

# National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



ERA25MA171

## **AIRWORTHINESS**

Group Chair's Factual Report

February 9, 2026

## **A      ACCIDENT**

Location:     Jersey City, New Jersey  
Date:          April 10, 2025  
Time:          1515 eastern daylight time  
Helicopter:   Bell 206L-4, registration N216MH

## **B      AIRWORTHINESS GROUP**

|                |                                                                                                   |
|----------------|---------------------------------------------------------------------------------------------------|
| Group Chairman | Chihoon Shin<br>National Transportation Safety Board<br>Washington, District of Columbia          |
| Group Member   | Leani Benitez-Cardona<br>National Transportation Safety Board<br>Washington, District of Columbia |
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| Group Member   | Jon Michael<br>Rolls-Royce<br>Indianapolis, Indiana                                               |
| Group Member   | Chris Gatley<br>Van Horn Aviation<br>Tempe, Arizona                                               |

## **C SUMMARY**

On April 10, 2025, about 1515 eastern daylight time, a Bell 206L-4, N216MH, was involved in an accident near Jersey City, New Jersey. The pilot and 5 passengers on board were fatally injured and the helicopter was substantially damaged. The helicopter was operated by New York Helicopters Charter Inc. under the provisions of Title 14 Code of Federal Regulations Part 91 as a sightseeing flight. Based on ground witness videos, the helicopter was in cruise flight when an inflight breakup occurred, resulting in a separation of the main rotor, main transmission, tail rotor, and tail boom from the main fuselage. Automatic dependent surveillance - broadcast (ADS-B) data showed the helicopter flying at an altitude of about 400 ft msl and a groundspeed of 90-95 kts before the inflight breakup occurred.

On May 6-7, 2025, members of the Airworthiness Group convened at Bell facilities in Fort Worth, Texas to examine the main transmission and attaching hardware as well as the fuselage roof structure.

On June 17-18, 2025, members of the Airworthiness Group convened at AMF Aviation in Westfield, Massachusetts to examine the main rotor and fuselage. A specialist from the Smithsonian Institution's Feather Identification Lab (National Museum of Natural History) was invited by the NTSB to conduct sampling of the wreckage to identify potential bird remains. The main rotor blades were subsequently transported to the NTSB Materials Laboratory in Washington, District of Columbia (DC) for further examination. Additional sampling of the main rotor blades was conducted by the Feather Identification Lab at the NTSB Materials Laboratory.

The NTSB Structures Group Chair's Factual Report and the NTSB Materials Laboratory Factual Report for this investigation provides additional information on the examination of the main rotor blades as well as rotorcraft bird strike requirements. These reports can be found in the docket for this investigation.

## **D DETAILS OF THE INVESTIGATION**

### **1.0 Helicopter Information**

#### **1.1 Helicopter Description**

The Bell 206L-4 is type certificated under Federal Aviation Administration (FAA) type certificate data sheet No. H2SW. The 206L-4 has a two-bladed semi-rigid (teetering) main rotor system that provides helicopter lift and thrust. A two-bladed teetering tail rotor system provides thrust for helicopter directional control. A Rolls-Royce 250-C30P turboshaft engine was installed on the accident helicopter.

The accident helicopter was equipped with main rotor blades manufactured by Van Horn Aviation (VHA) and installed under the provisions of FAA supplemental type certificate (STC) No. SR02684LA (P/N 20633000-101).<sup>1</sup> The accident helicopter was also equipped with tail rotor blades also manufactured by VHA and installed under the provisions of FAA STC No. SR02249LA (P/N 2062200-501).<sup>2</sup> According to helicopter records, a Precise Flight Pulselite System was installed under the provisions of FAA STC No. SH3319NM.<sup>3</sup>

## **1.2 Helicopter History**

The accident helicopter, serial number (S/N) 52296, was manufactured in November 2004. Engine S/N CAE-890638 was installed at the time of the accident. According to accident helicopter records, at the end of the day before the accident, the helicopter had accumulated an aircraft total time (ATT) of 13,021.8 hours and the engine had accumulated an engine total time (ETT) of 23,351.8 hours.

## **2.0 On Scene and Post-Recovery Wreckage Examination<sup>4</sup>**

### **2.1 Accident Site**

#### **2.1.1 Accident Site Synopsis**

The helicopter wreckage was located in the Hudson River at depths ranging from 8 to 40 feet, depending on tidal conditions and distance from the shore. The helicopter wreckage was about 140 feet southeast of the northwest corner of the New Jersey Side Holland Tunnel Ventilation Building at 40° 43' 43.85" N, 74° 1' 38.77" W and included most of the main fuselage and engine (**figure 1**). The main rotor, main transmission, and roof structure assembly were found around 40° 43' 48.00" N, 74° 1' 30.60" W, about 721 feet northeast of the airframe recovery site. The tail boom, tail rotor, and tail rotor gearbox (TRGB) assembly were found 40° 43' 50.66" N, 74° 1' 35.30" W, about 725 feet northwest of the airframe recovery site. Main rotor blade foam core pieces and a severed bird wing were found on the ground and roof tops around 40° 44' 3.89" N, 74° 1' 40.80" W, about 2,000 feet northwest of the airframe recovery site.

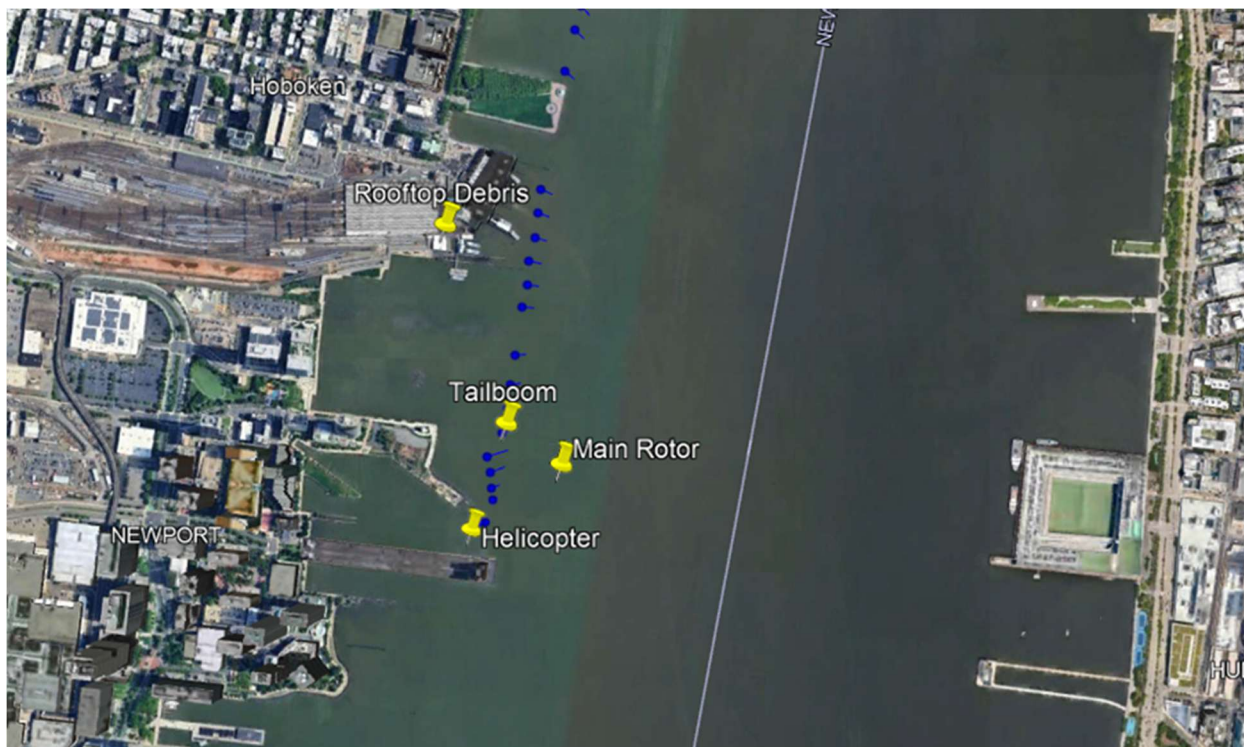
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<sup>1</sup> FAA Form 337 for the installation of STC No. SR02684LA was not present in the airworthiness file for N216MH.

<sup>2</sup> FAA Form 337 showed STC No. SR02249LA was installed on N216MH on January 27, 2017.

<sup>3</sup> The Precise Flight Pulselite System uses a lighting controller to pulse, or flash, the existing lights on the aircraft. According to the manufacturer's website, the purpose of the Pulselite System is "to reduce bird strikes and to increase aircraft recognition for collision avoidance with other aircraft." For the accident helicopter, the Pulselite system controlled pulsing of the nose-mounted landing light. FAA Form 337 showed STC No. SH3319NM was installed on N216MH on January 14, 2005.

<sup>4</sup> The terms "left", "right", "up" and "down" are used when in the frame of reference of looking forward from the aft end of the helicopter, i.e. aft-looking-forward. All locations, directions, and clock positions will be viewed from aft-looking-forward unless otherwise specified.



**Figure 1.** The GPS points for the accident helicopter, tail boom, main rotor and rooftop debris. Blue dots denote the ADS-B track of the accident helicopter.

### 2.1.2 Wreckage Recovery

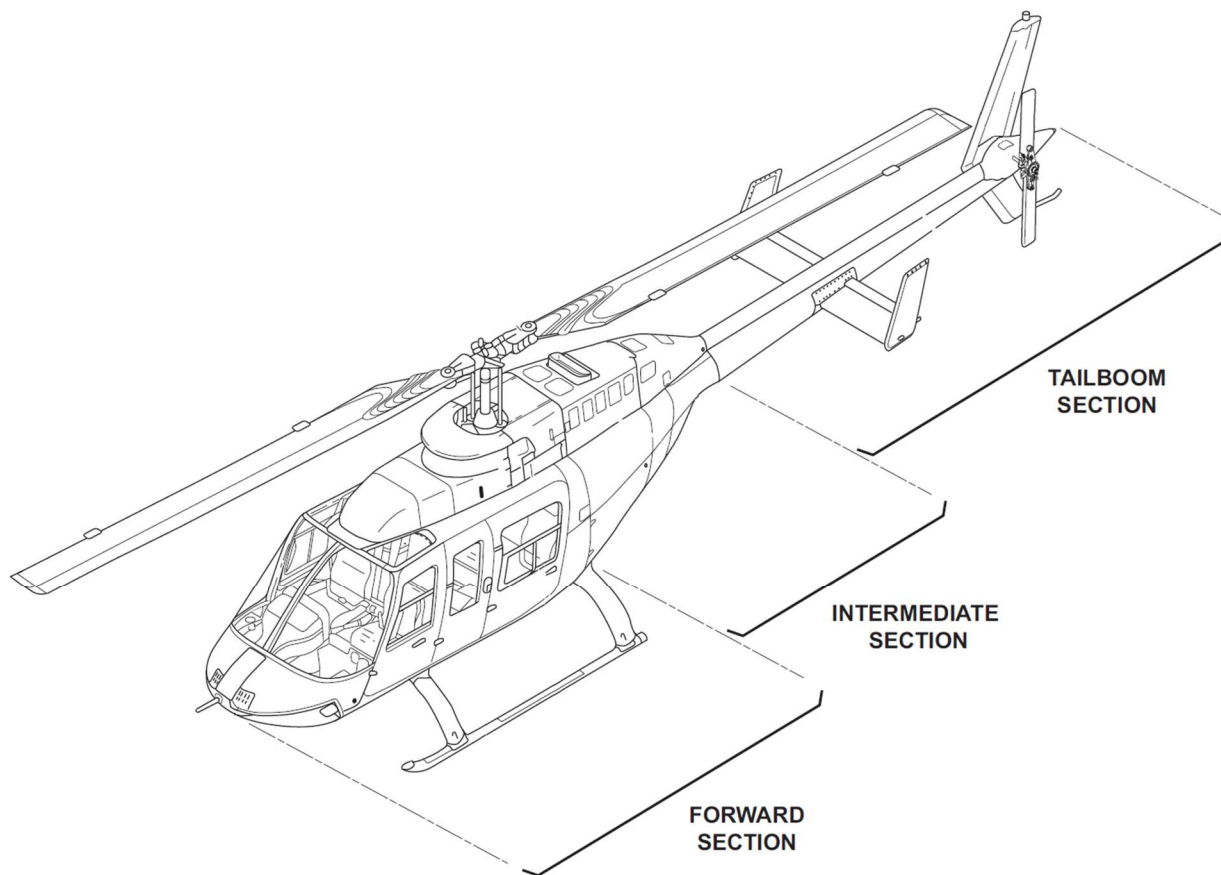
On April 10, 2025, about 2007 eastern daylight time, the US Army Corps of Engineers (USACE) recovered the major wreckage of the helicopter with NTSB support. USACE utilized a 99-ft long Drift Collection Vessel (DCV) equipped with a crane to recover the wreckage. The airframe was partially submerged which made it accessible for recovery. All items were video surveyed before being rigged by the divers. Smaller items were recovered by dive teams from the New York Police Department (NYPD).

Recovery operations began the night of the accident with retrieval of the main fuselage and engine wreckage as well as floating debris. Diving operations were conducted by NYPD and sonar scanning was conducted by the NYPD and the USACE. Recovery operation continued through April 15, 2025 when the tail boom, main rotor, main transmission, and roof structure were recovered. All recovered wreckage was transported to USACE Facility in Jersey City, New Jersey.

## 2.2 Structures

### 2.2.1 System Description

The Bell 206L-4 helicopter fuselage is composed of three structural sections: the forward section, the intermediate section, and the tail boom section (**figure 2**). The forward fuselage contains the cockpit and cabin, including the bulkhead aft of the cabin. The roof structure, which supports the main transmission system, is part of the forward section. The intermediate section extends aft from the bulkhead aft of the cabin and contains the baggage compartment and supports the engine deck. The tail boom section supports the horizontal stabilizer, vertical fin, the tail rotor drive system, and the tail rotor system. For the purpose of this report, the forward and intermediate sections together will be referred to as the main fuselage.

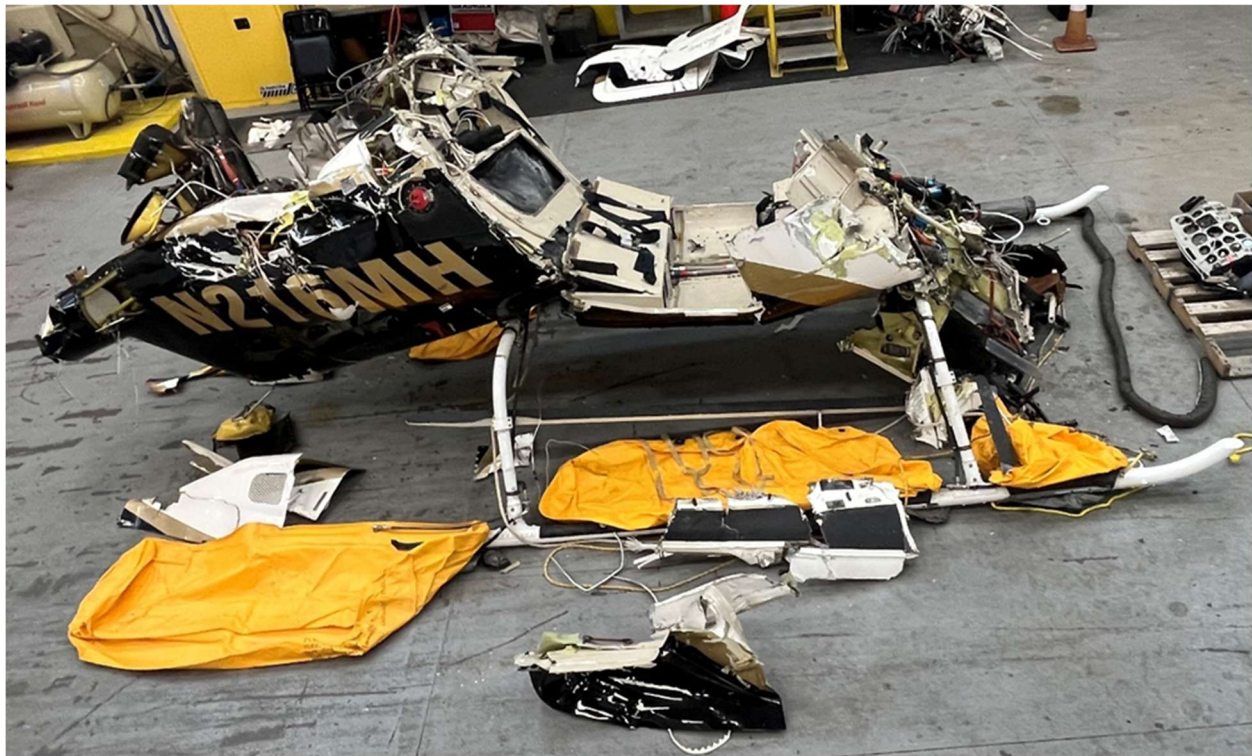


**Figure 2.** A diagram showing the locations of the forward section, intermediate section, and tail boom section.

### 2.2.2 Main Fuselage

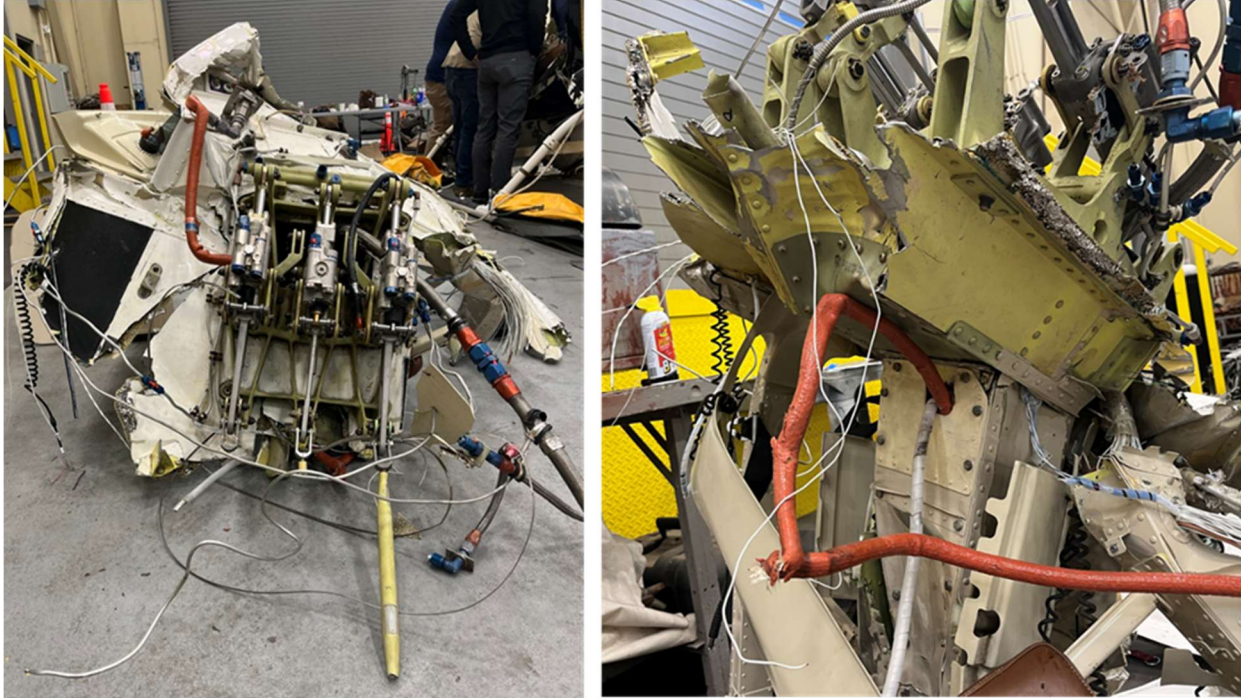
The main fuselage showed significant impact damage throughout (**figure 3**). The nose of the fuselage was partially separated and was found in the area of the

right cockpit seat. The forward crew bulkhead's left-side vertical structure was present but had fractured and separated at its lower end. The left-side vertical structure continued to the left-side lateral structure, the latter of which remained connected to the center post assembly. The right-side vertical structure was fractured and separated at its lower end. The right-side vertical structure exhibited multiple fractures, was deformed, and had a flattened appearance. Black-colored scuff marks were observed on the outboard painted surfaces and on the lower portion of the skin that attaches to the right-side vertical structure. The upper end of the right-side vertical structure was fractured and separated from the right-side lateral structure. The right-side lateral structure was partially separated from the center post assembly.

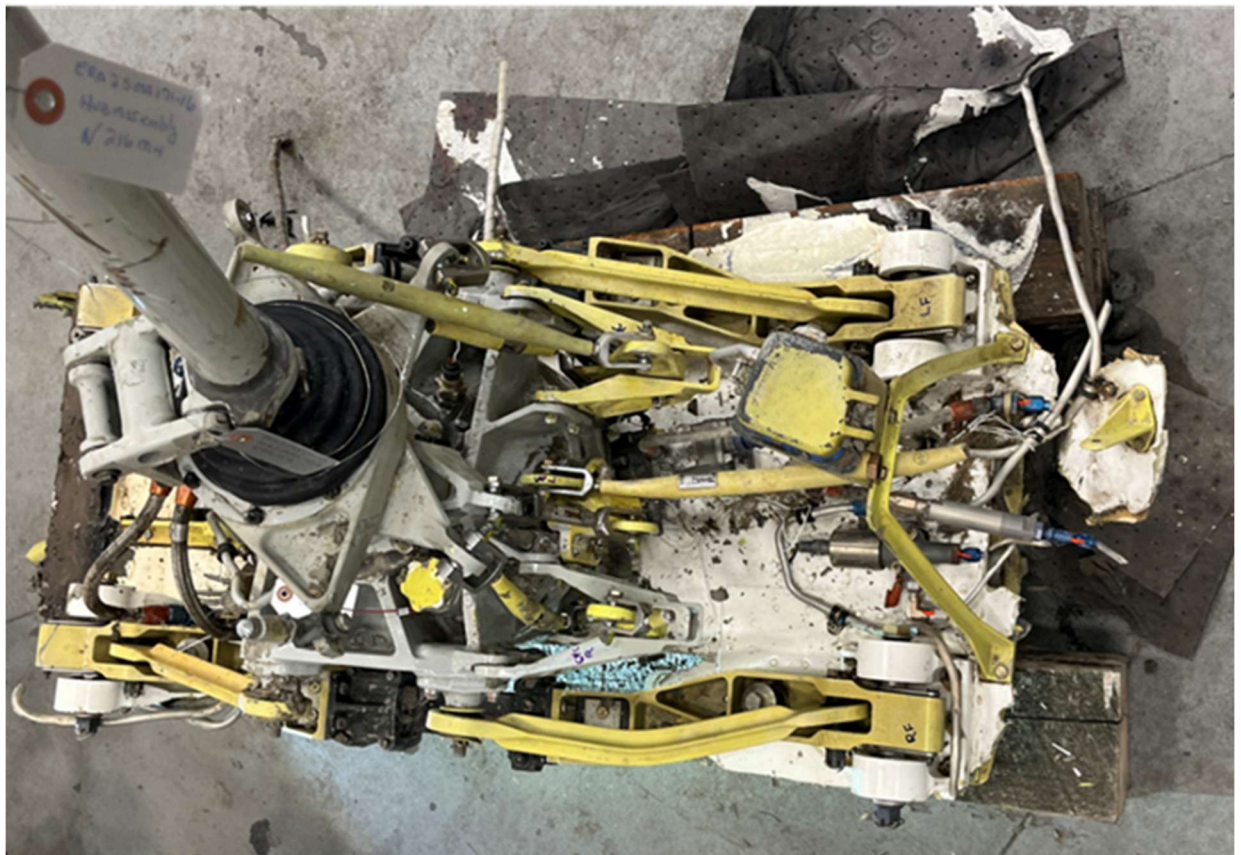


**Figure 3.** The right side of the main fuselage.

The airframe structure was composed of the crew bulkhead, the center post assembly, the cabin roof beam assembly, and the cabin bulkhead. The cabin roof beam assembly separated from the crew bulkhead and the cabin bulkhead. The forward portion of the cabin roof beam assembly remained attached to the main fuselage by the center post assembly (**figure 4**). The cabin roof beam assembly fractured into two pieces with the fracture occurring about 20.5 inches aft of the forward edge of the roof beam assembly. The forward section remained with the main fuselage and the aft section, which contained the bulk of the roof beam, remained with the main rotor and gearbox assembly (**figure 5**). The separated roof structure was about 72 inches long (forward to aft) and 21.5 inches wide.



**Figure 4.** The forward section of the cabin roof beam assembly.



**Figure 5.** The aft section of the cabin roof beam assembly.

The fractured surfaces were visually inspected, and they had a dull, grainy appearance consistent with overstress fractures. All deformations at the fractured surfaces of the forward section of the cabin roof beam assembly had a torsional counterclockwise (up-looking-down) directionality, with the right side of the roof beam having a downward directionality. All deformations at the fractured surfaces of the aft section of the cabin roof beam assembly (containing the main transmission) had a torsional counterclockwise (up-looking-down) directionality with a downward component to the right.

The center post assembly was present and was fractured at its lower end. The center post assembly was pushed to the aft and left into the cabin. On the upper end of the center post assembly, the right side was fractured adjacent to the riveted connection to the roof beam. The forward end of the roof beam remained connected to the center post assembly, but was fractured about 4 inches (lower side) to 9 inches (upper side) from the aft-most rivet. All fracture surfaces showed signs of overload.

The aft cabin bulkhead was fractured about 15-16 inches from the bottom of the crew bulkhead step (left side). The fractures showed signatures of overload. The remnant skin was deformed in the aft and outboard directions with a slight twisting directionality. On the right side of the aft cabin bulkhead, the vertical structure was continuous until it transitioned to the lateral structure. The right-side lateral structure was fractured about 4 inches inboard of a cutout for wire bundles. All fracture surfaces showed signs of overload.

The lower section of the fuselage remained attached to the skid landing gear. The left and right skids did not show impact deformation. The forward cross tube fractured and separated from the left skid tube's saddle. The forward cross tube remained attached to the right skid tube's saddle. The right step was present and remained attached to the aft cross tube. The right step was fractured at its forward end but its attachment point remained installed on the forward cross tube. The aft cross tube remained attached to the saddles of the right skid and left skid tubes. The left step remained attached to the aft cross tube but was separated from its forward cross tube attachment.

### **2.2.3 Main Fuselage Doors**

The left cockpit door, connected to a piece of left nose structure, and the two left cabin doors were found and recovered separate from the main wreckage. The forward edge of the forward left cabin door was deformed at the height of the upper hinge. The deformation was in the aft and outboard direction. The forward cabin door hinges attach the door to the forward crew bulkhead. A 66-inch long section of the left side cabin door upper frame was recovered, and the mating forward section remained attached to the main fuselage.

The right aft cabin door was recovered separate from the main wreckage. A 15.5 inch long section of the left side cockpit door upper frame, including the forward end, was recovered. The mating section, about 24 inches long, which included part of the cabin door upper frame, was also recovered. The right cockpit door was recovered separate from the main wreckage. The right cockpit door exhibited impact deformation in the downward direction.

#### **2.2.4 Main Fuselage Seat and Restraints**

All seat cushions remained installed within the fuselage except for the right cockpit (pilot's) seat cushion. The pilot's seat cushion was recovered separate from the main wreckage. A small feather was found on the pilot's seat cushion and was collected for further analysis. The seat cushions were removed from the cabin to facilitate examination of the fuselage.

The left cockpit seat restraints remained installed and buckled. The left lap belt and the left shoulder restraint were cut (likely by first responders).

The right cockpit seat restraints remained installed and buckled and exhibited no cuts. The shoulder harness remained installed on the buckle. The right lap belt anchor remained connected to separated structure.

The forward-facing cabin left seat's restraints remained installed and buckled. The left lap restraint was cut (likely by first responders) but the shoulder harness and its inertia reel were installed but the harness was separated from the lap belt buckle.

The forward-facing cabin center seat's restraints remained installed and buckled, and showed no signs of cuts. The inertia reel and shoulder harness for the center seat were not found. The inertia reel coil was found unwound.

The forward-facing cabin right seat's restraints remained installed and buckled. The right lap belt was cut (likely by first responders). The inertia reel and shoulder harness remained installed but were separated from the lap belt buckle.

The aft-facing cabin right seat restraint remained installed and buckled. The right (personal frame of reference) lap belt was cut (likely by first responders). The inertia reel remained installed on the structure and the shoulder harness was separated from the lap restraint.

The aft-facing cabin left seat restraints remained installed but was unbuckled. The restraints did not exhibit any cuts.

### 2.2.5 Tail Boom Section

The forward end of the tail boom remained attached to the intercostal support of the intermediate section of the fuselage via its four attachment bolts, but was fractured (**figures 6 and 7**). The fracture was measured from the intercostal support (boom station (BS) 31.855) and was about 7.25 inches at the 12 o'clock position, about 13 inches at the 3 o'clock position, about 10.25 inches at the 9 o'clock position (along the rivet line), and about 14 inches at the 6 o'clock position. The fracture surfaces exhibited signatures of overload. On the upper right quadrant, the skin was deformed in the outboard and forward direction. Contact marks were observed on the upper surfaces of the tail boom's forward end. These contact marks had a lateral (left-and-right) directionality. These contact marks started about 3.5 inches from the hanger bearing support (co-located at the tail boom attachment point) and measured about 6 inches in length, and about 3 inches in width. The upper-right intercostal bolt joint longerons fractured at the aft end of the attachment fitting. The upper-left intercostal bolt joint attachment fitting separated from the upper-left longeron about 0.1 inch and the separation extended for about 2.3 inches. The upper-left intercostal bolt joint attachment fitting slightly separated from the lower longeron for about 0.5 inch on the aft end. Both upper-left intercostal longerons were deformed to the right.



**Figure 6.** The forward portion of the tail boom attached to the intermediate section.



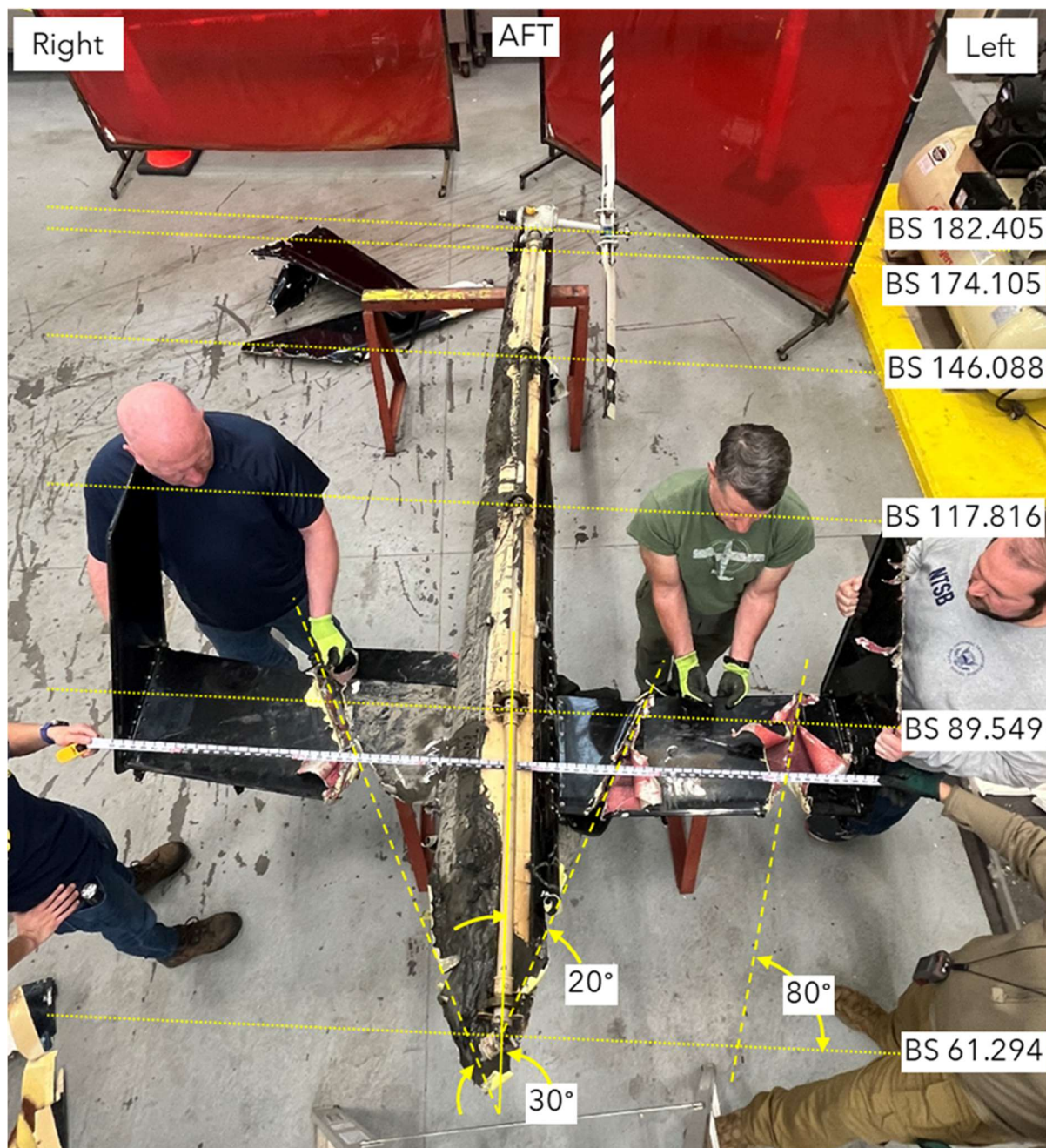
**Figure 7.** The fractured forward portion of the tail boom at its attachment point.

The tail boom assembly was recovered separated from the main fuselage with sections of the left and right horizontal stabilizers, right elevator, TRGB and tail rotor installed (**figure 8**). The forward end of the tail boom was fractured and bent upwards, the aft end had a slight bent to the left. The fracture at the forward end tail boom assembly (recovered separate from the main fuselage wreckage) had a straight-line appearance, possibly due to main rotor blade contact.



**Figure 8.** The recovered tail boom.

Two distinct fractures, one to the left and one to the right of the centerline of the tail boom, were found (**figure 9**). Both fractures had an up and aft directionality. At the 12 o'clock location of the fracture, the tail boom extended to about 7 inches forward of BS 61.294 (the No. 2 TRDS hanger bearing mount). At the 7 o'clock location of the fracture the tail boom extended to about 6 inches aft of BS 61.294. The cut to the right side had an angle of about 30° with respect to the tail boom center line and extended about 15 inches aft of BS 61.294. The cut to the left side had an angle of about 20° with respect to the tail boom center line and extended about 16 inches aft of BS 61.294. Both fractures at the forward end of the tail boom assembly were in alignment with the fractures on both horizontal stabilizers and the horizontal stabilizer sections recovered separately. There were no ballast weights on the mid tail boom location.

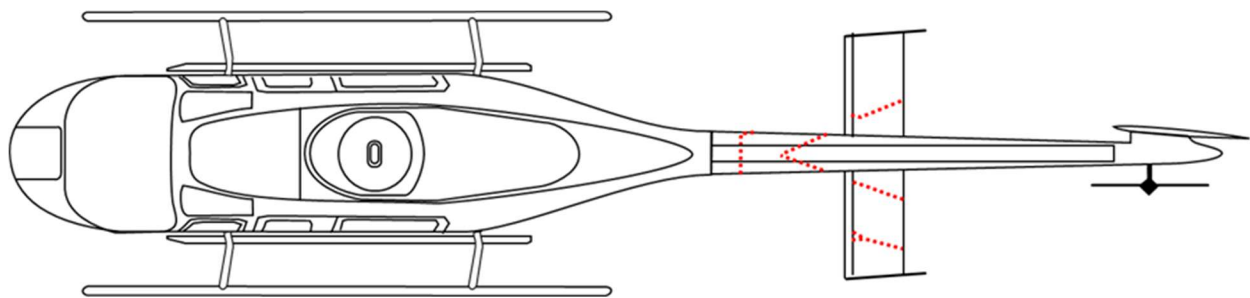


**Figure 9.** The location and angles of fractures observed on the tail boom.

The left stabilizer was fractured about 3 inches outboard of the tail boom on the leading edge and about 11 inches outboard of the tail boom on the trailing edge. The right stabilizer was fractured about 6 inches outboard of the tail boom on the leading edge and about 14 inches outboard of the tail boom on the trailing edge. The left and right stabilizer fractures both exhibited an upward directionality. A portion of the inboard right elevator, about 18 inches long, remained attached to the right horizontal stabilizer. A portion of inboard left elevator, about 9.25 inches long, was recovered separately. Both sections of inboard stabilizers had the inboard

trailing edge corner bent down. A separated portion of the left side of the horizontal stabilizer, about 18 inches long, was recovered. This separated portion's outboard fracture matched the fracture observed on the left finlet section and the fracture had an upward directionality. Horizontal stabilizer leading edge slats had separated from their mounts and were not recovered.

The left and right finlets were recovered separated from the tail boom (**figure 10**). The right finlet vertical structure did not exhibit any significant impact damage. The right finlet remained attached to the right end of the horizontal stabilizer, but this portion of the horizontal stabilizer was fractured. This fracture was located about 21.5 inches inboard of the right finlet at the leading edge and was about 17.5 inches inboard of the right finlet at the trailing edge. The fracture on the right horizontal stabilizer section attached to the right finlet exhibited a downward directionality for the fracture from the 1/3 chord (about 9 inches) to the trailing edge. The fracture from the leading edge to the 1/3 chord (about 5 inches) had an upward directionality. A feather was found on the horizontal stabilizer near the fracture.



**Figure 10.** A diagram showing the locations of the fractures (red-dotted lines) observed on the tail boom and horizontal stabilizer.

For the left finlet, the upper portion of the leading edge was fractured and separated from the finlet. The skin exhibited deformation and curling in the inboard direction. A feather was found on the upper surface of the left portion of the horizontal stabilizer attached to the left finlet. The left portion of the horizontal stabilizer attached to the left finlet was fractured at two locations. The outboard fracture was about 6-7 inches inboard of the finlet at the leading edge and about 3.5 inches inboard of the finlet at the trailing edge. The inboard fracture is about 18 inches apart from the outboard fracture on both the leading and trailing edges. These horizontal stabilizer fractures exhibited an upward directionality.

The tail boom top skin was buckled from the 10 o'clock to the 2 o'clock position along BS 117.816. The deformation extended about 25 inches forward and aft of BS 117.816 on the left and transitioned to a crease about 1 inch wide on the top and right. The tail boom top skin was buckled from the 11 o'clock to the 3 o'clock position along BS 146.088. The deformation extended about 2 inches aft of BS

146.088 on the left and transitioned to a crease about 1 inch wide on the right, located about 3 inches aft of BS 146.088.

The tail boom had a large opening, consistent with tail rotor blade tip contact, at BS 146.088 that extended from the 7 o'clock to the 11 o'clock positions and was about 5 inches wide (**figure 11**). The skin was deformed forward and outboard on the forward edge and inboard on the aft edge. Adjacent to the opening was a dent about 5 inches wide that extended from the 7 o'clock edge of the opening to the 5 o'clock position.



**Figure 11.** The opening observed at BS 146.088 consistent with tail rotor blade contact.

At the aft end of the tail boom, there was deformation between 2 inches aft of BS 174.105 and BS 182.405. The skin dented inboard and forward, and the depth of the dent increased to a maximum of about 2 inches deep as it extended aft. The aft skin separated from the TRGB and fin support assembly (the TRGB mounting fixture) through the rivet holes. The TRGB mounting fixture was fractured at the forward end on the vertical stabilizer mounting brackets and at the aft end between the 1 o'clock and 7 o'clock position. The fractured surfaces were visually inspected, and they had a dull, grainy appearance consistent with overload. Portions of the fractured brackets remained with the vertical stabilizer. The 4 fasteners forward of BS 174.105, two at the left and two at the right, were not present. (The 4 fastener holes are used for attaching the TRGB fairing.)

The tail boom upper fairing (tail rotor drive shaft cover) had severe deformation in the inboard direction consistent with collapsing against the driveshaft. The forward-left section of the fairing separated from the remaining fairing and was deformed upwards. The fracture started at the forward end of the fairing and extended aft about 37 inches to the edge of the fairing.

The upper vertical fin section of the fin assembly was found separated from the empennage. An impact fracture on the lower end of the upper vertical fin section had a right-to-left directionality (**figure 12**). An intact feather and feather-like fibers were found on the fracture surface of the upper vertical fin section. The anticollision light remained installed on the upper end of the vertical fin. At the lower end of the upper vertical fin section, the trailing edge skin exhibited peeling in the up direction. The lower vertical fin section was found separated from the main wreckage. An impact fracture on the upper end of the lower vertical fin section had a left-to-right directionality. The stinger remained installed on the lower vertical fin section and did not exhibit anomalous damage.

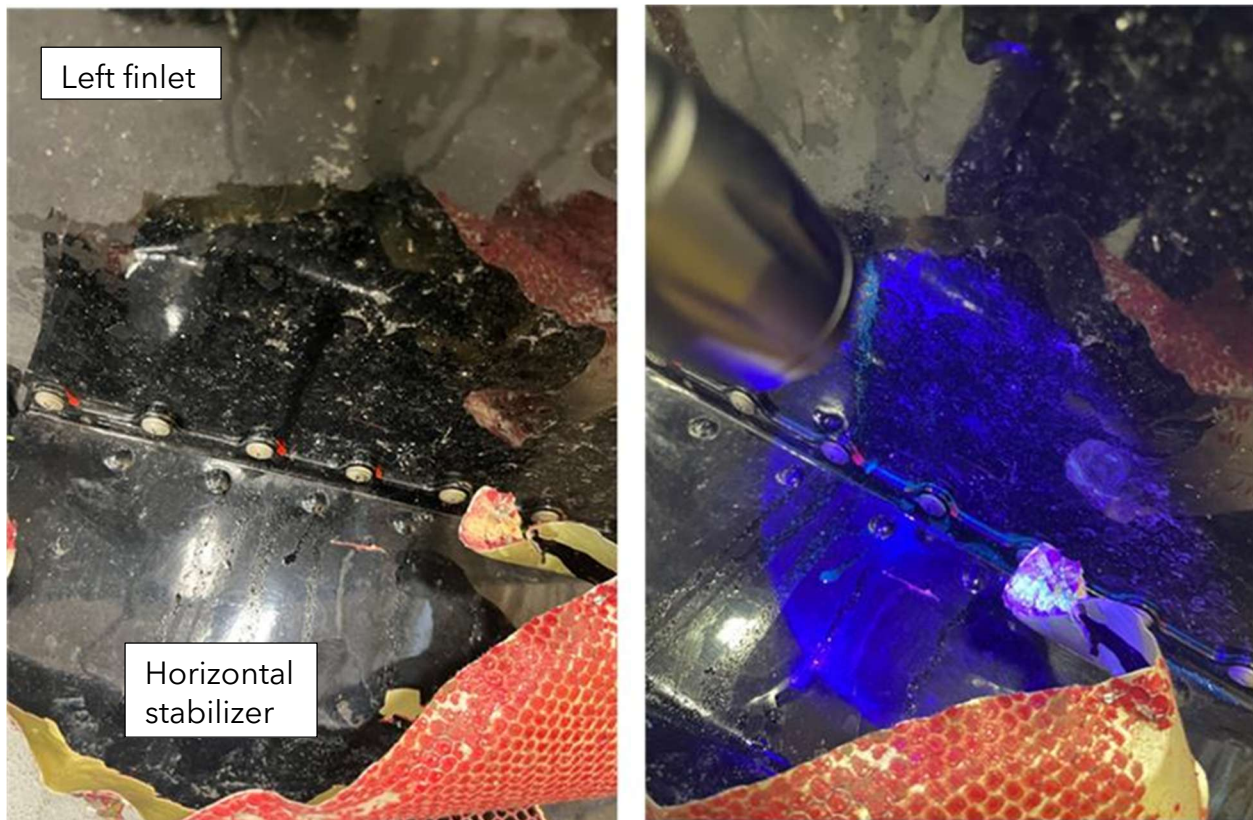


**Figure 12.** The upper and lower vertical fin sections.

An ultraviolet (black) light inspection of the horizontal stabilizer, left finlet, and right finlet was conducted by investigators.<sup>5</sup> Areas on the left finlet's inboard surface and its joint with the horizontal stabilizer had a tacky consistency and fluoresced under ultraviolet light (**figure 13**). Samples of these indications were collected for further analysis.

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<sup>5</sup> Ultraviolet light can reveal evidence of avian remains, known as snarge, that may fluoresce under that type of lighting



**Figure 13.** The inboard surface of the left finlet and upper surface of the horizontal stabilizer where the left finlet attaches to the horizontal stabilizer. The left image shows this area in normal light and black light illumination on the right image.

### 2.2.6 Fuel System

The forward-left, forward-right, and aft fuel cells remained installed within the fuselage. None of the fuel cells exhibited punctures or tears. The fuel filler cap remained installed and closed, but the locking mechanism tab was open. The fuel filler cap was opened and remnant fuel was present within the aft fuel cell, but the fuel level was low. The aft fuel cell's lower fuel quantity probe was removed and its wiring remained connected. Viewing the fuel through the aft fuel cell's lower fuel quantity probe port, the remnant fuel within the aft fuel cell had a clear appearance. The forward-left fuel cell's fuel quantity probe was removed and no remnant fuel was visible within the fuel cell. The forward-left fuel cell's fuel vent port remained installed and the fuel vent line remained connected to the union at the lower end of the center post assembly. The forward-right fuel cell's vent port had fractured at its port, but the fuel vent line was present nearby. The forward-right fuel cell's vent line remained connected to the union at the lower end of the center post assembly. Viewing the inside of the forward-right fuel cell found no remnant fuel within the fuel cell.

The forward fuel cells' fuel vent line was continuous from the lower end of the center post assembly through the center post assembly to the aft cabin bulkhead and

to the fuel vent union (which leads to the fuel vent on the right side of the helicopter). The fuel shutoff valve remained installed on the right side of the aft cabin bulkhead and its fuel and electrical lines remained connected. The fuel shutoff valve's fuel vent line remained connected to the fuel vent union.

A fuel sample was obtained from the aft fuel cell using a pump. The first fuel sample taken was about 7 oz and the second fuel sample taken was about 8.25 oz. Both samples had a clear appearance with no visible sediment or water.

## **2.3 Flight Control System**

### **2.3.1 System Description**

The cockpit flight control system is composed of cyclic, collective, and directional (pedal) controls. The mechanical linkages for the pilot (right seat) flight controls are routed below the pilot and passenger seats, aft to the center of the helicopter, and vertically through the center post assembly (also known as the "broom closet") to the cabin roof. On the cabin roof, the cyclic and collective flight control linkages connect to three [hydraulic] servo-actuators that are installed on the servo actuator support in front of the main rotor gearbox. The three servo-actuators are identified as lateral cyclic (left), collective (center), and longitudinal cyclic (right).

The pedal control linkages are routed from the cabin roof back to the tail rotor servo-actuator, located in the intermediate fuselage (between the main fuselage and tail boom), and then to the tail rotor. The tail rotor servo-actuator provides hydraulic assistance for the pedal controls.

### **2.3.2 Cockpit Flight Controls**

The helicopter was configured for the pilot to fly in the right seat and for single-pilot operations. The collective control remained installed but its base was fractured from the collective torque tube. The left seat collective control was not installed consistent with single-pilot controls. The collective friction spring was not present in the cockpit wreckage and was not recovered.

The left portion of the cyclic torque tube and its support remained installed in the cockpit wreckage. The right portion of the cyclic torque tube was fractured and separated along with the right side torque tube support, which were not found in the wreckage. The right seat cyclic control was not found. The forward-right portion of the cyclic yoke (connected to the cyclic torque tube) was fractured and separated from the wreckage. Only the forward-left portion of the cyclic yoke remained connected to the cyclic torque tube. The aft portion of the cyclic yoke remained installed and connected to the mixing unit assembly.

The left seat pedal controls were present but were in the lock-out configuration due to an installed tail rotor pedal lockout kit.<sup>6</sup> For the left seat pedal controls, only the left pedal was present; the right pedal had fractured from its support. The right seat pedal controls were present. For the right seat pedal controls, only the left pedal was present; the right pedal had fractured and separated from its support. The central pedal bellcrank, located between the left and right seat pedal controls, was separated from the wreckage and not found. The pedal interconnect rods were fractured and not found, but their rod ends remained connected on the left and right pedal controls' bellcranks. The pedal counterweight bellcrank remained installed on the structure but the counterweight had fractured and separated from the bellcrank. The input and output control rods remained installed on the pedal counterweight bellcrank but the control tubes were separated.

The elevator control tube was present and remained installed on the elevator control bellcrank (adjacent to the mixing lever). At the forward end of the elevator control tube, the shear rivet was not present and the connecting rod (which connects to the cyclic torque tube) was separated from the control tube. The elevator connecting rod remained installed on the cyclic torque tube.

### **2.3.3 Non-rotating Flight Controls**

The cyclic mixing lever remained installed at the bottom of the center post assembly. The left and right cyclic control tubes were present within the center post assembly, remained installed at both ends, and both control tubes were continuous to the lateral (left) and longitudinal (right) servo actuator input levers, respectively. The collective control tube was present, but its lower rod end was fractured, elongated, and separated from its bearing; the lower rod end bearing remained installed on the mixing lever. The collective control tube was continuous to the collective servo actuator input lever. The directional control tube remained installed to the bellcrank adjacent to the mixing lever and was continuous up through the center post assembly and connected to its upper bellcrank (at the top of the center post assembly). The elevator control tube was fractured at its lower rod end but was continuous up through the center post assembly and connected to its upper bellcrank (at the top of the center post assembly). The elevator control tube lower rod end remained installed on its bellcrank, the latter of which remained installed adjacent to the mixing lever. At the upper end of the center post assembly, the directional and elevator bellcranks remained installed. At the output side of these bellcranks, the directional and elevator control tubes remained connected via their [forward] rod ends, but these control tubes were fractured. The fractures were co-located with the roof beam fracture near the upper end of the center post assembly. The remaining segments of the directional and elevator control tubes were located within the roof beam assembly (containing the main transmission) that was recovered

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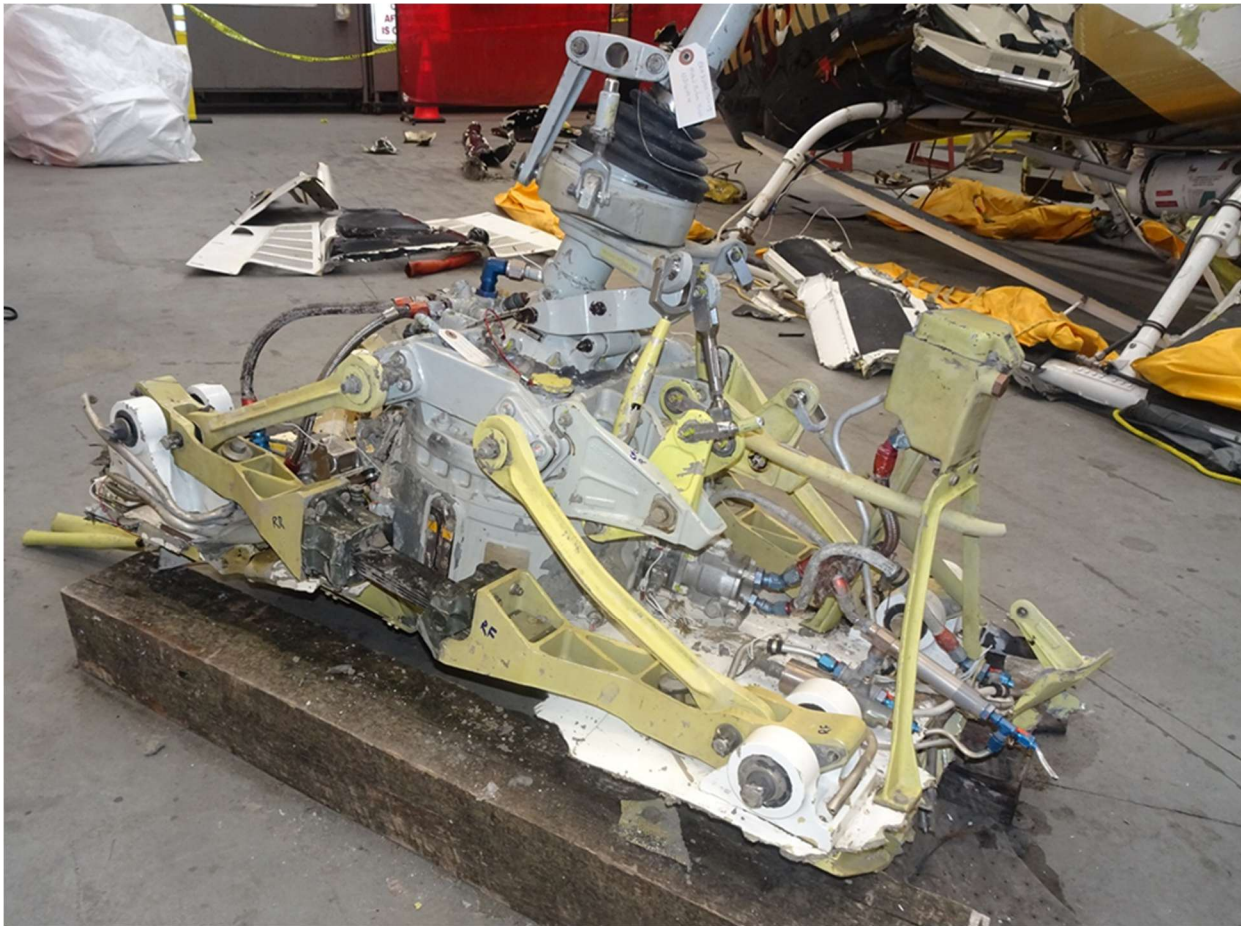
<sup>6</sup> A tail rotor pedal lockout kit was installed in accordance with STC No. SR00513AT.

separately from the main wreckage. At the aft side of the roof beam assembly, the directional and elevator control tubes remained connected to two bellcranks. On the output side of these two bellcranks, another set of control tubes remained connected. These two control tubes were fractured in overload at the tube's thin wall.

For the directional and elevator control systems, their forward walking beams located near the aft cabin bulkhead were separated from the structure and not recovered. The aft portion of the directional and elevator control tubes, located underneath the engine firewall, were present and connected to their respective aft walking beams. The directional and elevator control system's aft walking beams remained installed in the intermediate section of the fuselage. The forward portion of the directional and elevator control tubes remained installed to their respective aft walking beams but were fractured in a location near the forward tail boom fracture (close to the tail boom attachment point).

The servo actuator support remained installed on the roof beam. The three servo actuators remained installed on the support. The control rods from the center post assembly remained attached to all three servo actuator input levers. The three servo actuator output end assemblies (output rods) remained attached to the servo support levers (at the aft end of the servo support). On the lateral (left cyclic) servo actuator, the clevis connection to the servo actuator output was fractured at the threaded end (nearest to the clevis). On the collective (center) servo actuator, the clevis connection remained intact but the control tube was fractured at the threaded end of the clevis. On the longitudinal (right cyclic) servo actuator, the clevis connection remained intact but the control tube was fractured near its upper threaded end.

The bellcranks mounted to the main transmission housing's forward side remained installed (**figure 14**). For the lateral (left) cyclic and collective (center) control tubes, the clevis connections at their forward ends were fractured, but their aft clevis connections remained installed on their respective transmission-mounted bellcranks. The longitudinal (right) cyclic control tube had fractured and separated at its aft clevis connection, but the aft clevis connection remained installed on its transmission-mounted bellcrank. The control tube for longitudinal (right) cyclic remained installed between the transmission-mounted bellcrank and the stationary swashplate, but the stationary swashplate had rotated to the left from its normally installed orientation to about 45°. The control tube for lateral (left) cyclic remained installed on its transmission-mounted bellcrank but had fractured at the upper ends of the threads for the clevis connection at the stationary swashplate. The collective (center) control tube remained installed between its transmission-mounted bellcrank and the collective lever. The collective lever had separated from its pinned connection to the collective sleeve, but the collective lever had rotated to the left from its normally installed orientation by about 30°. The swashplate and support assembly data plate showed P/N 206-010-450-123 and S/N REFS-37.



**Figure 14.** The bellcranks installed on the forward side of the main transmission housing.

The lower right cyclic (longitudinal) control tube from the actuator only had the clevis attachment to the bellcrank remaining below the swashplate (non-rotating ring). The bellcrank itself was bent to the left. The clevis threads were broken and missing at the root. The upper right cyclic control tube attached to the swashplate was attached but bent to the left. The lower left cyclic (lateral) control tube attached to the bellcrank below the swashplate (non-rotating ring) had fractured at the actuator end, where the threads of the clevis attach to the control tube. The clevis was separated but attached to the lateral cyclic actuator. The bellcrank itself appeared undamaged. The upper left cyclic control tube attached to the swashplate was bent to the left and failed at root of clevis. The collective lever link attached to collective lever and bellcrank was undamaged. The lower collective control tube is bent left and failed at the actuator clevis' threaded end. The detached clevis was attached to the actuator.

The elevator control tube within the tail boom was missing and not recovered with the wreckage. The tail rotor (TR) pitch control tube was fractured at the forward

section of the separated tail boom. Continuity was established from the control tube to where the pitch change lever is normally installed.

#### **2.3.4 Main Rotor Rotating Flight Controls**

The idler lever torque stripes were broken. A gouge was noted on the top corner of the idler lever's aft bolt. The idler link was undamaged. The washer at the idler link's connection to the rotating swashplate was present. All other attaching hardware was present and undamaged. The rotating swashplate pivot sleeve (uniball) was installed and bent over within the mast by approximately 23° aft. River sediment was found under the boot. No other damage or debris was noted within the rotating swashplate assembly.

The blue pitch change link (PCL) and red PCL trunnion bearings did not exhibit binding when manually moved, and no anomalous damage was found on the bearings. All hardware was present on the PCLs. The red PCL fractured 11.5 inches from the swashplate center clevis bolt. The blue PCL fractured at the clevis threaded end. The bolt on the red PCL was rusted. The red PCL clevis rotated smoothly in all directions by hand. The blue PCL clevis required more force to move by hand. Both PCL tubes were bent. The blue PCL had a puncture 6" from top of clevis, likely from impact to bolts attaching the pillow block to the main rotor. At the lower end of the red PCL, the tube was able to be rotated by hand, away from its jam nut, exposing about one thread. The red PCL lower clevis was also bent. The rotating swashplate lugs, to which the lower ends of the PCLs attach, did not exhibit anomalous damage. All observed fractures with the PCLs had signatures of overload.

#### **2.3.5 Tail Rotor Rotating Flight Controls**

The pitch change lever and the idler assembly were not present in the recovered tail boom wreckage. The pitch change control rod (going through the TRGB output shaft) remained installed but was bent at the threaded portion of the rod end. The pitch of the tail rotor blades moved smoothly by hand and through its full range of travel. The tail rotor hub remained installed on the tail rotor output shaft. All attachment hardware for the tail rotor hub and blades remained secure. The static stop exhibited bending due to hard contact. The rubber bumper was not flush with the yoke. No bending was noted in the pitch links, and all hardware was present.

#### **2.3.6 Hydraulic System**

The manifold remained installed on the servo actuator support. The pressure and return lines remained installed on the manifold. All hydraulic lines between the manifold and the three servo actuators were fractured and separated. Remnant hydraulic lines were present adjacent to the servo actuator support and roof structure.

Only a portion of one of the four hydraulic reservoir mounts (the aft-left mount) was present on the roof structure. The hydraulic reservoir and its filter, along with the hydraulic relief valve and solenoid, remained installed on the separated cabin roof beam assembly. The reservoir was severely damaged and corroded around the tubing connections, as well as bent forward and left. The pin that secures the latch for the reservoir was pulled by investigators, and the screen and reservoir were inspected. Water intrusion and sediment were present within the reservoir, with trace amounts of hydraulic fluid observed. The hydraulic supply line from the reservoir was fractured, with remnant hydraulic fluid leaking from the fractured line near the forward left section of the roof beam assembly.

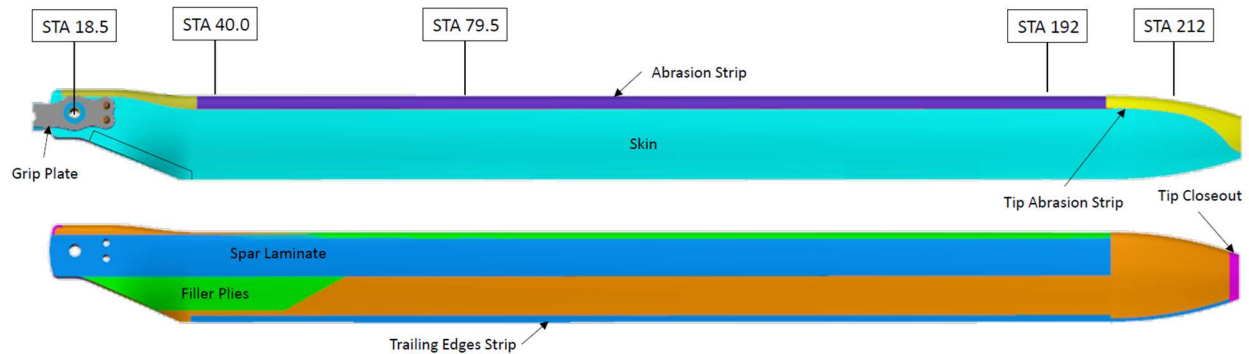
## **2.4 Main Rotor System**

### **2.4.1 System Description**

Power from the engine accessory gearbox is transferred through a freewheeling unit to the main transmission via the engine-to-transmission (input) drive shaft. Kaflex couplings on both the forward and aft ends of the input drive shaft allow for minor angular and axial misalignment between the engine and main transmission. The accident helicopter was equipped with a rotor brake that is installed between the engine accessory gearbox output flange and the aft Kaflex coupling of the input drive shaft. The main transmission contains a single-stage sun and planetary gear system that turns the main rotor shaft (also called the main rotor mast). The main transmission is attached to the airframe via pylon assemblies composed of four nodal beam mounts, two nodal beams, and four lift links.

The main rotor hub is splined onto the main rotor shaft. Each main rotor blade is connected a grip and spindle assembly. Each grip and spindle assembly is connected to the main rotor hub via a tension-torsion strap. A pitch horn is connected to the inboard end of each grip and spindle assembly.

Each main rotor blade is assigned a color, red or blue, to identify its position in the main rotor system. This color assignment is consistent with the pitch change link (PCL) that is connected to the respective main rotor blade. The VHA main rotor blade is constructed of composite materials with carbon fiber skins and spar, a foam core, an inconel leading edge for the span of the blade except for the tip section leading edge which is composed of nickel (**figure 15**). A trailing edge strip, which spans the majority of the blade, adheres the upper and lower skins at the trailing edge and is abutted to the foam core. Grip plates, located at the inboard end of the main rotor blade, attaches the blade to its respective grip and spindle assembly. According to VHA, the original design of the STC No. SR02684LA had two trim tabs for each blade, but these trim tabs were subsequently removed from the design. The accident main rotor blades were manufactured after this design modification and never had trim tabs installed.



**Figure 15.** The general construction of the VHA main rotor blade.

## 2.4.2 Main Rotor Drive System

The freewheeling unit remained installed on the engine gearbox. The freewheeling unit rotated freely when manually rotated clockwise (aft-looking-forward) but would not rotate when attempting to rotate in the counterclockwise direction. A portion of the aft Kaflex coupling of the engine-to-transmission (input) drive shaft remained attached to the freewheeling unit but its flex frames exhibited fractures with signatures of overload. The forward portion of the Kaflex coupling of the engine-to-transmission drive shaft remained attached to the main transmission input pinion flange but its flex frames also exhibited fractures with signatures of overload. The remainder of the Kaflex drive shaft was not found. The rotor brake calipers and disc remained installed on the freewheeling unit output flange.

The main transmission remained installed on the separated roof beam. The four nodal beam mounts and the two nodal beams remained installed on the separated roof beam, and the four lift links remained installed between the nodal beams and the transmission housing link attachments. The two drag pins remained installed on the separated roof beam, and their up-stops remained installed on the drag pins. The two stop mounts for the drag pins remained installed on the aft side of the transmission housing. The transmission housing was whole and did not exhibit evidence of cracks or fractures. The lower portions of the transmission housing exhibited severe corrosion and lifting paint consistent with prolonged water immersion. The oil level was not discernable through the sight glass. Removal of the main transmission upper chip detector revealed no evidence of magnetic debris. Removal of the main transmission sump chip detector revealed white-colored corrosion byproduct, but no evidence of magnetic debris. A large quantity of white-colored liquid drained from the main transmission when the sump chip detector was removed.

A brass-colored data plate was observed in the location where the original data plate is normally installed and was not consistent with a Bell-installed data plate. (Note: according to Bell, this type of brass data plate is allowed to be installed.) Rotation of the MR mast was not possible due to the bent mast and the non-rotating

swashplate and rotating swashplate contacting each other. The swashplate boot was separated from the swashplate but present on the main rotor mast. The safety wire securing the boot was loose. The swashplate uniball did not exhibit anomalous damage. The swashplate assembly was able to be manually tilted.

Cracks were observed on the paint layer in the area between the top case and the main case, from 6 o'clock to 9 o'clock (up-looking-down). There was no anomalous damage on the nodal beams, including the forward arms, aft arms, and flexure. The forward-right link assembly was bowed to the right. The other three link assemblies had no damage. The hardware at the link assemblies were present. The up-stop o-ring at the forward-right and aft-right exhibited compression damage. The two aft nodal beam support mounts remained installed on the roof beam. Light gouging damage was observed on top of the two aft nodal beam support mounts, likely from debris impact. The tuning weights remained installed on all four nodal beam arm assemblies. The main transmission oil filter housing remained installed and all connections were present. Small corrosion on the oil filter housing was present where paint was missing. The Kaflex drive shaft forward fitting remained attached to the main transmission input quill. Corrosion was observed on the Kaflex drive shaft forward fitting. The flex frames had fractured and were not found in the recovered wreckage. The main transmission oil pump and tach generator were installed and had considerable corrosion on their housings. Corrosion was noted around the main transmission case.

### **2.4.3 Main Rotor Mast and Hub Assembly**

The main rotor mast nut was installed. One flap restraint, on the blue main rotor blade side, was damaged and could not be moved by hand. The red main rotor blade flap restraint was undamaged. The spring was not present on the red flap restraint, while the blue flap restraint spring was damaged. The main rotor mast nut lock and bolt remained installed and safety wired. The main rotor hub assembly did not exhibit anomalous damage above the mast. Both red and blue main rotor blade bump stops exhibited evidence of hard contact with the mast. The main rotor mast showed hard contact with the bump stops, with possible gouging on the blue main rotor blade side bump stop (**figures 16 and 17**).

The total length of the mast was measured 23.5 inches from the base of the mast to the main rotor hub. Scratching of the paint layer was observed through the mast. The swashplate support was fractured at the tube underneath and concentric with the collective lever. The collective lever pins remained installed on the collective lever but were not connected to the collective sleeve due to rotation of the collective lever to the right from its normally installed position. The mast deflection at its bottom end was approximately 18° forward. The mast deflection at the top of the main rotor hub was approximately 23° aft.



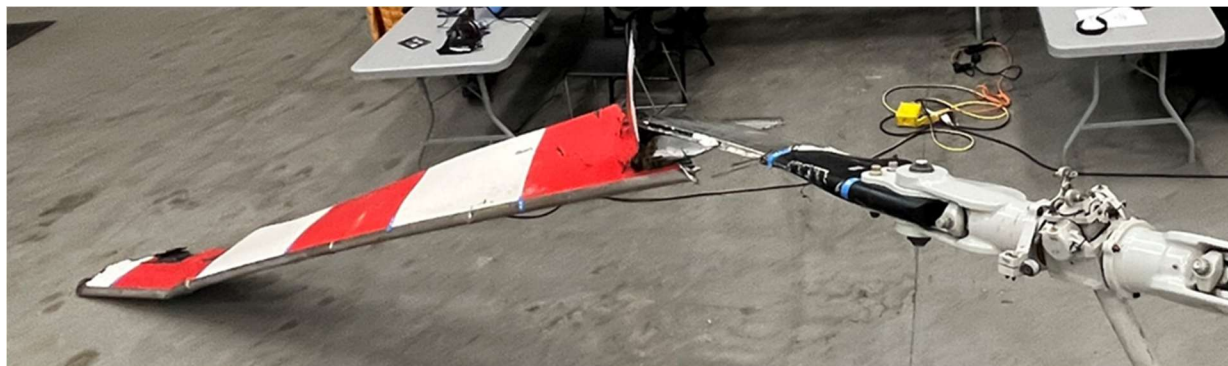
**Figure 16.** The main rotor mast showing contact with the bump stop adjacent to the red main rotor blade.



**Figure 17.** The main rotor mast showing contact with the bump stop adjacent to the blue main rotor blade.

#### 2.4.4 Red Main Rotor Blade

The red main rotor blade, P/N 20633000-101 and S/N A304, remained attached to the main rotor assembly but partially fractured (**figure 18**). The full length of the trailing edge had separated, splitting the blade spanwise, allowing most of the foam core to separate from the blade. Pieces of foam core were recovered from the river and from the rooftop debris location. The trailing edge strip had separated from the red main rotor blade and was not found.



**Figure 18.** The red main rotor blade.

The red blade had partially fractured at STA 64.5, which coincided with the outboard end of the doubler stack where the red blade remained attached by a section of spar laminate, about 3 inches wide (**figure 19**). The leading edge abrasion strip fractured at STA 64.5, but the section up to the inboard end of the abrasion strip was not recovered. The top and bottom skins separated from the doubler stack at red blade STA 38.5 up to red blade STA 64.5. The fracture had an angle of 60° with respect to the abrasion strip outboard of the fracture.

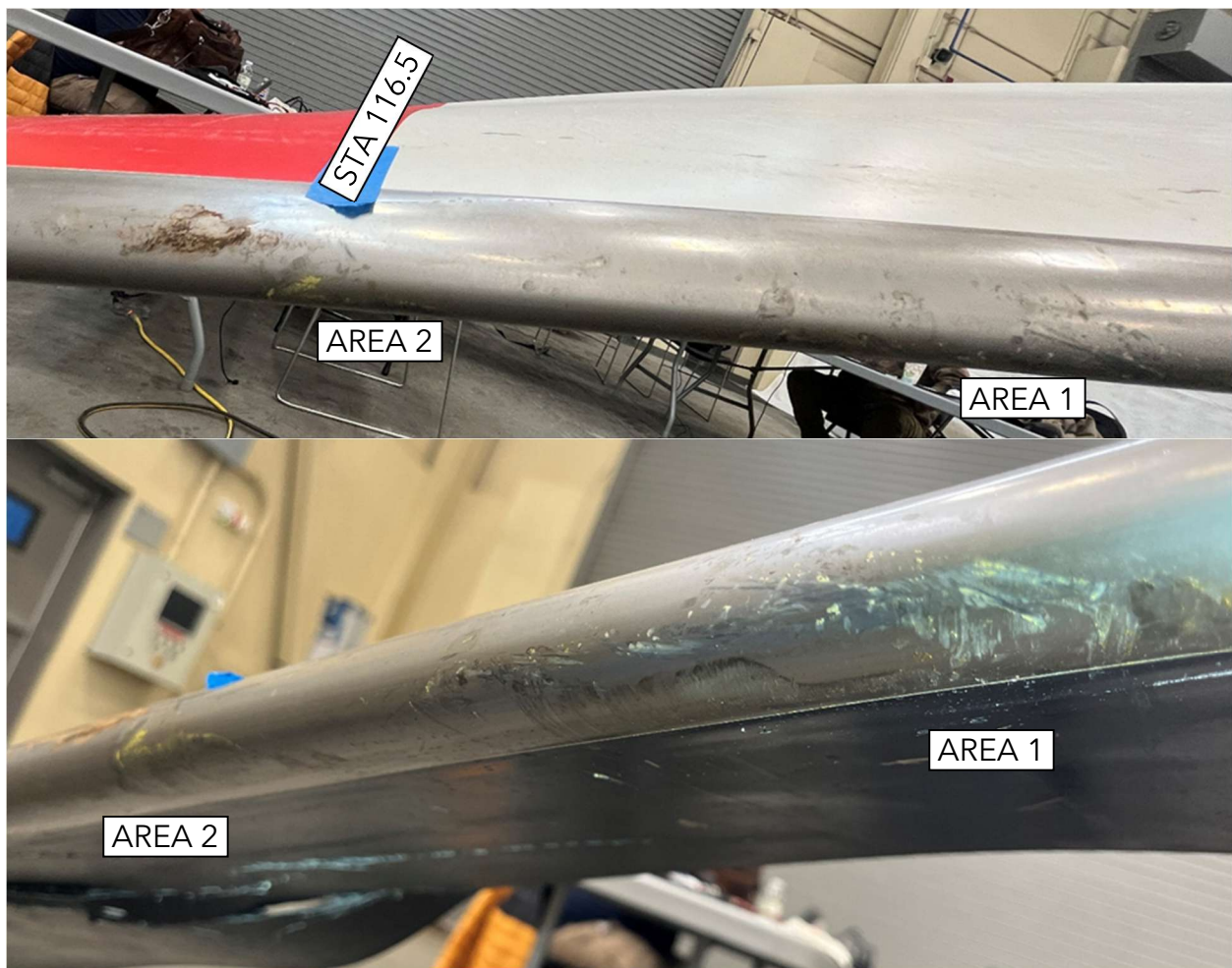


**Figure 19.** The separation of the red main rotor blade between STA 38.5 and STA 64.5.

At red blade STA 29.5 there was an area of delamination on the leading edge that extended about 1.5 inches to the trailing edge on the upper and lower skins and about 10 inches outboard. There was similar delamination on the trailing edge.

At red blade STA 99.5 the abrasion strip fractured and deformed, consistent with impact. There were black and white paint transfer streaks along the bottom skin of the abrasion strip that extended about 2 inches outboard and 0.5 inch inboard of the fracture. The aft edge of the abrasion strip disbonded from the top and bottom skins. The bottom skin fibers deformed and frayed chordwise at STA 99.5 towards the trailing edge.

At red blade STA 102.5 to STA 116.5 there were 2 areas of black, white and yellow-green paint transfer (**figure 20**). The inboard area was 7 inches wide (inboard-to-outboard) and extended from the leading edge to the trailing edge on the bottom skin. The second area was about 2.5 inches wide (inboard-to-outboard) and was contained to the abrasion strip with some streak extending to the trailing edge.



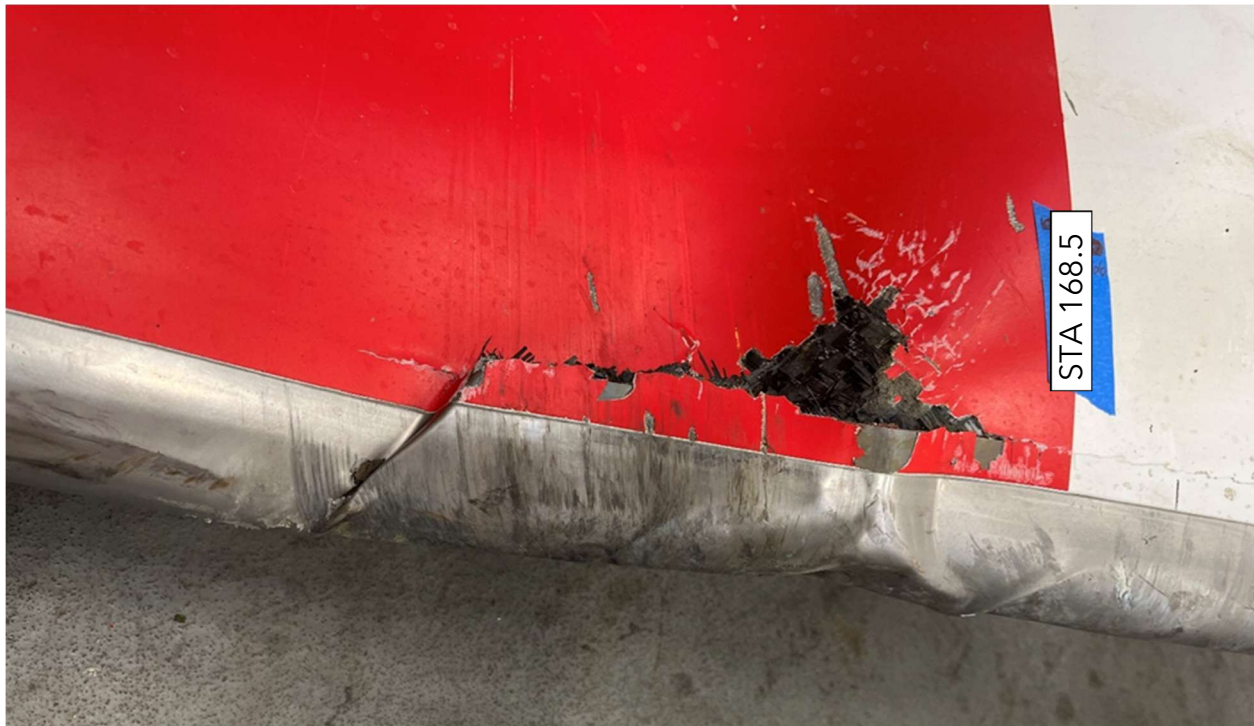
**Figure 20.** Damage at STA 112.5 to STA 116.5 on the red main rotor blade.

At red blade STA 128.5 there was deformation of the abrasion strip that extended to aft edge of the abrasion strip on the top and bottom skins (**figure 21**). The bottom skin fibers deformed and frayed chordwise along STA 128.5 towards the trailing edge. Starting at this station, there was an area of black, white and red paint transfer 21 inches wide (inboard to outboard) and was mostly contained to the abrasion strip, with some streaks extending to the trailing edge on the bottom skin and about 7 inches on the top skin.



**Figure 21.** Damage at STA 128.5 on the red main rotor blade.

At red blade STA 163.5 there was an area of black and yellow-green paint transfer 5 inches wide (inboard to outboard) and was mostly contained to the abrasion strip top and bottom skins. Adjacent to the paint, starting at red blade STA 168.5 there was a dent about 9 inches wide and 0.5 inch deep into the leading edge (**figure 21**). The dent bent the blade in an s-shape downwards and then upwards. The abrasion strip disbonded on the top and bottom skins and fractured at the outboard edge of the dent. The abrasion strip at the s-shape bend had black paint transfer 9 inches wide (inboard to outboard) and was mostly contained to the abrasion strip with some streaks extending to the trailing edge on the bottom skin and about 7 inches on the top skin.



**Figure 22.** Damage at STA 168.5 on the red main rotor blade.

At red blade STA 201 there was abrasion strip damage from the leading edge to the trailing edge (**figure 23**). About 21 inches of the blade tip, including the tip abrasion strip, was not found. The trailing edge had significant fraying on the top skin from red blade STA 179.5 to the edge at red blade STA 201.



**Figure 23.** Damage at STA 194.5 on the red main rotor blade.

### 2.4.5 Blue Main Rotor Blade

The blue blade data tag was not found on the blade. According to records, the main rotor blade was P/N 20633000-101 and S/N A303. The blue blade remained attached to the main rotor assembly but had partially fractured (**figure 24**). The full length of the trailing edge had separated, splitting the blade open spanwise, allowing some of the foam core to separate from the blade. The trailing edge strip was present.



**Figure 24.** The blue main rotor blade.

At blue blade STA 29.5 there was an area of severe delamination on the leading edge that extended about 2.5 inches toward the trailing edge on the top skin, about 1.5 inches on the bottom skin and about 10 inches outboard. There was similar delamination on the trailing edge.

At blue blade STA 61.5 the abrasion strip was fractured and gouged (**figure 25**). The damage extended to the blade upper skin in an angle consistent with the outboard end of the double stack. The abrasion strip disbonded on the lower skin from the inboard end to blue blade STA 63.5.



**Figure 25.** Damage on the blue main rotor blade at STA 61.5.

The blue blade partially fractured at STA 76 but remained attached by the bottom skin (**figure 26**). The fracture had an angle of 45° with respect to the abrasion strip outboard of the fracture and extended 6 inches toward the trailing edge where the fracture changed direction by 90° degrees outboard. The fracture maintained this direction until it reached the trailing edge. The top skin fibers deformed and frayed along the fracture.



**Figure 26.** Damage at STA 76 on the blue main rotor blade.

At blue blade STA 126.5 the abrasion strip disbonded and deformed upwards on the upper skin. From this damage location to about 13 inches inboard, there was black, green and yellow-green paint transfer contained to the abrasion strip with some streak extending to the trailing edge on the bottom skin. About 3 inches outboard of the edge of the dent there was red and black paint transfer, about 5.5 inches wide (inboard to outboard) contained to the abrasion strip with some streaks extending about 5 inches to the trailing edge on the top skin and some streaks extending to the trailing edge on the bottom skin.

At blue blade STA 149.5 there was an area of black, white and red paint transfer 5 inches wide (inboard to outboard) that was mostly contained to the abrasion strip with some streak extending about 5 inches to the trailing edge on the top skin and to the trailing edge on the bottom skin (**figure 27**).



**Figure 27.** Damage at STA 149.5 on the blue main rotor blade.

At blue blade STA 202.5 there was fracture and deformation of the abrasion strip that extended 7.5 inches to the trailing edge on the top skin and to the abrasion strip trailing edge on the bottom skin (**figure 28**).



**Figure 28.** Damage at STA 202.5 on the blue main rotor blade.

## **2.5 Tail Rotor System**

### **2.5.1 System Description**

Power from the freewheeling unit is transferred to the tail rotor via the tail rotor drive system. The tail rotor drive system contains a total of 7 tail rotor drive shafts (TRDS) excluding the oil cooler blower. The forward short shaft, composed of steel, is mounted between the freewheeling unit and the oil cooler blower. The aft short shaft, composed of aluminum, is attached to the aft side of the oil cooler blower, followed by 5 additional TRDS, also composed of aluminum, to the TRGB. A flexible disc pack coupling (also known as a Thomas coupling) is present at the connecting flanges of each TRDS to allow for axial and angular misalignments. The TRGB, mounted near the aft end of the tail boom, changes the direction of drive and also reduces the output speed of rotation at the tail rotor. The TRGB output shaft connects to the tail rotor yoke.

The two-bladed tail rotor is a semi-rigid (teetering) rotor system. Each tail rotor blade, composite in construction, is attached to the tail rotor yoke via two spherical bearings. The two spherical bearings accommodate blade pitch changes.

### **2.5.2 Tail Rotor Drive System**

The engine oil cooler blower remained installed on the airframe. The splined connections at its input and output did not exhibit anomalous wear or damage. The oil cooler blower shaft was able to be manually rotated but exhibited roughness when rotated. A portion of the forward (steel) short shaft remained attached to the freewheeling unit on the aft side of the engine gearbox. The No. 1 tail rotor drive shaft (TRDS), also called the aft short shaft, was not found.

Of the five hanger bearing supports, only the forward-most hanger bearing remained installed on the forward end of the tail boom. Rotational scoring was observed on the forward-left surfaces of the No. 1 hanger bearing support at the forward end of the No. 2 TRDS, near the tail boom attachment. The left side of the No. 1 hanger bearing support was deformed in the forward direction and the bearing support ring was fractured. The No. 1 hanger bearing was not found.

The spline adapter of the No. 2 TRDS remained partially connected to the flexible disc packs (Thomas coupling) at the No. 2 hanger bearing support, but the spline adapter was fractured in overload. The remainder of the No. 2 TRDS was not found. Scoring and gouging damage were noted to No. 2 hanger bearing forward face from the spline adapter bolts.

The No. 3 TRDS exhibited a slight bend, but no other damage was noted. The drive shaft was attached to both hanger bearings Nos. 2 and 3. The disc packs on

hanger bearing 3 were slightly deformed. Longitudinal shifting of the drive shaft was present. There was scoring and gouging damage to spline adapter bolts due to contact with the hanger bearing No. 3 forward face.

The No. 4 TRDS had no anomalous damage. Bearing grease was present on the drive shaft near the No. 3 hanger bearing. Grease was found protruding out of the hanger bearing mount. The disc packs on the No. 4 hanger bearing were slightly deformed.

The No. 5 TRDS had no anomalous damage. The No. 4 hanger bearing had no anomalous damage. The disc packs on the No. 5 hanger bearing were slightly deformed.

The No. 6 TRDS had rotational scoring starting 13.75 inches from the aft end of the aft spline adapter on the drive shaft. The scoring extended longitudinally by about 3 inches.

The TRGB remained installed on the tail boom wreckage and its installation hardware did not exhibit looseness. Manual rotation of the No. 3 TRDS resulted in a corresponding rotation of the tail rotor, confirming continuity of drive through the TRGB. Manual rotation of the tail rotor drive train exhibited roughness, but no evidence of severe binding or seizure of the tail rotor drive train. Additionally, no abnormal sounds were heard when rotating the TRGB.

Large portions of the TRGB outer housing exhibited severe corrosion and lifting paint consistent with prolonged water immersion. The oil level was not discernable through the sight glass. Removal of the TRGB chip detector revealed white-colored corrosion byproduct but no evidence of magnetic debris. The tail rotor output shaft did not exhibit evidence of bending deformation. The data plate was missing on the TRGB. The oil cap was removed, and sediment was found caked under the cap. The oil filler cap itself was damaged internally and required tooling to remove. Fluid was observed within the gearbox as the tail rotor was spun. Minor rust was noted on some of the gear teeth. There was water and sediment mixed with remnant oil within the TRGB. No other damage was noted on the internal gears to the TRGB.

### **2.5.3 Tail Rotor**

Both tail rotors were P/N 2062200-501. Tail rotor blade S/N F215 delaminated along the tip and trailing edge of the rotor (**figure 29**). The delamination extended about 5 inches aft of the tip on the inboard side and about 11 inches aft of the tip on the outboard side. The metal leading edge was dented from the tip to about 5 inches aft of the tip on both sides. The damage to the tip end of S/N F215 was consistent with an impact to the tail boom on BS 146.088. No other anomalous damage was

observed on the inboard end of tail rotor serial number F215. Tail rotor blade S/N F220 had a nick on the blade tip trailing edge and a gouge on the blade tip at the transition between the metal leading edge and composite blade. No other anomalous damage was observed on S/N.



**Figure 29.** Tail rotor blade S/Ns F215 (left) and F220 (right).

## **2.6 Engine**

### **2.6.1 Engine Description**

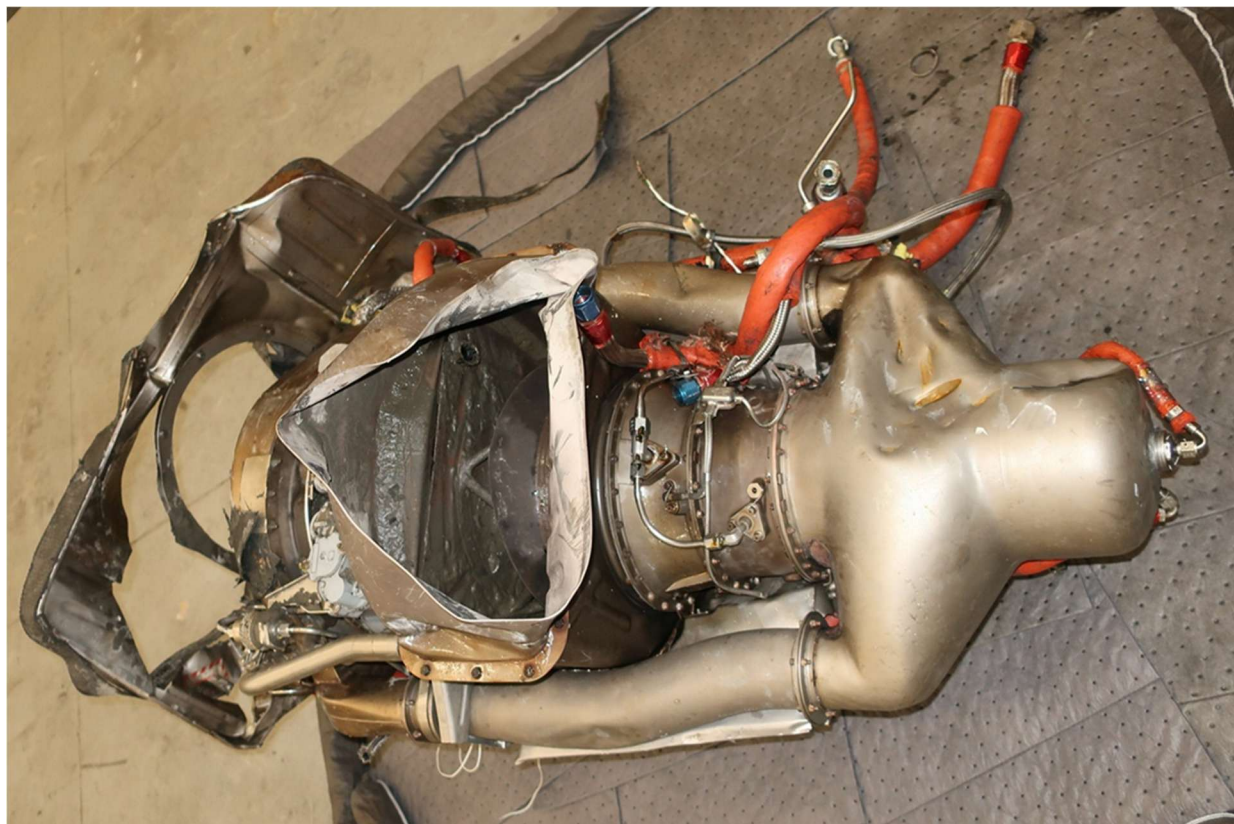
The Rolls-Royce Model 250-C30P is a turboshaft engine that comprises a single-stage centrifugal compressor, a single can-type combustor, and a turbine assembly that incorporates a two-stage gas producer turbine and a two-stage power turbine, also known as a free turbine. The gas producer turbine and the power turbine are not mechanically connected and rotate independently of each other. The gas producer turbine drives the compressor as well as most of the engine-mounted accessories. The power turbine delivers power to the helicopter rotor system via the engine accessory gearbox. The accessory gearbox drive splines deliver power to the main rotor.

### **2.6.2 Engine Observations**

The engine was recovered as a whole assembly and remained attached to the helicopter via lines and hoses. The hoses were disconnected by investigators to separate the engine from the main fuselage. Neither the fuel control unit (FCU) nor the power turbine governor (PTG) linkages remained connected to the cockpit controls. The PTG input control lever could not be easily moved. The FCU input control lever rotated freely. Neither the N1 nor the N2 systems could be rotated by hand. All engine external fuel, oil, and pneumatic lines did not exhibit looseness when checked by hand. All four starter-generator cooling blades were fractured and the fan case was crushed inward.

The compressor inlet was full of mud. Two compressor inlet guide vanes were bent in the direction of compressor rotation while two were distorted in the direction opposite of normal rotation. The fifth inlet guide vane did not exhibit similar distortion to the other four. The mud was manually removed from the compressor inlet and then rinsed with water. The first stage compressor blades did not exhibit evidence of hard body FOD ingestion. On the first stage compressor blades, one blade was bent.

The two compressor discharge tubes remained installed between the compressor section and the combustor section and exhibited indentations. Wrinkling was observed on the right top portion of the outer combustion case (**figure 30**). The compressor bleed air manifold was dented inward at the 5 and 7 o'clock positions and the compressor scroll was dented at the 7 o'clock position.



**Figure 30.** The recovered engine after it was separated from the wreckage.

The airframe-mounted scavenge oil filter element was stuck within its filter housing. The filter had to be cut in order to remove it, which resulted in bright-colored aluminum particles on the filter element in the area of cutting. However, the filter element did not contain ferrous debris. The airframe-mounted engine oil reservoir was found in the recovered wreckage. The lower half of the oil reservoir remained partially attached to the structure. The upper half of the oil reservoir had separated from the structure. The oil cooler radiator remained installed. The input

fuel line to the airframe fuel filter was fractured. The airframe fuel filter bowl contained residual fuel in addition to water and mud.

## **2.7 Additional Systems**

The cockpit instrument panel was structurally separated from the fuselage but remained attached via wires. The caution and warning panel and a portion of the glare shield were cut from the instrument panel and retained for further evaluation.<sup>7</sup> The rotor brake lever was found stowed. On the overhead panel, the anti-collision light switch was in the “off” position. The circuit breaker for the emergency flotation system was found extended, but none of the other circuit breakers were found extended.

The emergency flotation system gas reservoir remained installed. The reservoir gauge indicated slightly above 2,000 psi. The reservoir valve was opened by investigators to discharge the pressurized gas prior to movement of the wreckage. The battery was found installed in the cockpit nose wreckage and remained connected. The battery was disconnected and removed by investigators. Three six-pound weights (PN 206-031-237-113) were found installed on the nose ballast location.

The emergency locator transmitter (ELT) switch in the cockpit instrument panel was found in the “ON” position. The ELT was found installed in the area underneath the engine firewall. The ELT did not exhibit external damage. The switch on the ELT was found in the “OFF” position. The ON/OFF switch on the ELT confirmed it was manually moveable.

## **3.0 Main Transmission and Roof Structure Examination**

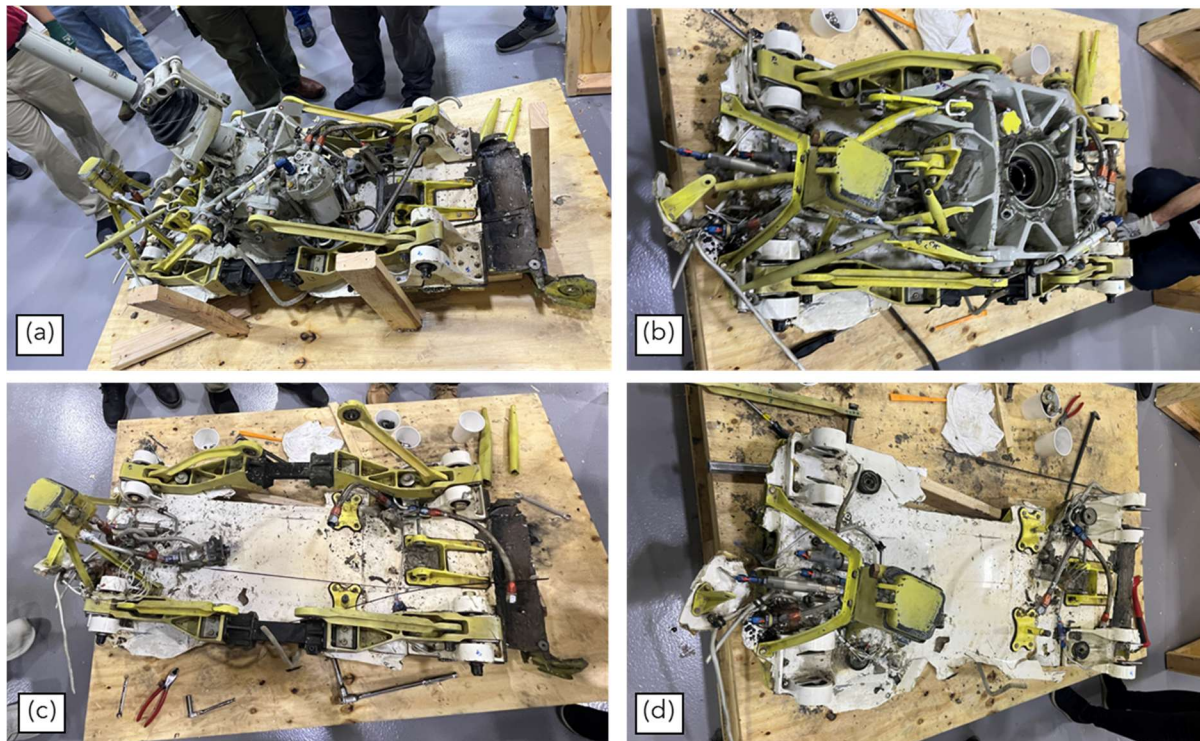
On May 6-7, 2025, members of the Airworthiness Group convened at Bell facilities in Fort Worth, Texas to examine the main transmission and attaching hardware as well as the fuselage roof structure.

The mast and swashplate support assembly fasteners were removed and the mast assembly was separated from the main transmission (**figure 31**). The lower stem of the mast, mast bearing, and the internal surfaces of the main transmission housing exhibited corrosion. The mast bearing was able to be rotated by hand, and the bearing rotated with minimal roughness without evidence of seizure. The lift link bolts that attach to the main transmission, the hydraulic pump fasteners, and the drag pin nuts were removed and the main transmission was separated from the roof assembly with the use of a hoist and a hoist plate that was bolted to the main transmission at the swashplate fastener holes. The lower lift link bolts were removed and the lift links

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<sup>7</sup> The NTSB Materials Laboratory examined the caution and warning panel bulb filaments for evidence of stretching. See NTSB Laboratory Specialist’s Factual Report No. 25-077 for additional details.

were separated from the nodal beams. The nodal beams were removed by removing the bolts that attach to the roof structure supports. The hydraulic reservoir was removed from the roof structure by removing the fasteners.



**Figure 31.** Sequential photos of removing the transmission and mounts from the roof structure.

### 3.1 Main Transmission Examination

Both left and right spherical bearings from the transmission restraint exhibited wear on their outer diameter surfaces. Additionally, the left and right bearing sleeves were pushed downwards about 0.010 inches and 0.050 inches, respectively, and also exhibited wear.

The planetary carrier output spline showed no mechanical damage and the gear teeth of the planetary gears exhibited contact patterns typical of normal service wear. Oil and sediment were present within the transmission and the mast splines. The transmission oil filler cap was removed and sediment was observed within the oil filler port. The oil filter was removed and contained no evidence of large metallic debris. Water and sediment was present within both the oil and the filter. Analysis of an oil sample by the Bell Field Investigations Lab found a 0.0015-inch zinc plating chip as well as magnesium particulate within the oil sample.

The ring gear and sun gear both exhibited no anomalous damage and their gear teeth exhibited contact patterns typical of normal service wear. The roller

bearings of the planetary gears exhibited normal service wear. Corrosion and sediment were observed on the ring and sun gear surfaces. The main transmission gear shaft support case exhibited significant corrosion such that the five spokes of the case were consumed by corrosion. The input driven gearshaft upper bearing exhibited corrosion. The gearshaft exhibited corrosion around its shaft and where the bearing's roller made contact with its inner diameter. The input pinion exhibited corrosion and its nut exhibited looseness, but the pinion gear teeth did not exhibit anomalous wear damage. The input pinion ball bearing did not exhibit anomalous wear or damage other than corrosion. The main input bearing and seal housing were corroded and the union filter going into the housing was full of sediment. The lower bearing case and mast alignment bearing were corroded and contained sediment. The lower bearing was able to be rotated by hand without restriction. Corrosion was found in the bottom of the main transmission case assembly, including pieces of the housing itself. The main bevel gear teeth exhibited contact wear typical of normal service wear as well as corrosion throughout.

The Nos. 1 and 2 transmission oil jets did not exhibit anomalous damage other than corrosion. The accessory gear exhibited corrosion but no other anomalous damage. The input driven shaft thrust bearings exhibited corrosion and could not be rotated by hand; pieces of corrosion byproduct were observed embedded within this bearing.

### **3.2 Main Rotor Mast Examination**

The mast was disassembled and removed from the swashplate assembly. The mast thrust ball bearing was removed. No flat spots were noted on the balls, minor corrosion was noted on the cage and the bearing balls. The mast had scoring and wear above the threads. Magnetic penetrant inspection of the mast found no crack indications. Mechanical rotational damage was noted between the rotating and non-rotating swashplate surfaces.

The mast collar set had no damage and the proseal was intact. The top case collective lever had a bent pin. The collective lever and drive idler had minimal damage with minor paint chips. The mast outer cap was removed and had no damage. The upper bearing race had no damage and the upper cap had typical wear. The pivot sleeve had corrosion and one of the teflon bushings was missing. One of the bushings had gouges from where the collective lever pin rotated out of the bushings. The gouge extended through the data plate. Gouges were noted on the pivot sleeve housing and on the inner teflon liner. The top of the swashplate support sleeve was fractured. Sediment was noted on the sleeve as well as corrosion. The swashplate duplex bearings were removed and no evidence of wear was found. The duplex bearings were able to be rotated and did not exhibit binding or restriction.

### 3.3 Roof Structure (figure 32)

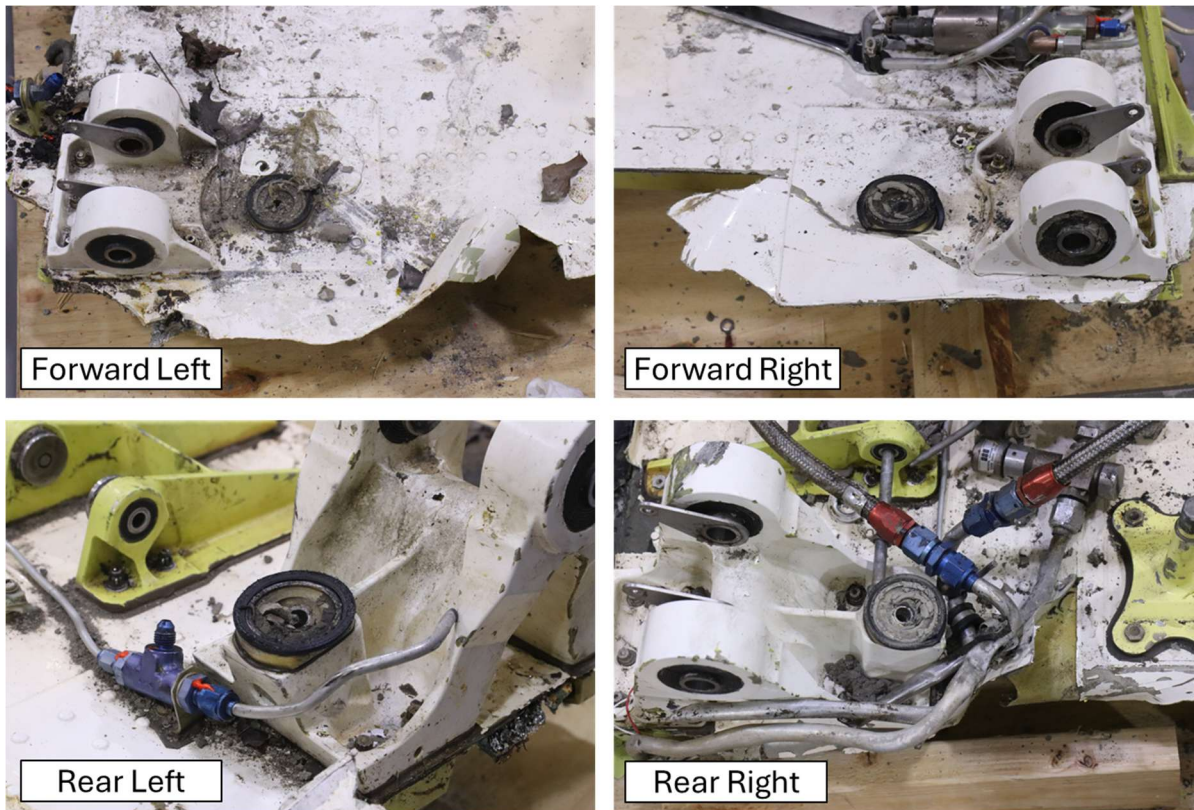
After teardown the roof structure, two repairs relating to the roof structure which were documented in the accident helicopter maintenance records, were identified by investigators. One of the repairs was determined to be outside of the recovered wreckage. The group examined the location of the other repair, specifically the roof upper skin between the cabin bulkhead and the aft bulkhead. There was no evidence of pre-existing cracks or anomalies associated with this repair.



**Figure 32.** The upper and lower surfaces of the roof structure.

The inboard side of the right rear nodal beam attachment lug had a deep gouge which continued to the rear end of the right nodal beam upper surface. The left and right drag pins exhibited contact damage at the base of the pins on the forward and aft faces. The four stop assemblies on the lower side of the left and right

nodal beams had evidence of contact (**figure 33**). The forward right stop exhibited evidence of hard contact on the forward right quadrant and the rubber pad was broken. The rear right rubber pad was nicked.



**Figure 33.** The lower stops of the left and right nodal beams.

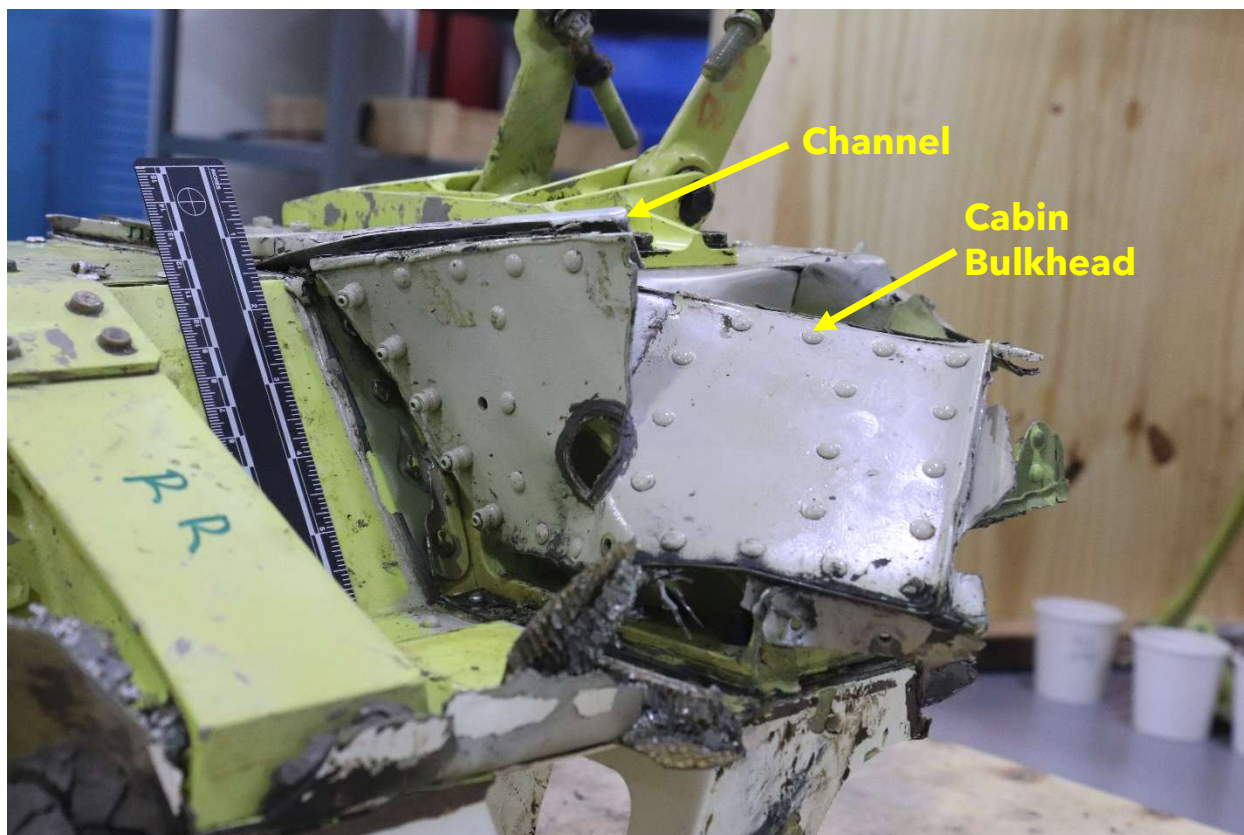
The right side of the roof beam assembly had downward bending deformation of the upper face of the beam, and the right side of the wall was buckled. The lower face of the roof assembly was bent, collapsing inward to the roof beam assembly centerline. Three of the lift links exhibited no anomalous damage. The forward-right lift link was bowed outboard, consistent with a compressive buckle. The remaining three lift links did not exhibit significant deformation. The nodal beams did not exhibit deformation. The rear end of both nodal beams had gouges. The gouge at the right nodal beam rear end is adjacent to the gouge damage on the nodal beam attachment lug.

The fractured surfaces were visually inspected, and they had a dull, grainy appearance consistent with overstress fractures. The directionality of the fracture was consistent with initiation near the rear left side with final separation at the forward right side. The cabin bulkhead separated completely from the roof beam structure at the left rear side except for an attachment flange (**figure 34**). The channel at the cabin bulkhead station was fractured in downward bending.



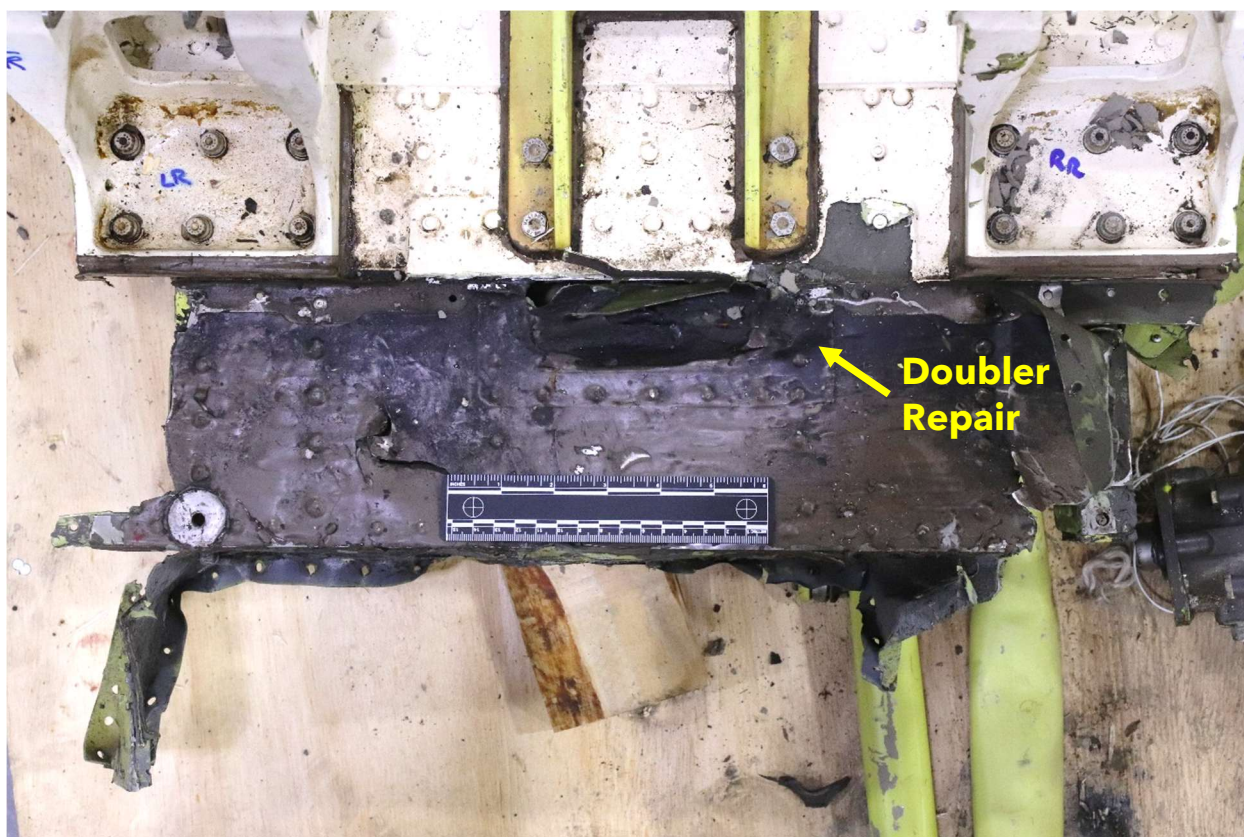
**Figure 34.** Roof beam structure left rear side.

The cabin bulkhead on the right side separated from the roof and the side of the roof beam but remained attached to the channel. The channel remained attached to the bottom of the roof beam (**figure 35**). The channel was deformed in the downward and aft direction. All of the fractured rivets were examined and found to be consistent with tensile or shear overstress. The remaining attached bulkhead exhibited aft bending and torsion.



**Figure 35.** Roof beam structure right rear side.

The remaining section of the aft bulkhead on the outboard ends of the roof beam assembly (both sides) were bent aft (**figure 36**). A doubler repair on the top skin of the aft bulkhead was located about centerline and was deformed downward.



**Figure 36.** Aft bulkhead deformation and the doubler repair.

#### **4.0 Main Rotor Examination and Sampling for Bird Remains**

On June 17-18, 2025, members of the Airworthiness Group convened at AMF Aviation in Westfield, Massachusetts to examine the main rotor. A specialist from the Smithsonian Institution's Feather Identification Lab (National Museum of Natural History) was invited by the NTSB to conduct sampling of the wreckage for bird remains.

##### **4.1 Main Rotor Hub**

The main rotor mast nut was removed from the mast. The mast nut was tight when removed and the threads did not exhibit anomalous damage. The flap restraint was removed from the trunnion. The two screws retaining the flap restraint to the trunnion did not exhibit tightness. One flap restraint screws was slightly bent. The flap restraint was bent slightly upward. The flap stops had contact marks that appeared heavier than typical service wear.

The trunnion upper and lower surfaces had no evidence of cracks or gouging damage. Grease was present on the splines for the trunnion and mast. The splines did not exhibit anomalous wear or fractures. The latch bolt thread protrusion was measured between the end face and nut's upper surface. For main rotor blade S/N

A303, the latch bolt thread protrusion was 0.412" on the advancing side of the blade and 0.241" on the trailing side of the blade. For main rotor blade S/N A304, the latch bolt thread protrusion was 0.444" on the advancing side of the blade and 0.240" on the trailing side of the blade.

A trunnion centering measurement of the gap between the trunnion and the pillow block was taken. The side without the data plate measured 0.195". The opposite side with the data plate was measured about 0.194".

The inboard portions of the main rotor blades and the hub were 3D scanned using a FARO scanner. Subsequently, the inboard portions of the main rotor blades were removed from the hub. The blade bolt for S/N A303 contained two fishing line weights.<sup>8</sup> The blade bolt for S/N A304 contained no weights. There were no cracks or anomalous wear between the blade bolts, blade grips, and the blade upper and lower plates.

## **4.2 Main Rotor Blades**

The main rotor blades were photo-documented by an NTSB materials engineer. The main rotor blades were also sampled for evidence of bird remains by an ornithologist from the Smithsonian Feather Identification Lab.

## **4.3 Airframe**

A piece of the aft cabin frame and the right roof structure (with black-colored grip surface on the outside) was examined. This piece contained the upper-aft corner of the left-side door frame. The structural frame had separated from this piece at STA 147, but the rivet heads were present and fractured in overload. A portion of the frame at STA 155 that connected to a vertical elbow that connected to the aft portion of the separated roof structure showed signatures of overload. The vertical elbow was not present on either the separated frame piece from STA 155 or on the separated roof structure.

Several locations of the airframe, including the horizontal stabilizer and finlets, vertical fin, fuselage, and the main rotor pitch links, were also sampled by the Smithsonian ornithologist.

## **5.0 Engine Examination**

On September 3, 2025, an NTSB powerplants investigator and representatives from Bell and Rolls-Royce conducted a teardown examination of the accident engine at Rolls-Royce facilities in Indianapolis, Indiana.

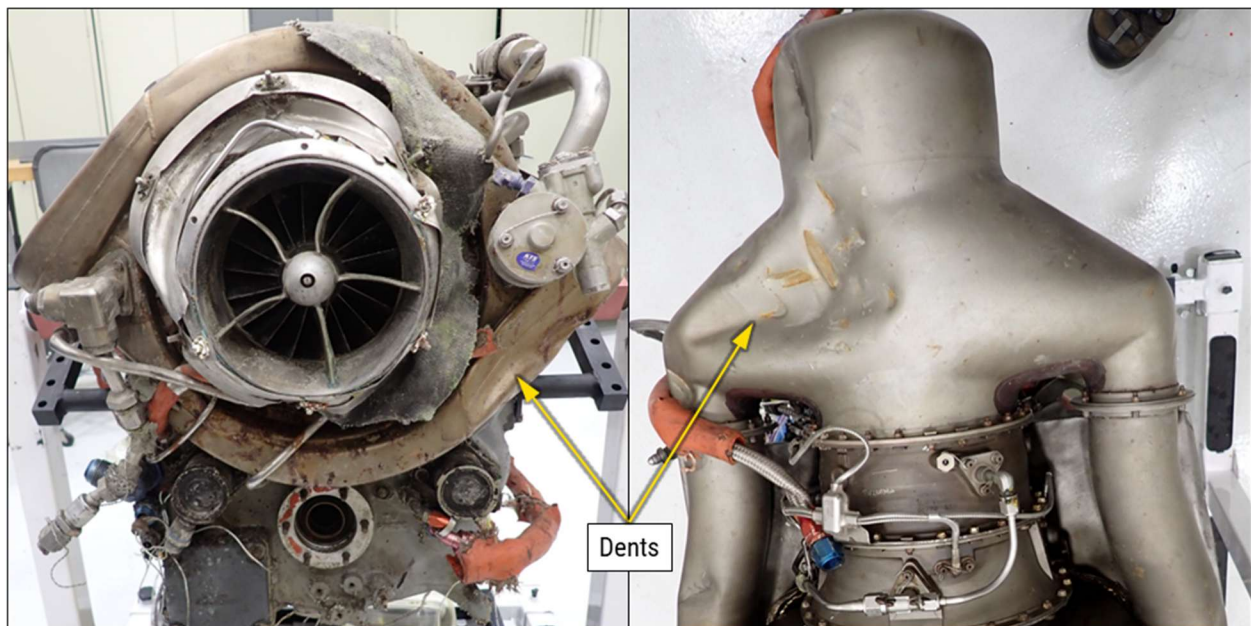
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<sup>8</sup> The Bell 206 L4 maintenance manual recommends using 44 caliber lead shot in the blade bolts for spanwise balance adjustments, as required.

The engine was secured inside a metal shipping container when the investigation team arrived. The engine was removed from the container and placed into a stand. According to the engine data plate, the engine S/N was CAE-890638.

There was no evidence of external fire or radial uncontainment. The stage 4 power turbine (PT) blades appeared full length when viewed through the exhaust collector. Attempts to rotate the gas producer (GP) via the front impeller and the PT via the stage 4 PT blades were unsuccessful as both spools were seized.

The top right and aft surfaces of the outer combustion case were dented. The forward side of the left scroll channel and both left and right compressor discharge air tubes were also dented. The compressor front support vanes were deformed. One inducer blade appeared bent when viewed through the front support. The compressor front assembly, an airframe component attached to the front support, was deformed around the front of the engine and had to be cut for removal. Earthen debris was found lodged between the front assembly and the engine (**figure 37**).



**Figure 37.** Dents in the left scroll channel (left) and outer combustion case (right)

Two magnetic chip detectors monitor oil flow within the system. An upper detector samples oil flow from all the scavenge pumps flowing out of the engine to the oil cooler while a lower detector samples oil only from within the gearbox. Both chip detectors were found dry. The upper detector had dirt adhered to the tip, while the lower detector had small debris (**figure 38**). The oil filter element appeared undamaged and the filter pleats were free of debris.



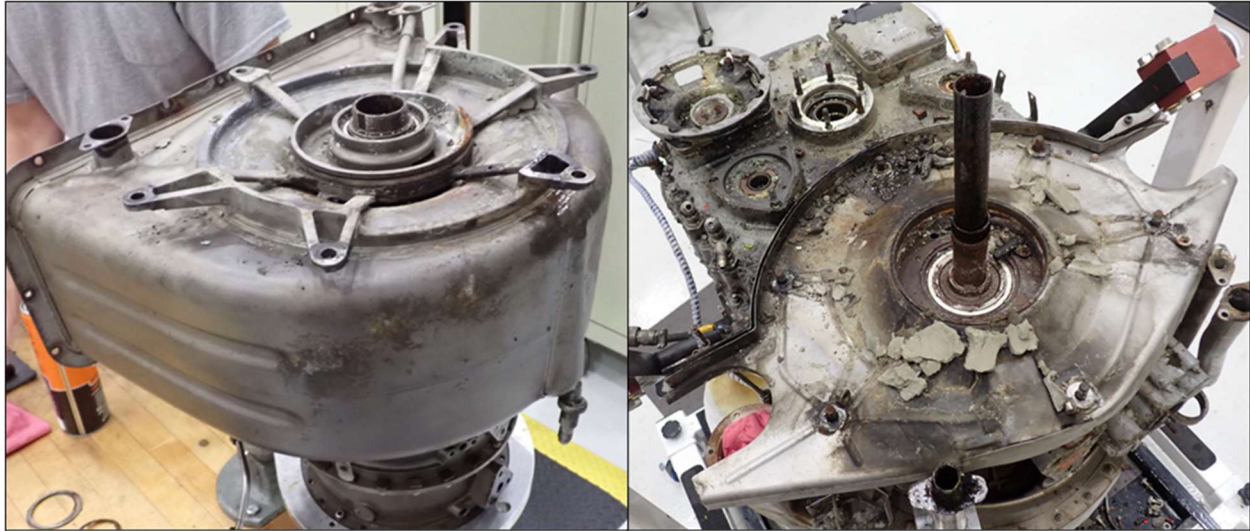
**Figure 38.** Upper (left) and lower (right) chip detectors

The PT governor appeared intact and its drive shaft spun freely. The input throttle lever shaft was bent and prevented lever actuation. The airframe linkage control arm was still attached to the lever shaft. Both minimum and maximum throttle stop set screws were present and safety wired together. However, the minimum set screw was partially unscrewed and had no torque stripe.

The fuel control unit (FCU) throttle lever input shaft was fracture separated and its throttle lever was disconnected. Control drive shaft rotation was smooth. The aft, lower left corner of the FCU main body had impact damage. Residual fuel was found in the fuel line from the FCU back to the firewall and in the fuel bypass line back to the fuel pump. The fuel pump was intact and its drive shaft was undamaged.

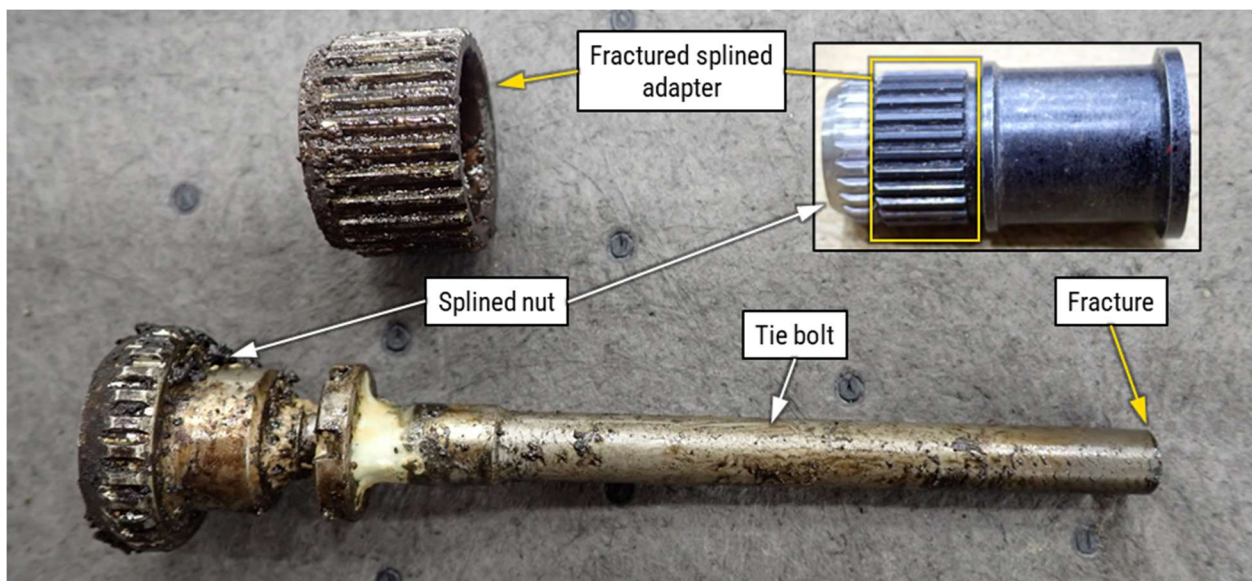
Sediment accumulated inside of the outer combustion case near the fuel nozzle. Case deformation made removal of the combustion liner difficult, but the liner was intact with corrosion and yellow deposits on its surfaces. The liner's inlet swirler airfoils appeared full length and undamaged. The fuel nozzle tip had corrosion deposits. The igniter plug was rusted and covered with sediment.

The turbine assembly, consisting of the exhaust collector, PT, and GP, was removed from the gearbox. Earthen debris was lodged between the assembly and the gearbox heatshield. The turbine-to-compressor coupling shaft was still connected to the spur adapter gear (SAG) shaft sticking out from the gearbox. Surfaces around the SAG were corroded. The SAG's two o-rings and forward retaining ring were in-place and appeared in good condition. The PT-to-pinion gear coupling was intact with corrosion on its outer surfaces. Aft splines of the PT shaft-to-pinion gear coupling appeared intact. PT rotation was achieved by attaching a wrench to the inner splines of the PT outer shaft. Rotation was smooth but had some resistance (**figure 39**).



**Figure 39.** Turbine assembly (left) removed from gearbox and heatshield (right)

A splined adapter is held onto the front of the stage 2 rotor by a splined lock nut, and the GP stage 1 and 2 rotors are retained together by the adapter, a tie bolt, and a rear tie bolt nut. The forward four inches of the tie bolt was found fracture separated inside the turbine-to-compressor coupling shaft. The front splined nut was still screwed onto the tie bolt and the front end of the splined adapter was fracture and separated. All parts were covered in dirt and oil (**figure 40**). The remainder of the tie bolt and rear nut were recovered when the GP turbine was disassembled.



**Figure 40.** Recovered tie bolt and splined adapter (inset shows exemplar splined nut and adapter)

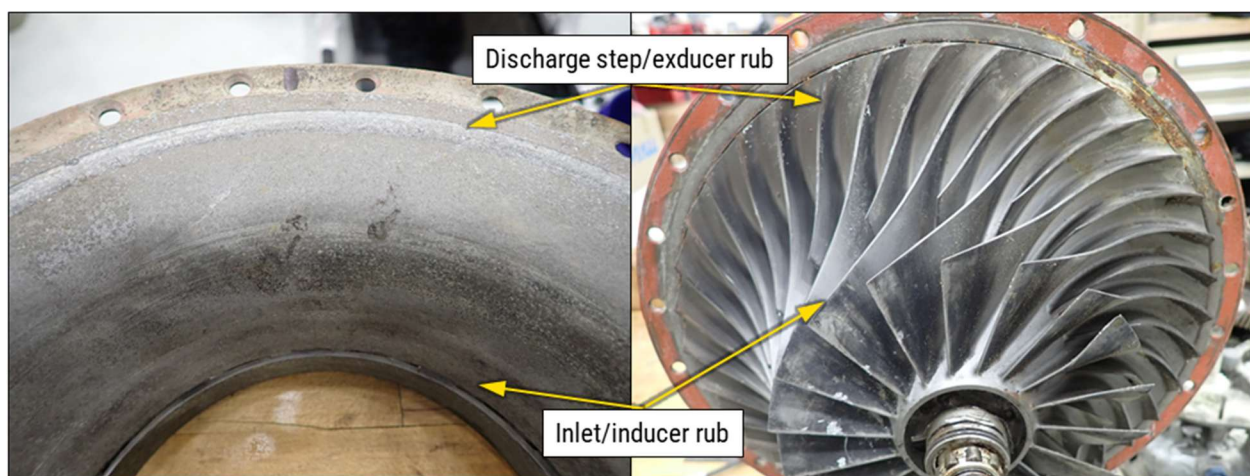
The PT assembly was removed from the PT support housing. Both no. 5 and 6 bearings were removed and could not be rotated by hand. The stage 3 and 4 PT

rotors appeared in good condition with all airfoils full length and no damage found to the curvic coupling teeth. Both inner and outer PT shafts and the forward labyrinth seal were in good condition. Both stage 3 and 4 nozzles were intact with metal splatter on all suction side airfoil surfaces. The stage 3 and 4 blade tracks on the stage 4 nozzle had light circumferential rubbing.

The stage 1 nozzle shield and rear oil sump cover were removed from the GP support. The exposed no. 8 bearing cavity was oil-wetted and dark in color. The ball bearing elements and race area were rusted.

The fractured splined adapter was still attached to the forward side of the GP stage 2 rotor and interfered with the no. 7 roller elements during disassembly. This prevented removal of the GP stage 2 rotor from the PT bearing support. Both the stage 1 and 2 GP rotors appeared in good condition. All airfoils were full length and had metal splatter adhered to their suction side surfaces. No damage was found on the curvic coupling teeth. The GP stage 1 and 2 nozzles were intact. All airfoils were full length with metal splatter adhered to their suction side surfaces. Stage 1 and 2 GP blade tracks and the inner airseal land on the stage 2 nozzle had light, circumferential rubs.

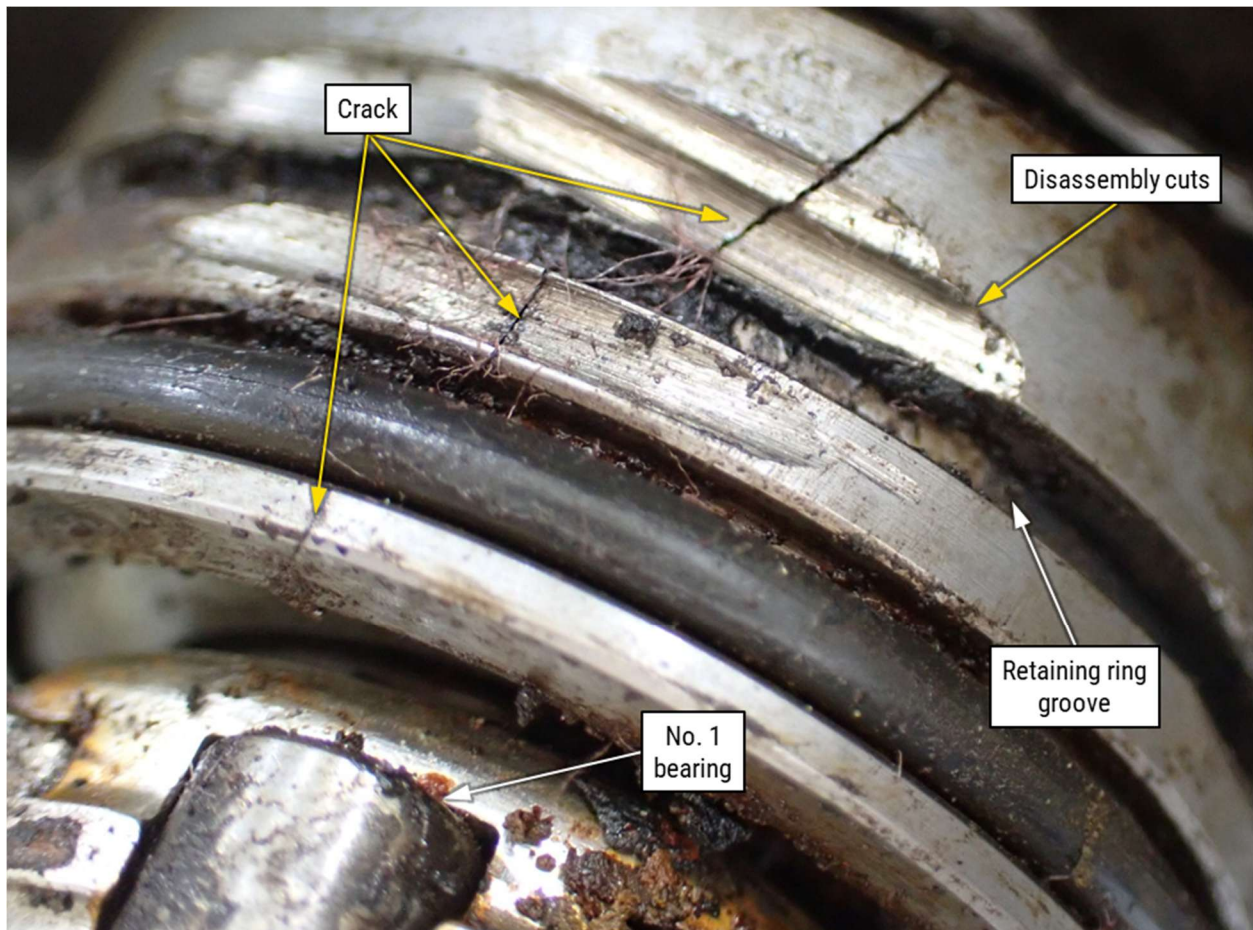
The deformed shroud-bleed air manifold had to be cut from the shroud housing for removal. The contoured inner shroud surface was cleaned with a brush and soapy water. The shroud surface had a machined step near the shroud discharge. The shroud also had light rubs near the inlet. Corresponding rubbing was found on the impeller vanes near the inducer and exducer (**figure 41**).



**Figure 41.** Inner shroud surface (left) and impeller (right)

The no. 1 bearing housing was stuck within the compressor front support because the internal retaining ring holding the oil seal assembly to the housing could not be fully compressed. The base of the no. 1 bearing housing had to be cut for

removal. The exposed no. 1 bearing roller elements were all present but corroded and difficult to rotate. The oil seal assembly was found cracked (**figure 42**).



**Figure 42.** Cracked no. 1 bearing oil seal assembly

The gearbox cover was removed from the accessory housing. All internal gears were present with no missing gear teeth. Gears were either completely seized or very difficult to rotate. White sediment had accumulated at 6 o'clock within the gearbox. A hole had corroded through the gearbox cover near the starter generator pad.

## **6.0 Accident Helicopter Maintenance**

According to the operator, the helicopter was maintained under the manufacturer's recommended inspection program, specifically a 300-hr progressive inspection program detailed in the Bell 206L-4 maintenance manual. The Bell 206L-4 300-hr progressive inspection program has six events that occur at intervals of 50 hrs. After completion of the event 6 inspection, the progressive inspection cycle begins again with event 1. A complete cycle of all six event inspections are to be completed within 12 calendar months. In the event that all six events are not completed in a 12 calendar month period, the remaining events must be completed before operating

the helicopter. **Table 1** shows a summary of the recent helicopter maintenance accomplished on the accident helicopter and discussed in detail in this section.

**Table 1.** A summary of recent maintenance actions and events for the accident helicopter.

| <i>Date</i>       | <i>ATT<br/>(hours)</i> | <i>Event or maintenance action</i>                                                            |
|-------------------|------------------------|-----------------------------------------------------------------------------------------------|
| April 9, 2025     | 13,021.8               | Day before the accident                                                                       |
| April 7, 2025     | 13,013.1               | Snow baffles removed                                                                          |
| March 27, 2025    | 12,992.4               | Main rotor mast nut retorque                                                                  |
| March 27, 2025    | 12,991.3               | Swashplate and support assembly replaced                                                      |
| February 27, 2025 | 12,975.4               | 100-hr inspection and event 2 of 300-hr progressive inspection                                |
| January 16, 2025  | 12,945.5               | Tail rotor hub assembly removed and replaced; roll staked main rotor pitch link bearing       |
| January 3, 2025   | 12,933.3               | Event 1 of 300-hr progressive inspection; 100/300-hr inspection of VHA tail rotor blades      |
| December 13, 2024 | 12,808.9               | Event 6 of 300-hr progressive inspection; 100-hr inspection of VHA main and tail rotor blades |
| December 4, 2024  | 12,874.1               | Snow baffles installed                                                                        |
| November 7, 2024  | 12,847.1               | Event 5 of 300-hr progressive inspection; 300-hr main rotor pitch change link inspection      |
| August 2, 2023    | 11,953.8               | VHA main rotor blade S/Ns A303 and A304 installed                                             |

The last helicopter maintenance record was dated April 9, 2025. As of the end of the day of April 9, 2025, the ATT was 13,021.8 hrs and an ETT was 23,351.8 hrs. The last maintenance action performed was the removal of snow baffles on April 7, 2025 at an ATT of 13,013.1 hrs and an ETT of 23,343.1 hrs. On March 27, 2025, at an ATT of 12,991.3 hours, the swashplate and support assembly was removed and replaced with swashplate and support assembly P/N 206-010-450-123 and S/N REFS-3 with a mast nut retorque due in 1-5 hours. On March 27, 2025, the operator accomplished a main rotor mast nut retorque at an ATT of 12,992.4 hrs. The reason for the swashplate and support assembly replacement was not listed. Log sheet no. 1340 that contains a discrepancy log, which should have been dated March 27, 2025, was not found in the logbook.

According to helicopter maintenance records, the last 100-hr inspection as well as an event 2 of the 300-hr progressive inspection program and a 150-hr engine inspection were performed on February 27, 2025 at an ATT of 12,975.4 hours.

In a maintenance entry dated January 16, 2025, at an ATT of 12,945.5 hrs and an ETT of 23,275.5 hrs, under work order WO216-25-001A, tail rotor hub assembly P/N 206-011-810-153 and S/N SH165197 was removed and a new tail rotor hub

assembly P/N 206-011-810-157 and S/N HB3346 was installed. The tail rotor was balanced to 0.17 ips. Additionally, a discrepancy stated "play in main rotor swashplate bearing" and its corrective action entry stated "roll staked main rotor pitch link bearing on swashplate ISAW [sic] Bell 206L4 standard practices manual chapter 9".

In a maintenance entry dated January 3, 2025, at an ATT of 12,933.3 hrs, an event 1 of the progressive 300-hr inspection program and a 100-hr and 300-hr inspection of the VHA tail rotor blades were accomplished.

A maintenance record, dated December 14, 2024, showed the helicopter began the day with an ATT of 12,890.3 hours and an ETT of 23,220.3 hrs and ended the day with an ATT of 12,894.4 hrs and an ETT of 23,224.4 hrs. In a maintenance record entry dated December 13, 2024, at a listed ATT of 12,808.9 hrs and an ETT of 23,215.9 hrs, under work order WO216-24-003I, multiple inspections were accomplished, including an event 6 of the progressive 300 hr inspection program, an inspection of the tail boom upper-left attachment fitting, a main transmission oil change, and 100-hr inspection of the Van Horn Aviation main and tail rotor blades. Additionally, the main rotor hub assembly was removed and replaced with an overhaul main rotor hub assembly, P/N 206-011-100-105 and S/N AAB-03024. The end of this entry had a line that stated a main rotor mast nut retorque was due in 1-5 flight hours. On the maintenance daily log page that contained this entry, which was also dated December 13, 2024, it listed the ATT 12,885.9 hrs and an ETT of 23, 215.9 hrs.

In a separate maintenance record entry dated December 13, 2024, at a listed ATT of 12,809.9 hrs but no listed ETT, under work order WO216-24-003I, the entry stated the main rotor mast nut retorque was complied with and a main rotor track and balance was accomplished. The end of this entry had a line that stated a main rotor mast nut retorque was due in 1-5 flight hours. Another main rotor mast nut retorque entry was not seen in the maintenance records until the March 27, 2025 entry.

A maintenance record, dated December 9, 2024, showed the helicopter began the day with an ATT of 12,884.2 hrs and an ETT of 23,214.2 hrs and ended the day with an ATT of 12,885.9 hrs and an ETT of 23,215.9 hrs. In a maintenance record dated December 4, 2024, at an ATT of 12,874.1 hrs and an ETT of 23,204.1 hrs, the snow baffles were installed.

In a maintenance record entry dated November 7, 2024, at an ATT of 12,847.1 hours and an ETT of 23,177.1 hrs, an event 5 of the progressive 300-hr inspection program and a 300-hr main rotor pitch change link inspection were accomplished.

According to helicopter records, the accident engine was installed on the helicopter on January 16, 2017 at an ATT of 9,111.4 hours and an ETT of 19,441.27

hours. The accident [VHA] main rotor blades were installed on the accident helicopter on August 2, 2023 at an ATT of 11,953.8 hours.

**Attachment 1** contains select logs from the daily maintenance log for the accident helicopter. **Attachment 2** contains select entries from maintenance logs for the accident helicopter.

## **E LIST OF ATTACHMENTS**

**Attachment 1** - Select daily maintenance logs for N216MH

**Attachment 2** - Select maintenance log entries for N216MH

Submitted by:

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