



October 26, 2022

AIR-22-08

Require Immediate One-Time Inspection of De Havilland Canada DHC-3 Horizontal Stabilizer Actuator

Introduction

The National Transportation Safety Board (NTSB) is providing the following information to urge the Federal Aviation Administration (FAA) and Transport Canada to take immediate action on the safety recommendations in this report. We identified this issue during our ongoing investigation of the September 4, 2022, accident involving a De Havilland Canada DHC-3, N725TH, which entered a nose-down, near-vertical descent and impacted the water in Mutiny Bay, near Freeland, Washington. The NTSB is issuing one urgent safety recommendation to the FAA and one urgent safety recommendation to Transport Canada.

Background and Analysis

On September 4, 2022, about 1509 Pacific daylight time, a De Havilland Canada DHC-3, N725TH, impacted the water in Mutiny Bay, near Freeland, Washington, and sank.¹ The pilot and nine passengers were fatally injured, and the airplane was destroyed. The scheduled flight was operated by Northwest Seaplanes dba Friday Harbor Seaplanes under Title 14 *Code of Federal Regulations* Part 135.²

The accident occurred during the second flight leg of the day. The airplane departed from Friday Harbor Seaplane Base, Friday Harbor, Washington, about 1450 and was destined for Renton Municipal Airport, Renton, Washington. Witnesses near the accident site reported, and security camera video showed, that the airplane was in level flight before it entered a slight climb and then pitched down in a nose-low, near-vertical descent until water impact.

¹ Viking Air Limited is the current type certificate holder for the DHC-3 airplane.

² Visit [ntsb.gov](https://www.ntsb.gov) to find additional information for this ongoing NTSB investigation (case no. [DCA22MA193](https://www.ntsb.gov/investigation.aspx?caseid=DCA22MA193)).

A review of FAA tracking data revealed that the accident flight lasted about 18 minutes with the airplane in cruise flight at altitudes mostly between 600 and 700 ft mean sea level (msl) and at groundspeeds between 115 and 125 knots. During the final minutes of the flight, the airplane began a climb, reaching a maximum altitude of about 1,000 ft msl before entering a rapid descent. The data ended shortly thereafter.

During the examination of the airplane wreckage, the NTSB found that the clamp nut that attaches the top eye end and bearing assembly of the horizontal stabilizer actuator (also referred to as the trim jack assembly) to the actuator barrel had unscrewed from the barrel.³ The examination also found that the circular wire lock ring, which was designed to prevent the clamp nut from unscrewing, was not present.⁴ Examination of the threads of the clamp nut and actuator barrel at the NTSB's Materials Laboratory showed no evidence that the threads failed in overstress or that the clamp nut and the horizontal stabilizer actuator barrel pulled apart from each other (that is, no evidence of stripped threads was found). Figure 1 shows a diagram of a horizontal stabilizer actuator, figure 2 shows an exemplar lock ring (with the tang that is secured into the clamp nut), and figure 3 shows the clamp nut and the lock ring groove around the barrel separated, as found during the airplane examination.

³ The horizontal stabilizer actuator is part of the airplane's pitch trim control system. The pitch trim wheel, which is located in the cockpit, is used to rotate the actuator through control cables without electrical or hydraulic assistance, extending (lengthening) or retracting (shortening) the overall length of the actuator. This extension or retraction changes the incidence of the horizontal stabilizer, thereby providing a mechanism for the pilot to relieve elevator control force pressure.

⁴ The operation to recover the airplane wreckage from the sea floor was completed on September 30, 2022, with about 85% of the airplane recovered. The wreckage was transported to the examination facility on October 3 and was examined from October 4 to 7. Follow-up activities in the NTSB Materials Laboratory occurred on October 18 and 19. As of the date of this report, the lock ring has not been found in the airplane wreckage.

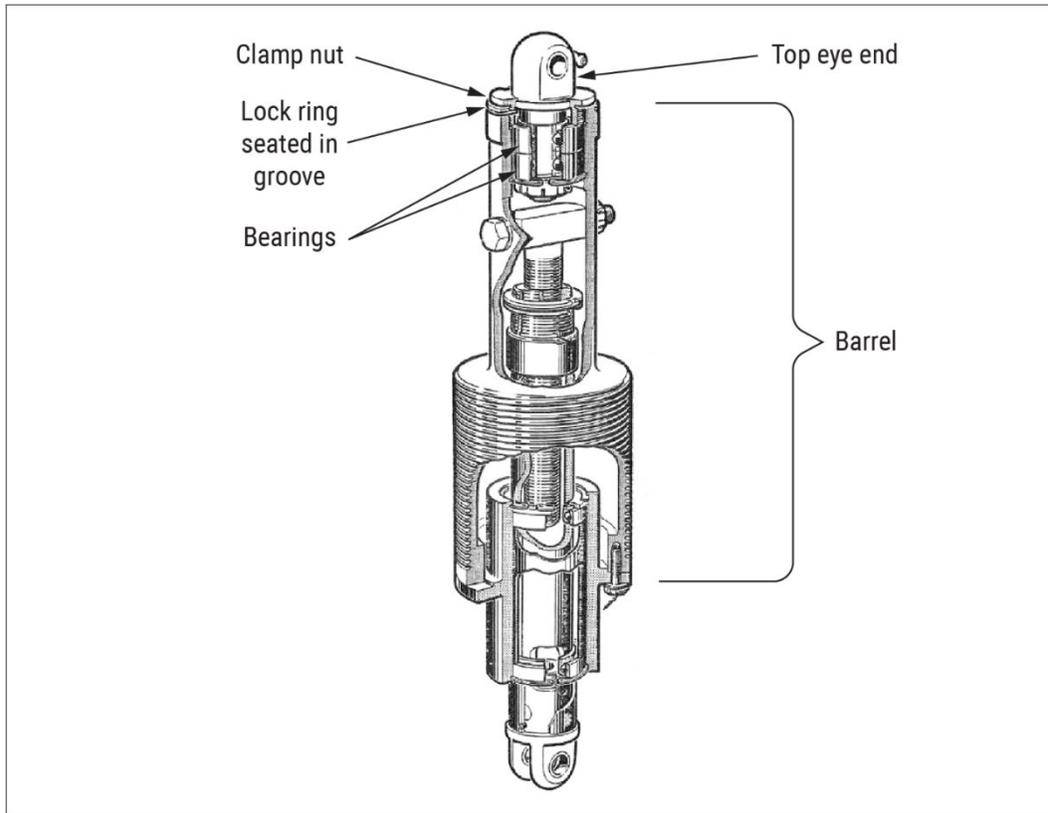


Figure 1. Horizontal stabilizer actuator (Source: Viking Air Limited).



Figure 2. Exemplar lock ring.



Figure 3. Clamp nut and barrel separation on accident airplane.

As shown in figure 3, the actuator is attached to the horizontal stabilizer with a bolt that connects the top eye end of the actuator to the rear mounting structure on the stabilizer. According to the DHC-3 aircraft maintenance manual, a clamp nut attaches the top eye end and bearing assembly to the barrel of the actuator. Both the clamp nut and the barrel end of the horizontal stabilizer actuator are threaded so that the clamp nut can be securely screwed into the actuator barrel.

During normal assembly, once the clamp nut is tightly screwed into the horizontal stabilizer actuator barrel, a hole is drilled through the clamp nut so that the hole aligns with another hole in the lock ring groove on the actuator barrel.⁵ The part of the lock ring that is bent inward (the tang) fits into the drilled hole, engaging both the barrel and the clamp nut and preventing the clamp nut from unscrewing from the

⁵ Five holes had been drilled into the accident clamp nut threads; three holes were damaged to the extent that they would not have allowed for the full insertion of the lock ring pin. Thus, it is possible for a lock ring not to be fully inserted into the clamp nut through those holes. The maintenance manual does not specify whether it is acceptable for the clamp nut to have multiple holes drilled; the investigation is exploring this issue.

barrel. If the actuator barrel and the clamp nut are not secured together and become separated, the actuator would not be able to control the position of the horizontal stabilizer, resulting in a reduction or loss of pitch control.⁶

At this time, the NTSB does not know whether the lock ring was present before the airplane impacted the water or why the lock ring was not present during the airplane examination. Our investigation into this accident, which is expected to include an evaluation of lock ring failure modes and a review of maintenance records and lock ring installation instructions, is ongoing. However, given the findings thus far from the investigation, we are concerned that a missing or an improperly installed lock ring on other DHC-3 airplanes has the potential to result in a catastrophic loss of control.

On October 26, 2022, Viking Air Limited published Service Letter (SL) DHC3-SL-27-001, DHC-3 Stabilizer Actuator Lock Ring - Special Inspection.⁷ The SL recommended that DHC-3 airplane operators “visually confirm that the stabilizer actuator lock ring is present, correctly seated in the groove in the upper housing...and the lock ring tang is engaged in the clamp nut.” Viking Air Limited stated that this action was to be performed “upon receiving this SL, regardless of when the most recent maintenance was completed.”

The actions described in the SL, if taken, should address the safety issue that we have identified thus far in this investigation. We note, however, that the SL is only advisory and that the potential for a catastrophic loss of control warrants immediate and mandatory action; the FAA (for US operators) and Transport Canada (the regulator for the state of design and manufacture of the airplane) have the authority to mandate such action.

The NTSB concludes that a missing or an improperly installed horizontal stabilizer actuator lock ring is an immediate safety hazard because it could result in a reduction or loss of pitch control during flight in De Havilland Canada DHC-3 airplanes. Further, a requirement for operators to report the findings of their inspections could help identify the scope of the problem. Therefore, the NTSB recommends that the FAA require all operators of De Havilland Canada DHC-3 airplanes to conduct an immediate one-time inspection of the horizontal stabilizer actuator lock ring in accordance with the instructions in Viking Air Limited SL DHC3-SL-27-001 and report their findings to the FAA. The NTSB also recommends that Transport Canada require all operators of De Havilland Canada DHC-3 airplanes to conduct an immediate one-time inspection of the horizontal stabilizer actuator lock

⁶ The actuator is the only means to hold the horizontal stabilizer in its position. If the clamp nut becomes unscrewed from the barrel during flight, the horizontal stabilizer would be able to rotate uncontrollably (trailing edge up or down) about its hinge.

⁷ The SL was dated October 25, 2022.

ring in accordance with the instructions in Viking Air Limited SL DHC3-SL-27-001 and report their findings to Transport Canada.

The NTSB notes that the need for these immediate actions is based on preliminary findings during our ongoing investigation. Additional actions may be recommended as the investigation proceeds.

Conclusion

Finding

A missing or an improperly installed horizontal stabilizer actuator lock ring is an immediate safety hazard because it could result in a reduction or loss of pitch control during flight in De Havilland Canada DHC-3 airplanes.

Recommendations

To the Federal Aviation Administration:

Require all operators of De Havilland Canada DHC-3 airplanes to conduct an immediate one-time inspection of the horizontal stabilizer actuator lock ring in accordance with the instructions in Viking Air Limited Service Letter DHC3-SL-27-001 and report their findings to the Federal Aviation Administration. (A-22-23) (Urgent)

To Transport Canada:

Require all operators of De Havilland Canada DHC-3 airplanes to conduct an immediate one-time inspection of the horizontal stabilizer actuator lock ring in accordance with the instructions in Viking Air Limited Service Letter DHC3-SL-27-001 and report their findings to Transport Canada. (A-22-24) (Urgent)

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