

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



WPR21FA143

AIRWORTHINESS

Group Chair's Factual Report - Supplemental

December 16, 2022

A. ACCIDENT

Location: Palmer, Alaska
Date: March 27, 2021
Time: 1834 Alaska daylight time
Helicopter: Airbus AS350 B3, registration N351SH

B. AIRWORTHINESS GROUP

Group Chair	Chihoon Shin National Transportation Safety Board Washington, District of Columbia
Group Member	Matthew Rigsby Federal Aviation Administration Fort Worth, Texas
Group Member	Sam Soloy Soloy Helicopters Wasilla, Alaska
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C. SUMMARY

On March 27, 2021, about 1834 Alaska daylight time, an Airbus AS350 B3 helicopter, N351SH, was substantially damaged when it was involved in an accident near Palmer, Alaska (AK). The pilot and four passengers were fatally injured, and one passenger was seriously injured. The helicopter was operated by Soloy Helicopters under Title 14 *Code of Federal Regulations* Part 135 as an on-demand air charter flight.

The majority of the wreckage was recovered and examined by the Airworthiness Group in April 2021.¹ The remainder of the wreckage, consisting of the outboard segments of the main rotor blades, aft tail boom section with the horizontal stabilizer and vertical fins, the tail rotor system, and various doors was recovered in July 2022. On October 18, 2022, members of the Airworthiness Group convened at Alaska Claims Services facilities in Wasilla, AK to examine the remainder of the wreckage recovered earlier in the year.

D. DETAILS OF THE INVESTIGATION

The wreckage recovered in July 2022 included the forward portions of the left and right skids, the two forward doors, outboard segments of three main rotor blades, portions of the left side engine inlet and the transmission upper cowlings, the aft tail boom section with the horizontal stabilizer, the vertical fins, and the tail rotor gearbox and tail rotor assembly.

1.0 Structures

The aft portion of the empennage had separated into two sections (**Figure 1**). One section was composed of the tail boom with the horizontal stabilizer. The second section was composed of the tail boom with the upper and lower vertical fins and the tail cone.



Figure 1. The aft tail boom section and the vertical fins.

¹ For the details of the main wreckage examination, see the Airworthiness Group Chairman's Factual Report in the docket for this investigation.

The horizontal stabilizer remained installed on the tail boom and was continuous through the tail boom structure (**Figure 2**). The right side of the horizontal stabilizer was deformed downward, and its outboard trailing edge exhibited impact deformation in the forward direction. The aft portion of the [right side] root end was separated consistent with the trailing edge deforming forward. The right side leading edge, about 2.5 inches outboard of its root, was deformed inward. The left side of the horizontal stabilizer exhibited less deformation than the right side. The outboard trailing edge exhibited minor impact deformation and puncturing of its upper surface. The Nos. 5 and 6 hanger bearing supports remained attached to the tail boom. The hanger bearings exhibited minor deformation.



Figure 2. The aft tail boom section with the horizontal stabilizer.

On the aft tail boom wreckage (with the vertical fins), the forward structure exhibited a counterclockwise twist. The vertical fins were whole and exhibited localized impact deformation on portions of their leading edges as well as the top portion of the upper vertical fin. The upper vertical fin trailing edge was displaced to the left of the tail cone while the lower vertical fin trailing edge was displaced to the right of the tail cone. The stinger did not exhibit impact deformation and remained attached to the lower vertical fin.

Both the left and right cockpit doors had separated from the airframe (**Figures 3 and 4**). The right cockpit door was whole and remained attached to a remnant piece of the windscreen side post. The right cockpit door handle (a black-colored handle) was in the "closed" position and remained functional. The right cockpit door emergency release handle (an orange-colored handle) remained stowed. The emergency release handle was actuated upward and the remnant windscreen side post separated from the right cockpit door.

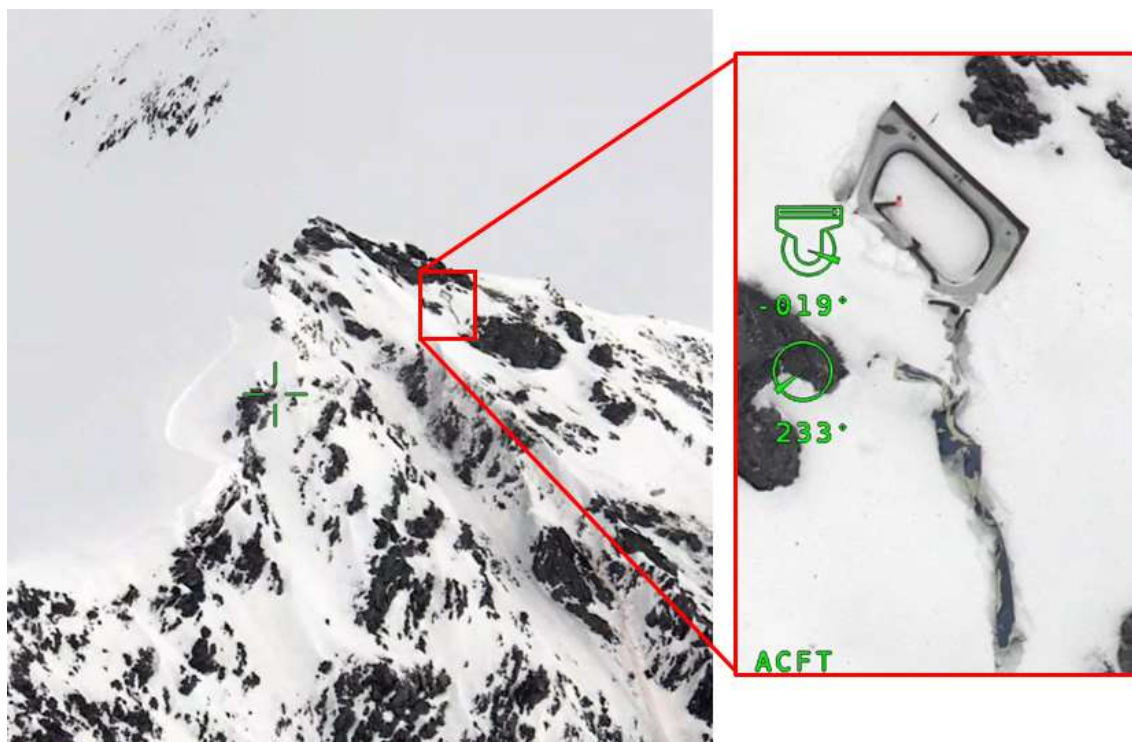


Figure 3. The left cockpit door.



Figure 4. The right cockpit door.

The upper portion of the left cockpit door was fractured and deformed at its upper-aft and forward vertical posts. The left cockpit door was not attached to any remnant piece of the forward windscreen side post. The left cockpit door handle was in the "open" position and remained functional. Based on the accident site photos, the left cockpit door handle was consistent with being in the "open" position (**Figure 5**). The left cockpit door emergency release handle remained installed but its release rod (within the cockpit door post) was deformed.



**Figure 5. The left cockpit door as seen at the accident site on March 28, 2021.
(Images courtesy of the Alaska State Troopers.)**

2.0 Tail Rotor System

The tail rotor, tail rotor gearbox, and pitch change spider were found as a single assembly and was separated from the tail boom (**Figure 6**). The tail rotor gearbox housing's left mount lug was fractured and exhibited signatures of overload. The corresponding fracture on the tail rotor gearbox housing's left mount lug remained installed on the tail boom section containing the vertical fin, with the spacer, nut plate, and safety wiring installed (**Figure 7**). The tail rotor gearbox housing's right mount lug was whole and the mounting bolt, with spacer, nut plate, and safety wire, remained installed on the bolt. The forward mount remained attached to the gearbox housing, but its two mounting lugs had fractured in overload. The corresponding fractured mounting lugs remained installed on the tail boom section containing the horizontal stabilizer.



Figure 6. The tail rotor and tail rotor gearbox.

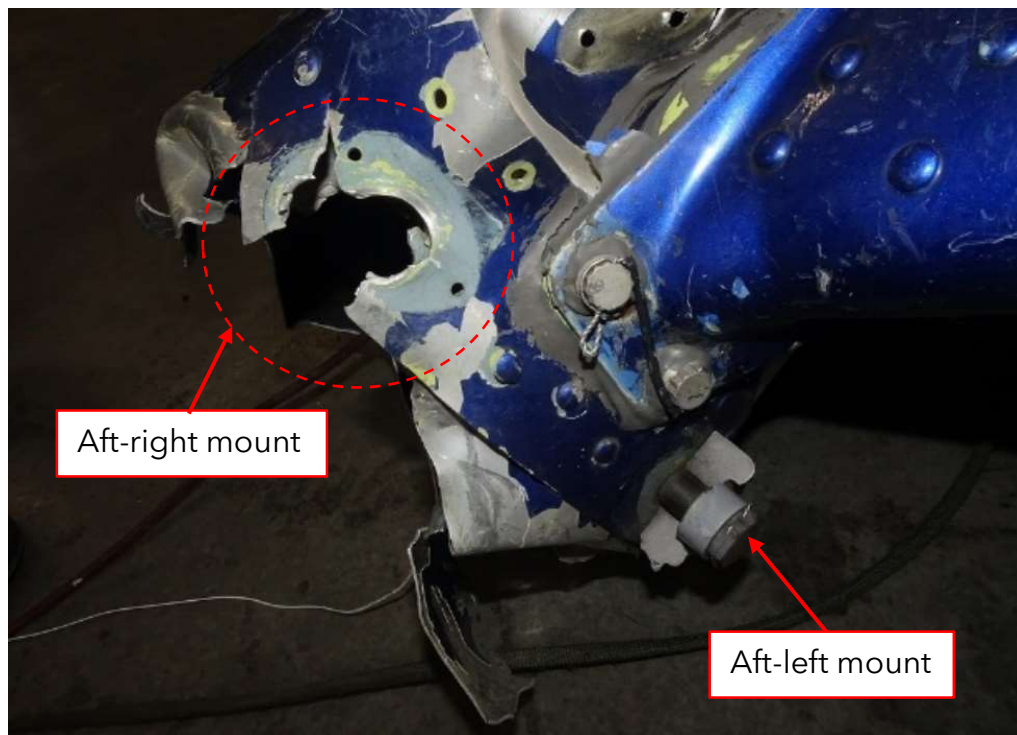


Figure 7. The tail gearbox aft mount locations near the base of the vertical fin.

Due to the presence of moisture and corrosion in the tail rotor gearbox, the tail rotor could not be easily rotated by hand and the pitch change spider could not be manually moved along the gearbox output shaft. The tail rotor pitch change links remained installed and were whole. The four half-moon elastomeric bearings, found at the root end of each blade airfoil, remained installed (**Figure 8**). One blade, with a

red-colored dot on its pitch link and pitch change spider attachment lug, was whole from the root to the tip but its afterbody and skin had fractured about midspan. The second blade's afterbody was fractured and separated from about midspan to the outboard end of the blade. The root end of the second blade was fractured circumferentially but remained attached to the spar. The leading edge of the second blade exhibited impact deformation on the outboard end of the blade, with a flattened appearance at the tip end. The two blade leading edges had deformed in the outboard-right direction.

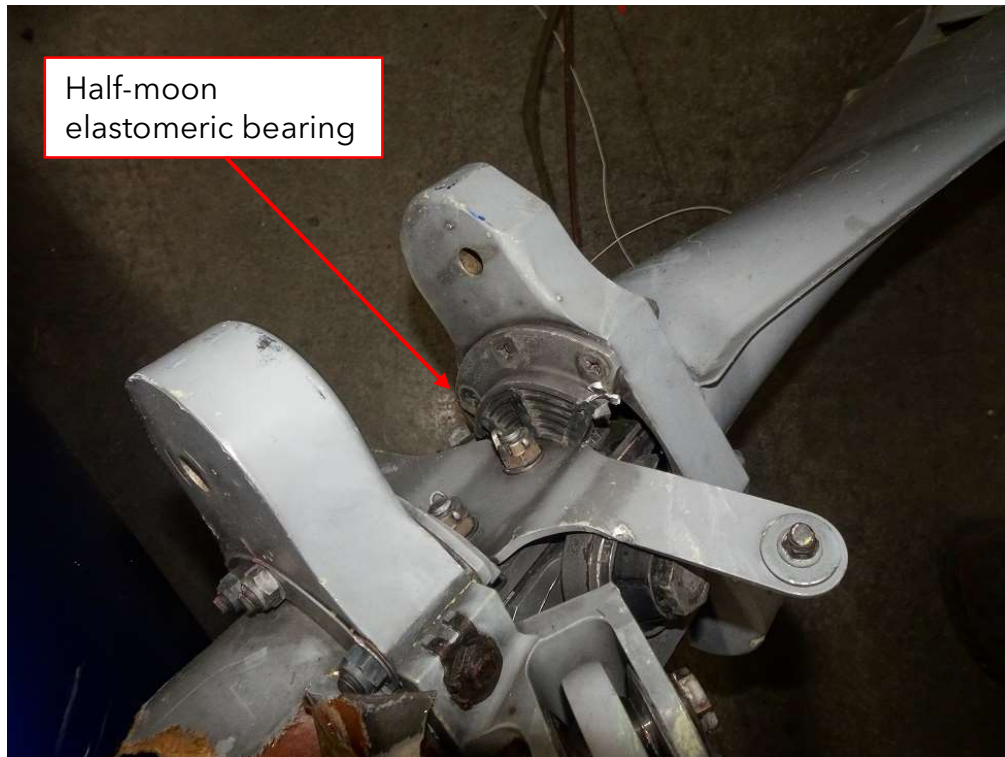


Figure 8. One of the four tail rotor half-moon elastomeric bearings.

The tail rotor gearbox output shaft and pitch change spider did not exhibit significant bending deformation. The tail rotor gearbox chip detector was removed, and no magnetic chips were present on the chip detector. The oil filler cap was removed, and no residual oil was observed within the gearbox. Rust-colored deposits were observed on both the strainer and the underside of the oil filler cap. The tail rotor pitch change bellcrank remained installed and connected between the pitch change spider and the yaw control tube (also called the tail gearbox actuating rod). The yaw control tube was fractured about 4.25 inches from its connecting bolt at the tail rotor gearbox and its fracture surface exhibited signatures of overload (**Figure 9**).

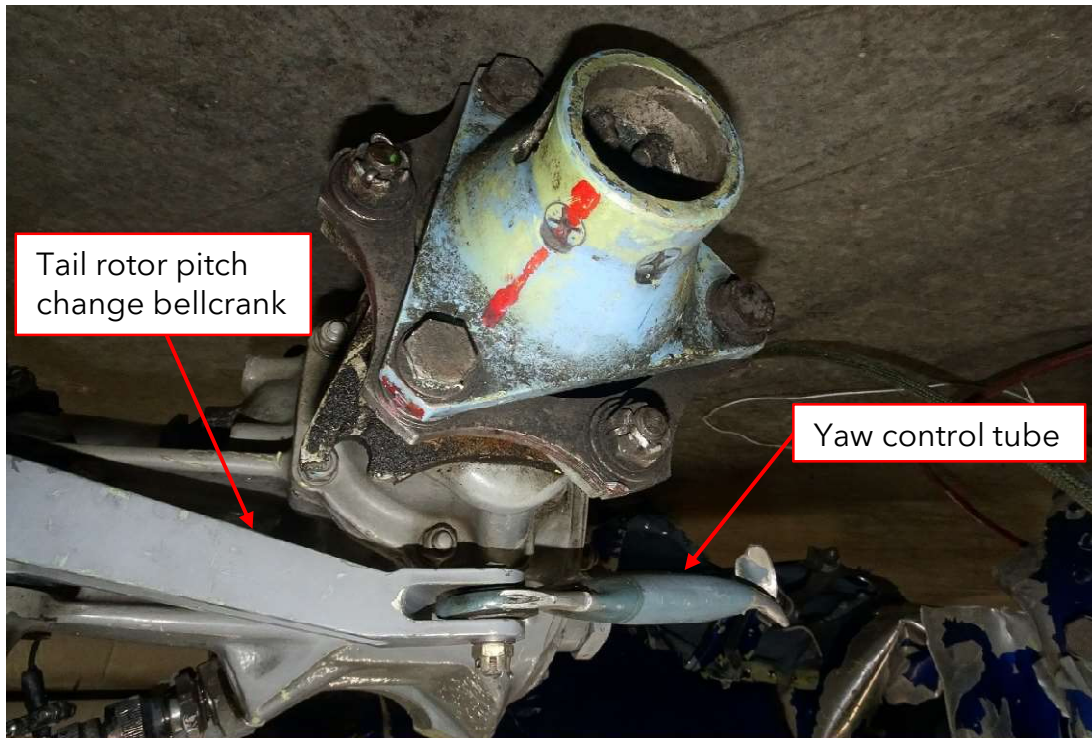


Figure 9. The yaw control tube installed on the tail rotor pitch change bellcrank.

The aft flange of the [aluminum] tail rotor drive shaft remained installed on the tail rotor gearbox input flange via flexible coupling. The flexible coupling was whole and exhibited minor deformation, but no fractures of its laminates. The five of the six screws that connect the thin-walled tube to the aft flange of the aluminum tail rotor drive shaft remained installed. The sixth screw was not present and its screw bore (on the aft flange) exhibited damage. The aft end of the thin-walled tube was fractured and retained within the aft flange; the fracture surfaces exhibited signatures of overload. The yaw control tube that remained within the tail boom (with horizontal stabilizer) wreckage measured about 28 inches in length. Another segment of the yaw control tube was found separated from the wreckage and measured about 18 inches in length.

A 62-inch segment of the tail rotor drive shaft, containing two hanger bearings, was present within the aft tail boom wreckage (**Figure 10**). A 22-inch segment of the tail rotor drive shaft, containing one hanger bearing, was found separated from the wreckage. The fracture surfaces observed on the tail rotor drive shaft exhibited signatures consistent with overload.



Figure 10. The 62-inch (left) and 22-inch (right) segments of the tail rotor drive shaft.

3.0 Main Rotor Blades

Three large segments of main rotor blades were recovered. One main rotor blade segment was about 153 inches in length, a second main rotor blade segment was about 130 inches in length, and the third main rotor blade segment was about 67 inches in length.²

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² During the April 2021 wreckage examination, the inboard section of the 'yellow' main rotor blade measured about 33 inches in length; the inboard section of the 'blue' main rotor blade measured about 56 inches in length; and the inboard section of the 'red' main rotor blade measured about 104 inches in length.