September 18, 2025 Aviation Investigation Report AIR-25-06

Address Fatigue Cracking in Hydraulic Landing Gear Actuators on Cessna 210 and 210B Airplanes

Introduction

The National Transportation Safety Board (NTSB) is providing the following information to urge the Federal Aviation Administration (FAA) and Textron Aviation to take action on the safety recommendations in this report. They are derived from findings from five investigations involving fatigue cracking in Cessna 210 and 210B airplane hydraulic landing gear actuators. The NTSB is issuing one recommendation to the FAA and one recommendation to Textron Aviation, the type certificate holder for Cessna airplanes.

Background and Analysis

Since 2015, the NTSB has investigated five accidents where the main landing gear of a Cessna 210 or 210B airplane failed to fully extend, resulting in either an emergency gear-up landing or the landing gear collapsing at touchdown.[1] The probable cause determination was nearly identical in all cases: fatigue failure of the hydraulic landing gear actuator.

Table. Cessna hydraulic actuator failures

Date	NTSB Case Number	Airplane Model	Location
January 8, 2015	CEN15LA116	Cessna 210	Sullivan, Missouri
July 11, 2015	ANC15LA048	Cessna 210	Juneau, Alaska
January 14, 2018	ANC18LA019	Cessna 210	Juneau, Alaska
August 9, 2022	CEN22LA378	Cessna 210B	Clinton, Arkansas
May 30, 2023	WPR23LA213	Cessna 210B	Tacoma, Washington

[1] Visit ntsb.gov to find additional information in the public docket for these NTSB investigations. Use the CAROL Query to search safety recommendations and investigations (case numbers included in the table).

The hydraulic actuator fractures from these events were also nearly identical: fatigue cracks initiated from pitting corrosion along the retainer ring groove corners on the interior of the actuator housing and propagated outward into the housing (see figures 1 and 2). When the cracks grew large enough, the housing fractured, which resulted in a loss of hydraulic fluid, leading to the actuator failing in service.

Figure 1. Actuator with fatigue cracking (from NTSB case number ANC18LA019).

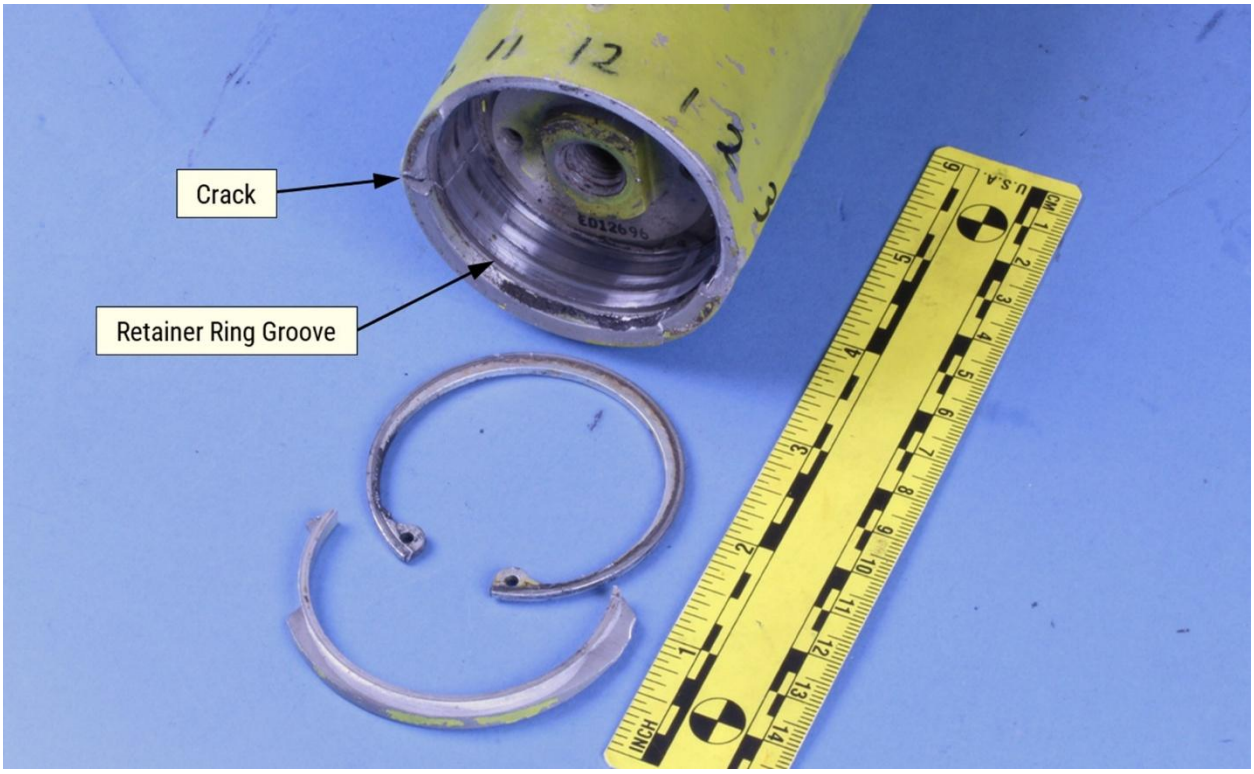

Figure 2. View into the actuator housing with the retainer ring groove and crack indicated (from NTSB case number ANC15LA048).

A review of service difficulty reports (SDRs) submitted to the FAA revealed five additional occurrences of landing gear actuators that described similar modes of failure. These occurrences did not result in substantial airframe damage and, therefore, were not classified as accidents to be reported to the NTSB. However, they described a fracture of the actuator cylinder and loss of hydraulic pressure rendering the landing gear system inoperative. Since the occurrences were not formally investigated, the NTSB did not determine the exact nature of these fractures.

The material used to manufacture the actuator (Cessna part number 1280501-1/-2 or Electrol part number EA1614-1/-2) is an aluminum alloy tempered to maximum strength and hardness but susceptible to specific corrosion mechanisms, like pitting.[2] The NTSB's examination of the failed actuators found that the geometry of the housing where the retainer ring is located may impart a high stress concentration at the area of fatigue crack initiation. In three of the accidents we investigated (ANC15LA048, ANC18LA019, and WPR23LA213), pitting corrosion

[2] According to Cessna, the actuator body was forged from AA 2014 aluminum alloy then heat-treated to the T6 condition, a heat-treating process designed to impart the highest mechanical properties for the alloy.

observed in the retainer ring groove served as areas of increased stress concentration, acting as sites for fatigue crack initiation.[3]

Since these cracks are entirely inside the actuator, they would be difficult to find with many standard techniques, like fluorescent penetration or visual examination. However, with correctly calibrated inspection equipment and procedures, ultrasonic inspection or eddy current inspection should be able to detect such cracks before they propagate through the barrel of the actuator. Currently, no life limit has been defined or established for this actuator.

Cessna has issued three service letters concerning these hydraulic actuators since 1967; however, none addressed the failure mode found in these accident investigations.[4] These service letters required periodic inspections for cracking of the housing and replacement of the spindle assembly and associated bearings, but none focused on the retainer ring. In 1976, the FAA issued Airworthiness Directive (AD) 76-04-01 requiring compliance with the most recent Cessna service letter (SE 75-21).

Although no serious injuries have resulted from the actuator failures and accidents cited in this report, the risks associated with these failures could lead to more severe outcomes. An actuator failure that results in a gear-up landing or landing gear not configured for landing is of particular concern. Based on the consistency of the location, size, and physical features of the actuator cracks the NTSB has examined during our investigations, this issue with actuators in Cessna model 210 and 210B airplanes appears to be widespread.

The NTSB concludes that an inspection and overhaul of the hydraulic actuator in Cessna model 210 and 210B airplanes at a regular interval would increase opportunities to detect any defects before they progress to failure. We therefore recommend that Textron Aviation develop inspection criteria and an overhaul interval for Cessna part number 1280501-1/-2 or Electrol part number EA1614-1/-2 hydraulic actuators, develop a life-limit for when these actuators should be replaced, and issue

[3] The corrosion pitting is from normal chemical reactions of latent salt elements (Na, K, Cl, Ca, S, etc.) with the aluminum alloy. The pitting was found on all the groove surfaces, not just the corners. The corners of the retainer ring groove already act as stress concentrators, but when pitting develops at these corners, the local stress increases, and the pits act as fatigue crack initiation sites, as seen in the scanning electron microscope images of the fatigue cracks, and the optical metallography cross sections of the (not fully fractured) cracks in the retainer ring groove.

[4] Service Letter 67-16 (issued March 1967) called for inspections of a specific series of the airplanes (1964 Centurions). Cessna later released Service Letters SE 69-17 (September 1969) and SE 75-21 (October 1975), eventually applying to all Cessna model 210 airplanes manufactured between 1960 and 1964. SE 69-17 called for the affected actuators to be repaired following the instructions attached to the letter. SE 75-21 revised the previous letters to indicate that all Electrol actuators installed in the applicable 210 series airplanes be modified in accordance with instructions attached to the letter.

a service bulletin with this information to detect defects before they progress to fatigue failure.

The NTSB also recommends that the FAA, once Textron Aviation has issued a service bulletin for Cessna and Electrol actuators, issue an AD to require the Textron Aviation service bulletin developed in response to Safety Recommendation A-25-37.

Conclusions

Finding

An inspection and overhaul of the hydraulic actuator in Cessna model 210 and 210B airplanes at a regular interval would increase opportunities to detect any defects before they progress to failure.

Recommendations

New Recommendations

As a result of this investigation, the National Transportation Safety Board makes the following new safety recommendations.

To the Federal Aviation Administration:

Issue an airworthiness directive to require the Textron Aviation service bulletin developed in response to Safety Recommendation A-25-37. (A-25-36)

To Textron Aviation:

Develop inspection criteria and an overhaul interval for Cessna part number 1280501 1/-2 or Electrol part number EA1614-1/-2 hydraulic actuators, develop a life-limit for when these actuators should be replaced, and issue a service bulletin with this information to detect defects before they progress to fatigue failure. (A-25-37)

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References

Federal Aviation Administration (FAA). 1977. "Airworthiness Directives; Cessna Models 210 through 210D Airplanes." *Federal Register*, January 27: 76-04-01. https://drs.faa.gov/browse/excelExternalWindow/D313A249139D7B1A86256E0D00503C84.0001

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