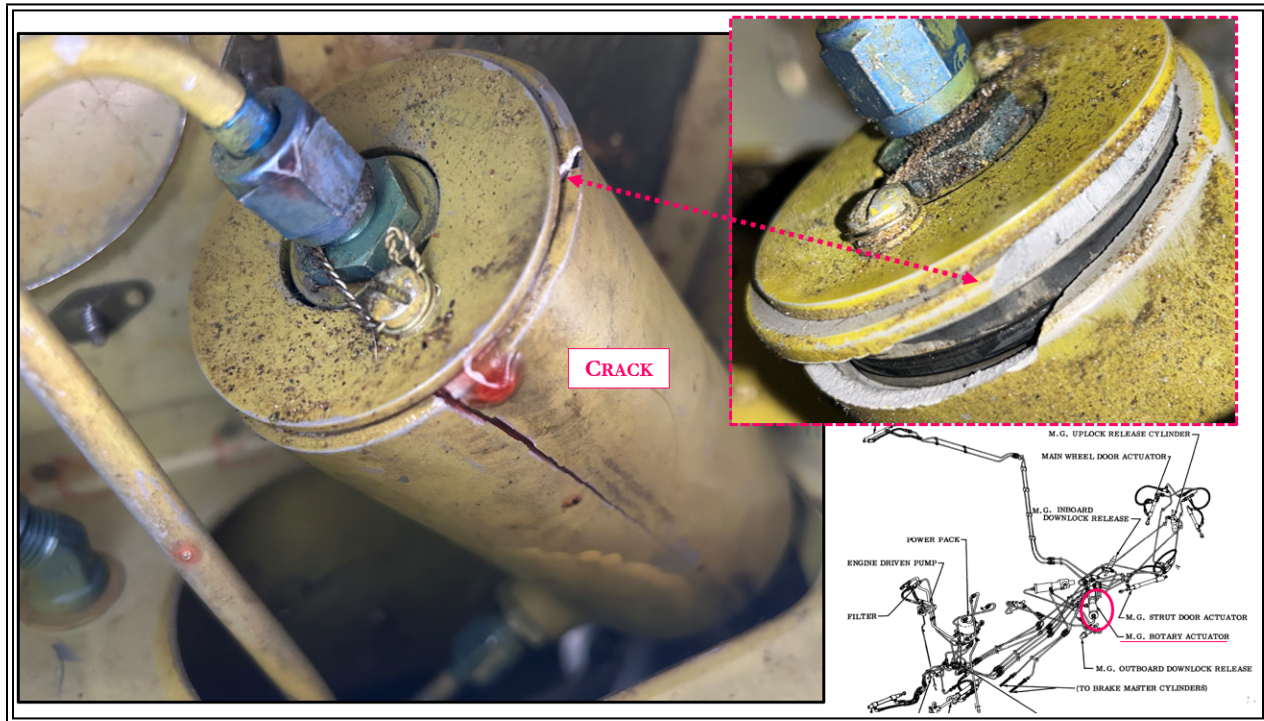


Figure 2: Cracked actuator and location in the airplane.

The Electrol Inc. actuator, part number (P/N) 1280501-1, was sent to the National Transportation Safety Board (NTSB) Materials Laboratory for examination. The examination revealed that there was a crack through the barrel, with circumferential and longitudinal sections. The crack initiated at the retaining ring groove, where corrosion pits were present, and propagated via fatigue circumferentially (see Figure 3). The longitudinal portion of the crack, which extended through more than half the actuator barrel's thickness, displayed signatures consistent with tensile overstress fracture. The actuator was composed of aluminum alloy, and its hardness and conductivity were consistent with the expected material properties.

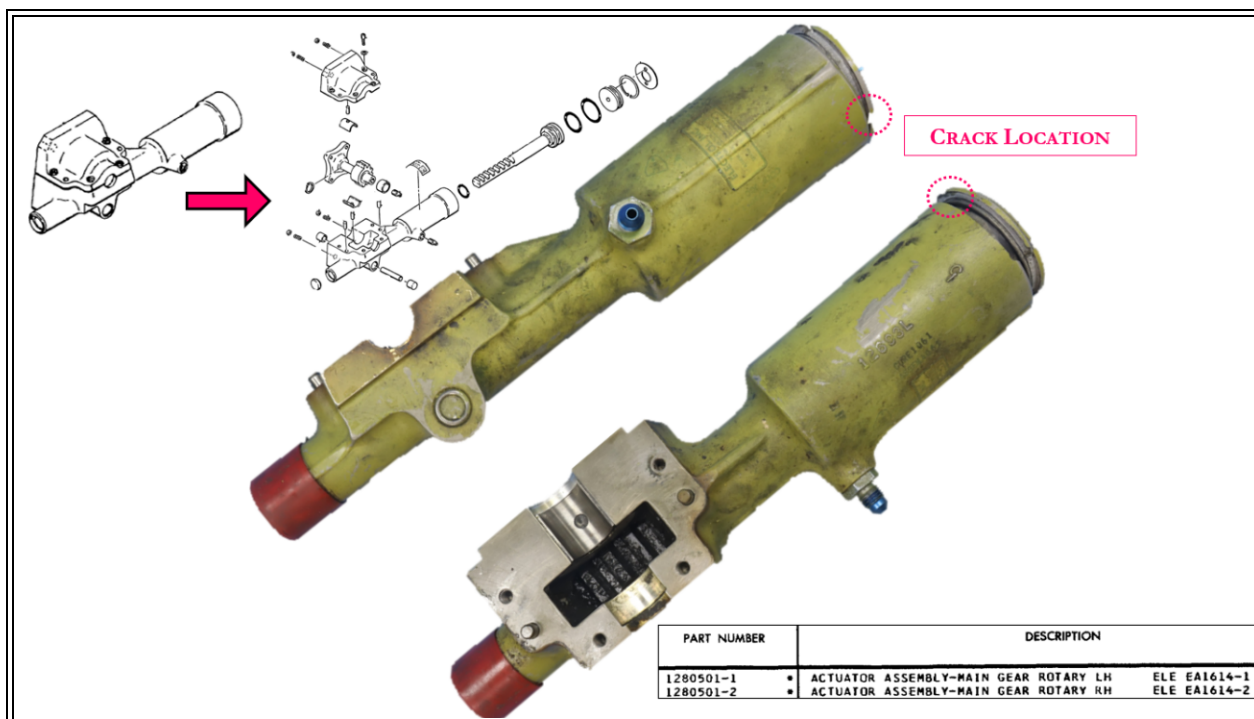


Figure 3: Crack location on the actuator barrel.

Scanning electron microscopy (SEM) examination confirmed that the fatigue cracking had originated at corrosion pits along the ring groove. As demonstrated by striation features, the fatigue crack propagated circumferentially around the barrel until it reached a critical size, and then partially fractured longitudinally from overstress. Corrosion pits were present at the fatigue crack initiation points along the groove.

The material examination of the actuator using energy dispersive x-ray spectroscopy (EDS) found the retaining clip groove contained remnants of the cadmium plating from the clip, and confirmed the presence of aluminum oxide at the crack initiation sites. These findings were consistent with fatigue failure due to the presence of corrosion pits and the progressive propagation of cracks under cyclic stress, leading to the actuator's failure and the release of hydraulic fluid.

Additional Information

ACTUATOR

Cessna sourced actuators from two companies: Electrol Inc. and Ozone. The Electrol Inc. unit used a snap ring to hold the end plug in place, with a cover plate positioned over the end plug to pull it out to

the snap ring and secure it. The Ozone design did not use a snap ring. Instead, the end cap was screwed in, which was a more robust design. A Service Bulletin was issued to address inspections of these actuators.

PRIOR ACCIDENTS

This is at least the fourth known failure of this actuator, and numerous other accidents may have been a result of other actuator failure, but those units could not be examined. The National Transportation Safety Board has examined and investigated the actuators of 4 accidents (including this one):

Cessna 210 accident that occurred in Juneau, Alaska in 2015

- Actuator P/N EA1614, S/N 267 (Electrol Inc.)

Cessna 210C accident that occurred in Juneau, Alaska in 2018

- Actuator P/N EA1614..., S/N 275... (Most of placard obliterated)

Cessna 210B accident that occurred in Clinton, Arkansas in 2022

- Actuator P/N EA161402, S/N 190 (Cox Airparts)

The fractures from all these accidents were identical. The location, size, and physical features of the cracks were consistent and included fatigue cracks initiating from the retainer clip grooves on the interior of the actuator housings that propagated outward into the housing bodies. When the crack had grown large enough, the housing fractured, relieving hydraulic pressure, and causing the actuator to fail in service.

MAINTENANCE INSPECTIONS

There have been numerous service bulletins and airworthiness directives issued on these types of hydraulic actuators over the last several decades. These include:

Cessna Service Letter 67-16 (March 28, 1967) on replacement

- Covering Electrol actuators 1813-1/-2 with S/N 1-31 (except 27) and 1-32 (except 28-29), respectively

- Covering Electrol actuators 1614-1/-2 with S/N 405-415, 448-468 and 400-404, 444-453, respectively

Cessna Service Letter SE69-17 (September 16, 1969) on field repair

- Covering all actuators installed on 1964 Cessna 210s

Cessna Service Letter SE75-21 (October 3, 1975) on modification

- Covering Electrol actuators installed 1960 to 1964 in Cessna 210s

Airworthiness Directive 76-04-01 (January 27, 1977) on repair/replacement

- Covering Cessna P/N 1280102-1/-2 or Electrol 1471-1/-2

- Covering Cessna P/N 1280501-1/-2 or Electrol 1614-1/-2

Cessna Service Bulletin SEB01-2 Rev 2 (June 4, 2007)

- Covering actuator P/Ns 1281000-1/-2, 1281006-1/-2, 9882000-1/-2, 9882015-1/-2, 1241619-2, 1281001-1/-2/-3 for modification

-Covering 1281000-3/-4, 9882000-4/-5, 9882015-4, and 1281001-4/-5/-6 for inspection

These notices did not cover the actuators previously examined by the NTSB, though AD 76-04-01 covered the part in this investigation, having P/N 1280501-1. The markings on the actuator were consistent with it having been refurbished.

Administrative Information

Investigator In Charge (IIC):	Keliher, Zoe
Additional Participating Persons:	Frank Baker; Federal Aviation Administration; Seattle, WA
Original Publish Date:	February 20, 2025
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=192308

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](#).