Aviation Investigation Final Report

Location:	Kalea, Hawaii	**Accident Number:**	ANC22FA041
Date & Time:	June 8, 2022, 17:26 Local	**Registration:**	N402SH
Aircraft:	Bell 407	**Aircraft Damage:**	Substantial
Defining Event:	Part(s) separation from AC	**Injuries:**	3 Serious, 3 Minor
Flight Conducted Under:	Part 135: Air taxi & commuter - Non-scheduled - Sightseeing		

Analysis

The pilot reported the first part of the air tour flight around the island was normal. About 35 minutes into the flight, during cruise flight at 1,500 ft above ground level (agl), the helicopter experienced a violent upset, followed by an uncontrolled spin to the right. The helicopter entered a rapid descent, its airspeed decreased, and it continued to spin uncontrollably. The pilot attempted to recover control of the helicopter, but it impacted a lava field and came to rest on its left side.

Postaccident examination of the helicopter revealed the tail boom separated in flight. Further examination revealed there were no malfunctions or failures with the rotor systems, flight control systems, and engine before the tail boom separation.

Examination of the tail boom revealed the upper-left tail boom attachment bolt was not present in the wreckage and was not found. Circumferential gouge and impression marks within the upper-left attachment bolt holes indicated the bolt was installed before the accident but that it had fractured and migrated out. After the bolt fractured, the structural load increased on the remaining three tail boom attachment points. As a result, multiple origin fatigue cracks, as well as fatigue cracking originating from a single corrosion pit, initiated on the lower-left attachment fitting. Once the fatigue cracks grew to a critical length, all three remaining attachment fittings failed in overload, resulting in the tail boom separation. The examined tail boom attachment fittings and attachment hardware met manufacturing requirements, which were not a factor in this accident.

Due to the missing upper-left attachment hardware, the fracture mode and the duration of crack growth of the upper-left bolt could not be determined. The presence of sealant at the faying surface between the upper-left longeron and aft fuselage bulkhead indicated there was a small gap between those two structures. This gap was likely introduced during the

replacement of the upper-left longeron and aft fuselage bulkhead, per manufacturer technical bulletins (TB), about 8,050 flight hours before the accident.

The manufacturer reported a previous occurrence (on a different Bell 407) of a fractured upper-left attachment bolt that was attributed to abnormal loading of the bolt due to a gap and misalignment between the upper-left longeron and aft fuselage bulkhead. Similarly, the gap between the two structures on the accident helicopter likely applied abnormal loads on the upper-left attachment bolt that, over time, resulted in crack initiation on the bolt shank and the subsequent bolt failure. Due to structural deformation caused by the accident, it could not be determined if any axial misalignment was present between the upper-left longeron, the aft fuselage bulkhead, and the tail boom.

A 300-hour recurring inspection, which included a torque check of the four tail boom attachment bolts and visual inspection of the fittings, occurred about 114 flight hours before the accident and resulted in no anomalous findings. It is unlikely the bolt had fractured or had a crack of sufficient size to fail during this last torque check. Therefore, it is likely the upper-left attachment point continued to carry load during the last 300-hour torque check and that the multiple-origin fatigue cracking on the lower-left attachment fitting had not yet initiated. However, it is possible that the fatigue crack had already initiated from the single corrosion pit on the lower-left attachment fitting at the time of the last 300-hour recurring inspection, but that it was too small to visually detect.

In summary, examination of the wreckage revealed the accident occurred due to the in-flight separation of the tail boom during cruise flight, which resulted in the pilot's inability to control the helicopter. The tail boom separated due to the abnormal loading and fracture of the upper-left longeron attachment hardware. The presence of a gap between the upper-left longeron and the aft fuselage bulkhead, introduced during the accomplishment of manufacturer technical bulletins, likely led to the hardware failure.

Probable Cause and Findings

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

The in-flight separation of the tail boom as a result of abnormal loading and fracture of the upper-left tail boom attachment bolt due to a gap between the upper-left longeron and aft fuselage bulkhead.

Findings

Personnel issues	Installation - Maintenance personnel
Aircraft	Fuselage attach fittings sys - Fatigue/wear/corrosion
Aircraft	Rotorcraft tail boom - Failure

Factual Information

History of Flight

Maneuvering	Part(s) separation from AC (Defining event)
Maneuvering	Loss of control in flight
Maneuvering	Collision with terr/obj (non-CFIT)

On June 8, 2022, about 1726 Hawaii-Aleutian standard time, a Bell 407 helicopter, N402SH, sustained substantial damage when it was involved in an accident near Kalea, Hawaii. The pilot and two passengers sustained serious injuries, and three passengers sustained minor injuries. The helicopter was operated as a Title 14 *Code of Federal Regulations* Part 135 on-demand air tour flight.

According to the operator, Paradise Helicopters, about 1701, the helicopter departed the company base at Ellison Onizuka Kona International Airport at Keahole (PHKO), Kona, Hawaii, to the south for an air tour flight around the island. Automatic dependent surveillance-broadcast and company flight track data showed the helicopter traveled southeast toward an area known as South Point.

The pilot stated that the first part of the flight was normal. About 35 minutes into the flight, at an altitude of 1,500 ft agl and an airspeed of 130 knots, the helicopter experienced a violent upset, followed by an uncontrolled spin (yaw) to the right. A passenger, seated in the aft-left forward-facing seat, reported that as the helicopter continued to spin she observed something fall off the helicopter; however, she was not able to identify the specific part. The pilot communicated two mayday calls and attempted to recover helicopter control as it continued to spin uncontrollably and rapidly descend. The helicopter subsequently impacted a lava field and came to rest on its left side (see figure 1).

After the impact, about 1728, a passenger placed an emergency call to report that the helicopter had crashed. Simultaneously, the US Coast Guard Honolulu Joint Rescue Coordination Center received an emergency locator transmitter alert and initiated search and rescue operations.

Figure 1. Main wreckage in a lava field.

Pilot Information

Certificate:	Commercial	**Age:**	52,Male
Airplane Rating(s):	None	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	4-point
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	March 16, 2022
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	June 2, 2022
Flight Time:	7320 hours (Total, all aircraft), 1758 hours (Total, this make and model), 7000 hours (Pilot In Command, all aircraft), 144 hours (Last 90 days, all aircraft), 19 hours (Last 30 days, all aircraft), 5 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Bell	**Registration:**	N402SH
Model/Series:	407	**Aircraft Category:**	Helicopter
Year of Manufacture:	1997	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	53118
Landing Gear Type:	None; Skid	**Seats:**	7
Date/Type of Last Inspection:	AAIP	**Certified Max Gross Wt.:**	
Time Since Last Inspection:		**Engines:**	1 Turbo shaft
Airframe Total Time:		**Engine Manufacturer:**	ALLISON
ELT:		**Engine Model/Series:**	250-C47
Registered Owner:	K&S HELICOPTERS INC	**Rated Power:**	600 Horsepower
Operator:	K&S HELICOPTERS INC	**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:	Paradise Helicopters	**Operator Designator Code:**	

Airframe Structure Description

The helicopter fuselage was composed of three primary structural assemblies: the forward fuselage, the intermediate fuselage, and the tail boom. The intermediate fuselage begins at the rear of the passenger compartment and extends to the front of the tail boom. The aft portion of the intermediate fuselage is referred to as the aft fuselage. Four aft fuselage longerons—upper-left, upper-right, lower-left, and lower-right—are attached to the aft fuselage bulkhead.

The tail boom is installed to the intermediate fuselage with fasteners (bolts, washers, and nuts) to connect the four aft fuselage longerons to four corresponding longerons located at the forward end of the tail boom. According to Bell, the tail rotor thrust produces tension loads on the two left attachment points and compression loads on the two right attachment points. The weight of the tail boom as well as aerodynamic forces from the horizontal stabilizer applies tension loads on the two upper attachment points and compression loads on the two lower attachment points. As a result, the upper-left tail boom attachment point has the highest tension loading of the four attachment points. The lower-left attachment point carries the next highest load, followed by the upper-right and the lower-right attachment points.

Helicopter Maintenance Records

A review of the accident helicopter's maintenance records revealed that the most recent 300-hour torque check of the tail boom attachment fasteners was completed on May 4, 2022, at a

total airframe time of 22,891.4 flight hours. On June 6, 2022, 2 days before the accident, the helicopter had a total airframe time of 23,005.6 flight hours (114.2 flight hours since the torque check), 30,490 total flight cycles, and no additional maintenance had been conducted to the attachment fasteners since the torque check.

The tail boom (part number [P/N] 407-030-801-205D and serial number BP-1598) was installed on August 23, 2009, at a total airframe time of 5,780.0 hours. The tail boom was last removed and reinstalled on July 3, 2014, to facilitate longeron and frame repairs. According to the work order, a repair station assisted the operator accomplishing Bell TB 407-12-96 Revision A (Rev A). The subject of TB 407-12-96 Rev A was the installation of a redesigned aft fuselage upper-left longeron assembly.

TB 407-07-78, dated September 19, 2007, introduced an improved machined aft fuselage bulkhead, P/N 407-030-027-101. This was the P/N of the bulkhead installed on the accident helicopter. A later bulletin, TB 407-07-78 Rev A, issued In August 2020, introduced a new aft fuselage bulkhead that had a reinforced inside flange in the upper left area. The helicopter record list contained no entries regarding TBs 407-07-78 and 407-12-96.

Bell Technical Bulletins for the Aft Fuselage

Bell TBs 407-07-78 and 407-12-96 Rev A utilize an aluminum drill plate, manufactured locally in accordance with instructions provided in both TBs, to verify the location and planar alignment between the four tail boom attachment fittings and their bolt holes. Within TB 407-12-96 Rev A, before the final installation of the upper-left longeron and aft fuselage bulkhead to the aft fuselage, Step 23, a note recommends installation of the new improved machined aft fuselage bulkhead per TB 407-07-78. Additionally, this note states it is acceptable to reinstall the existing sheet metal aft fuselage bulkhead.

Bell TB 407-07-78 provides instructions in three parts for the installation of the new improved machined aft fuselage bulkhead. Part I contains instructions for the removal of the aft fuselage bulkhead and positional verification of the longeron fittings. Part II contains instructions for the installation of the bulkhead using existing pilot holes on the bulkhead and is considered the preferred method of installation. Part III contains instructions for drilling new pilot holes in the bulkhead (the existing pilot holes are not used). Part III is considered the alternate method for installing the bulkhead.

A note within TB 407-07-78, before Step 10, which accomplishes the final ream for the upper-left bolt hole, states not to drill the upper left upper longeron/fitting hole at this point if the aft fuselage bulkhead installation is accomplished in conjunction with the installation of a replacement upper-left longeron per TBs 407-12-96 or 407-17-125.

According to TB 407-07-78, the new aft fuselage bulkhead is initially secured to the four longeron fittings and the drill plate via four 3/16-inch diameter bolts that are torqued to 50 inch-pounds. At the four bolt hole locations, bushings are used to fill the gap between the

3/16-inch diameter bolt and the larger diameter bolt holes of the longeron fittings and the drill plate.

According to TB 407-12-96 Rev A, after removal of the existing longeron and a first-fit installation of the new upper-left longeron, the drill plate is temporarily secured to the upper-right, lower-left, and lower-right longeron fittings using the existing fasteners and torqued to 50 inch-pounds. The new upper-left longeron, whose fitting has a 3/16-inch diameter pilot hole, is secured to the drill plate using a 3/16-inch diameter bolt. Unlike TB 407-07-78, TB 407-12-96 does not specify instructions to use bushings for the installation of the 3/16-inch diameter bolt to secure the upper-left longeron to the drill plate. After securing the new upper-left longeron to the drill plate, the instruction states to verify that no gap exists between the longeron assembly and the drill plate and/or the spacer. A note preceding this step states that it is acceptable to hold the new upper-left longeron to the drill plate using a C-clamp until it is completely riveted to the fuselage.

The last step in Part I of TB 407-07-78 is to verify the four longeron fittings are in plane within 0.002 inches. A drill plate is attached to the four longeron fittings using the existing hardware that is torqued to 50 inch-pounds. The TB instructs that a gap check should be conducted between the drill plate and the aft face of each longeron fitting. If a gap is more than 0.002 inches on only one longeron fitting, the affected longeron must be replaced before the installation of the new aft fuselage bulkhead. If a gap is more than 0.002 inches on more than one longeron fitting, the affected longerons must be replaced, which requires installing the helicopter on a Bell-approved fuselage fixture.

According to TB 407-12-96 Rev A, before the installation of rivets for the upper-left longeron and aft fuselage bulkhead, sealant should be applied to these items. Specifically Step 23 of TB 407-12-96 Rev A, states the following:

Apply a coat of sealant (C-251) to faying surfaces of longeron assembly (2), aft fuselage bulkhead (6), the splices joining affected bulkhead sections and if needed the shims made in Step 20 before installing in place with drill plate (8). Secure longeron assembly (2) and bulkhead (6) with applicable rivets wet with sealant (C-251). Do not install rivets common to oil cooler fairing retainers (1, 2, Figure 2), the side skin panel (16, Figure 7) and the top skin (1, Figure 6) at this time, but secure any applicable shims made earlier with clecos.

According to Bell, if TB 407-07-78 is to be accomplished in conjunction with TB 407-12-96, then the aft fuselage bulkhead would be installed immediately before Step 23 of TB 407-12-96. Additionally, according to Bell the engineering drawing for the aft fuselage bulkhead installation does not require sealant between the contact surfaces of the aft fuselage bulkhead and the upper-left longeron.

In TB 407-07-78, both Parts II and III contain instructions to apply sealant to the faying surfaces of the shim and aft fuselage bulkhead.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	PHKO,37 ft msl	**Distance from Accident Site:**	49 Nautical Miles
Observation Time:	17:53 Local	**Direction from Accident Site:**	333°
Lowest Cloud Condition:	Few / 4900 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	Overcast / 7000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	9 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	250°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.98 inches Hg	**Temperature/Dew Point:**	27°C / 21°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Kona, HI (PHKO)	**Type of Flight Plan Filed:**	Company VFR
Destination:	Kona, HI (PHKO)	**Type of Clearance:**	None
Departure Time:	17:01 Local	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 Serious	**Aircraft Damage:**	Substantial
Passenger Injuries:	2 Serious, 3 Minor	**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	3 Serious, 3 Minor	**Latitude, Longitude:**	19.005372,-155.65457(est)

A National Transportation Safety Board (NTSB) examination of the accident site revealed the tail boom came to rest about 762 ft northeast of the main wreckage, which consisted of the fuselage, engine, and main rotor system. The tail boom separated from the aft fuselage at the tail boom attach point (see figures 2 and 3). The upper-left attachment fitting fastener was not present and the lower-left attachment fitting was fractured and displayed fatigue signatures. The fasteners for the lower-left, lower-right, and upper-right attachment fittings were present.

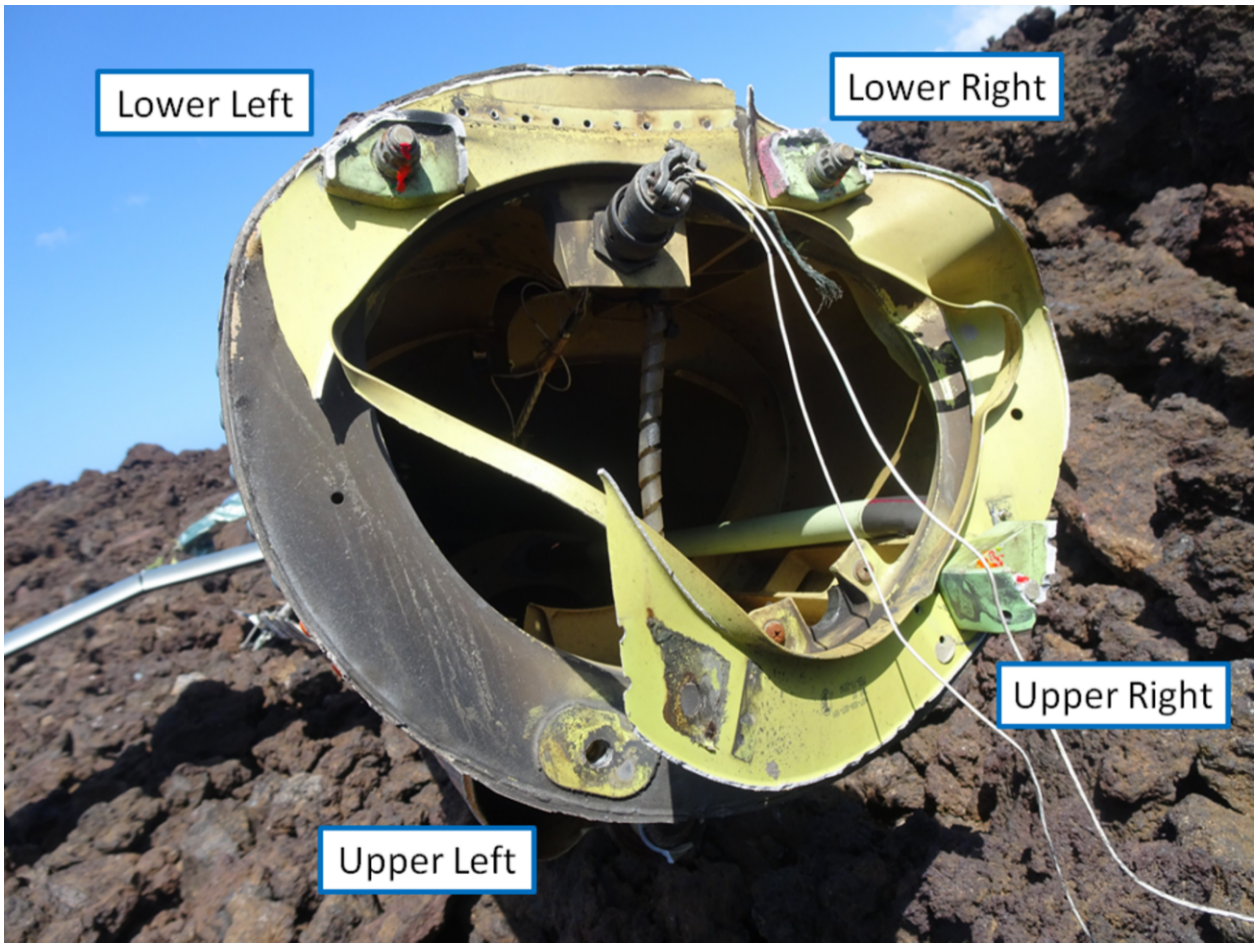

Figure 2. Tail boom at accident site with the four attachment fittings annotated.

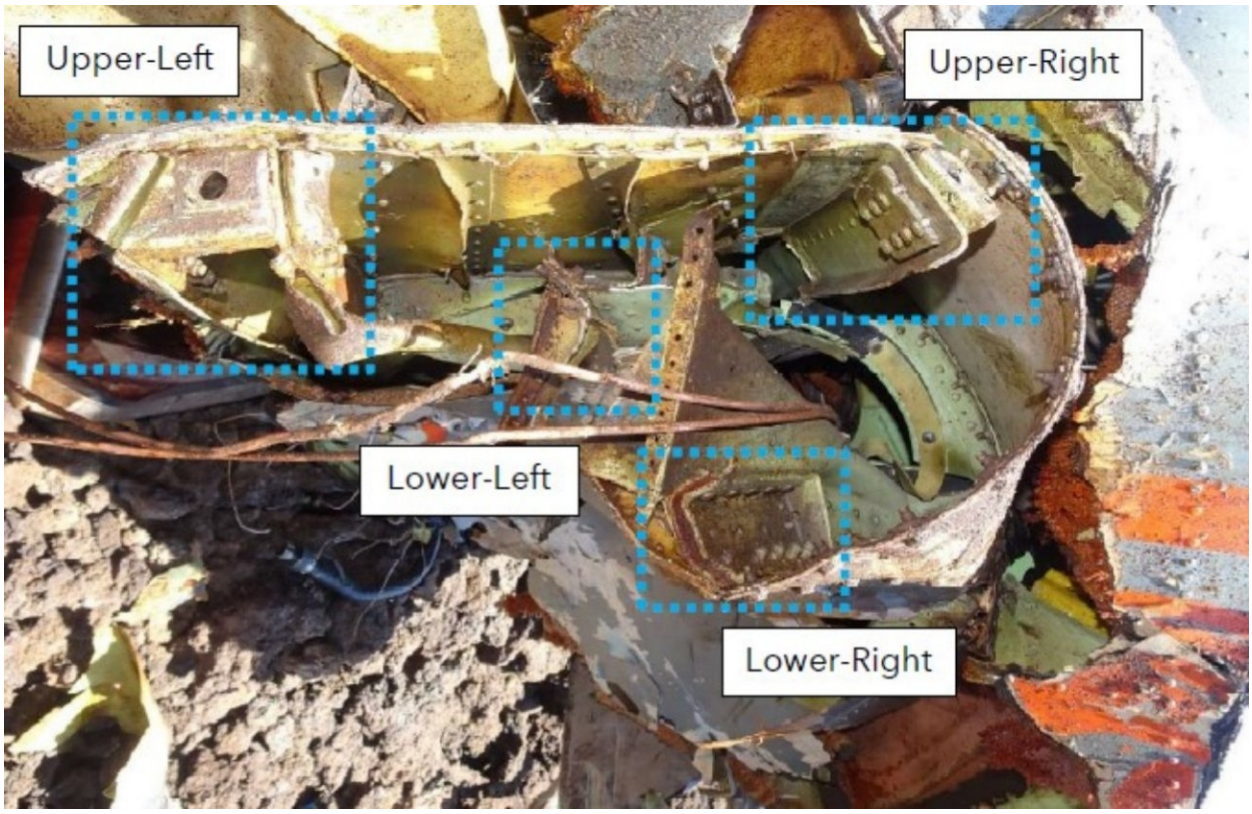

Figure 3. Aft fuselage at the accident site with the four longeron locations annotated.

Postaccident examination of the helicopter's rotor system, flight control system, and engine revealed no malfunctions or failures that would have occurred before the tail boom separation.

Portions of the tail boom structure, aft fuselage structure, attachment fittings and fasteners were retained for further examination by the NTSB's Materials Laboratory.

Disassembly of the Fractured Fittings

Significant deformation was observed throughout the tail boom-to-aft fuselage attachment structure. Examination of the upper-right, lower-left, and lower-right attachment hardware assemblies found their installation consistent with the requirements of the Bell 407 maintenance manual. Additionally, there was no evidence of corrosion preventative compound (CPC) on the exposed threads. Measurement of the attachment hardware torque found the upper-right and lower-right assemblies was greater than the specified lower torque limit. The lower-right fitting was fractured adjacent to the attachment bolt; the fracture surfaces exhibited signatures of overload.

Once the bolts were disassembled from their respective fittings, the washers, nuts, and shank portion of the bolts were inspected for evidence of CPC. The countersunk washer under the head portion of the bolts, shank portion of the bolts, washers adjacent to the nuts, and shank portion of each bolt were covered with CPC. Small amounts of CPC were transferred to the

threads as the washers were removed from the bolts.

The forward face of the fuselage frame in the area of the upper-left fitting contained a black paste-like deposit, consistent with CPC that was exposed to the environment and engine exhaust, whereas the areas that corresponded to the remaining fittings exhibited clean CPC. The aft face of the fuselage frame in the area of the upper-left fitting and the mating forward face of the tail boom bulkhead showed evidence of fretting. Evidence of sealant was noted on the faying surface between the aft fuselage bulkhead and upper-left longeron aft face.

Upper-Left Fitting

The upper-left fitting remained attached to the longeron on the upper fuselage structure and showed no evidence of a crack or fracture. Examination of the bolt hole revealed evidence of circumferential gouge and impression marks to include fretting, black and brown deposits consistent with iron oxide, and corrosion pits. The marks were more severe on one side of the hole, and the fretting and pitting corrosion was not uniform around the hole circumference.

Lower-Left Fitting

Examination of the lower-left fitting revealed the fracture face contained evidence of crack arrest marks typical of fatigue cracking that emanated from two separate areas, identified as O1 and O2 (see figure 4). Scanning electron microscope examination revealed that fatigue crack O1 emanated from multiple origins at the outer surface at an area that was located slightly forward of the inner transition radius of the diagonal wall member portion of the fitting. The fatigue origin contained no evidence of pitting corrosion. Fatigue propagation was down and through the wall then extended to the right of the fitting. The 1-inch fatigue crack contained alternating fatigue crack and overstress features.

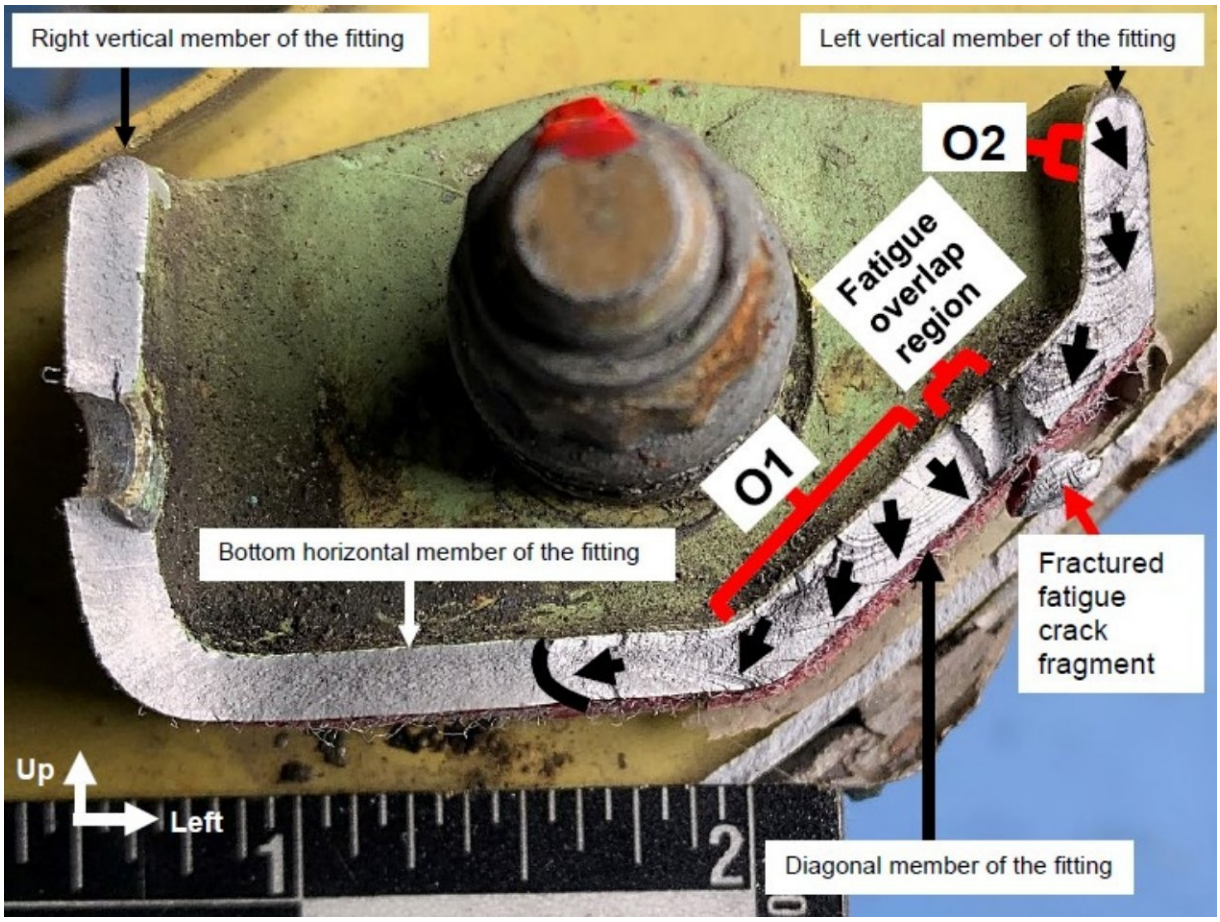

Figure 4. Fractured lower left fitting showing fatigue cracking indicated by brackets "O1" and "O2".

Fatigue crack O2 emanated from a corrosion pit at the outer surface in an area slightly forward of the inner transition radius near the upper right end of the fitting. The fatigue crack propagated through the wall and then extended down where it intersected the left edge of fatigue crack O1. The 0.75-inch fatigue crack region contained alternating fatigue crack and overstress features. The bolt hole showed evidence of severe spiral gouge marks and fine spiral scratches. The spiral gouge marks did not extend all around the bore.

Upper-Right and Lower-Right Fittings

The fracture faces of both the upper-right and lower-right fittings exhibited a rough texture on slanted planes consistent with overstress separation. The lower-right fitting showed evidence of severe spiral gouge marks and fine spiral scratches. The spiral gouge marks did not extend all around the bore. The upper-right fitting showed a circumferential gouge mark, fine circumferential scratches, and an isolated area of fretting.

Fuselage Frame Bolt Holes

The upper-left bolt hole contained circumferential gouge and impression marks. The marks

were more severe on one side of the hole. The remaining bolt holes in the fuselage frame showed no evidence of circumferential gouge marks or impressions.

The attachment bolts for the fittings were specified as NAS627 bolts. This specification indicated the hardness of a bolt was to be between 39 and 43 on the Rockwell C hardness scale (HRC). Rockwell hardness testing produced hardness values that were within the specified range for the upper-right and lower-left bolts; the hardness value for the lower-right bolt exceeded the upper limit by one hardness point (measuring 44 HRC). The material grade for the bolts complied with those specified by NAS627. The grip length and diameter of the bolts were within the specified ranges, and the washer inner and outer diameters were within specified range.

Tests and Research

As a result of the accident, the operator elected to replace the tail boom attachment hardware on their remaining five Bell 407 helicopters as a precautionary measure. The operator performed a torque check of all installed attachment hardware and reported no evidence of anomalous torque values or damage of the attachment hardware after their removal.

In addition, the operator performed an eddy-current nondestructive inspection on the aft fuselage longerons as another precautionary measure. The inspections found crack indications on two helicopters. On one helicopter, the crack indications were identified on the aft faying surface of the lower-left longeron at the bolt hole and within the bolt hole of the upper-left longeron. On the other helicopter, the crack indications were identified on the outboard surface of the outboard longitudinal channel of the upper-right longeron, on the inboard surface of the outboard longitudinal channel of the upper-left longeron, and on the lower surface of the outboard longitudinal channel of the upper-left longeron.

According to Bell, there was one reported previous occurrence of a fractured tail boom attachment bolt. Metallography of the fractured bolt found multiple-origin fatigue cracking through about 2/3 of the fracture cross-section, with the remainder of the fracture cross-section in overload. The location of the fracture on the bolt was estimated to be co-located with the aft face of the aft fuselage bulkhead. The fractured bolt was found during a 300-hour recurring torque check. The Bell Field Investigations Lab report that documented the fractured attachment bolt stated that the operator observed a gap between the aft fuselage bulkhead and the upper-left longeron as well as misalignment of the upper-left longeron bolt hole and a work aid to locate the aft fuselage longeron bolt holes. Since the bolt had been installed, four 300-hour recurring torque checks were performed, with the upper-left bolt found fractured

during the fourth check; about 297 flight hours had elapsed since the last torque check. Based on information provided by the operator, the upper-left longeron was replaced about 1,163 flight hours and 24 months before the detection of the fractured upper-left attachment bolt.

According to Bell, there was one reported occurrence of fatigue cracking of the aft fuselage lower-left longeron (on the radius that is adjacent to the bolt hole). The operator provided the Bell Field Investigations Lab with the lower-left longeron for examination. The fatigue crack was found on the forward face of the lower-left longeron attachment fitting (opposite the face that contacts the aft fuselage bulkhead). Metallography of the lower-left longeron found the fatigue origin was located at a corrosion pit within the lower-left longeron transition radius to the attachment bolt fitting. Other corrosion pits were found near the origin location. According to the Field Investigations Lab report, the occurrence helicopter had an airframe total time of 5,310 hours at the time the crack was discovered.

Additional Information

Postaccident Actions

On December 1, 2022, based on the findings of this investigation, the NTSB issued four urgent safety recommendations (two each to the Federal Aviation Administration [FAA] and Transport Canada [TC]). These recommendations (A-22-28 through -31) asked both regulators to require operators of Bell 407 helicopters to conduct 1) an immediate torque check of the tail boom attachment hardware and visual inspection of the tail boom attachment fittings for evidence of cracks and fractures and to report findings to the respective regulator and 2) subsequent torque checks and visual inspections at an interval significantly less than the currently required 300-hour interval until the causal factors that led to the separation of the upper-left attachment hardware (this accident) could be determined.

On December 8, 2022, Bell issued Alert Service Bulletin (ASB) 407-22-128 for a one-time torque check and inspection of the tail boom attachment hardware and fittings as well as reporting (to Bell) the findings from these actions. Subsequently, TCCA issued Airworthiness Directive (AD) CF-2022-68 on December 15, 2022, effective December 29, 2022, and the FAA issued AD 2022-27-08 on December 28, 2022, effective January 12, 2023. Both ADs required accomplishment of the Bell ASB though with compliance times that did not ensure immediate action as recommended (as of the publishing of this report, A-22-28 to the FAA is classified Closed—Unacceptable Action and A-22-30 to TC is classified Open—Unacceptable Response).

Neither AD required any further action subsequent to the one-time inspection, which was not responsive to the NTSB's recommendation for recurring checks and inspections (as of the publishing of this report, A-22-29 to the FAA and A-22-31 to TC are classified Open—Unacceptable Response).

On March 28, 2023, Bell provided the NTSB, FAA, and TCCA with a summary of the reported responses to the aforementioned actions. The Bell 407 worldwide fleet, inclusive of all series, was estimated at 1,546 helicopters. As of March 10, 2023, Bell had received a total of 554 responses, 14 of which reported anomalous findings. According to Bell, none of the anomalous findings involved a fractured bolt or a gross loss of torque, but several failed the torque check near their required torque value. Of the reported anomalous findings for attachment hardware torque, two were at the upper-left location, none were at the upper-right location, nine were at the lower-left location, and four were at the lower-right location. Of the total results of the reported movement of the fasteners, none were characterized as significantly below installation torque. For structural damage found on the attachment fittings, there was one report each for the upper-left and upper-right locations.

On January 12, 2024, TCCA informed the NTSB of an additional occurrence of a fractured upper-left tail boom attachment bolt that was discovered during a 300-hour torque check. For further information, reference NTSB investigation ENG23LA045.

Administrative Information

Investigator In Charge (IIC):	Sauer, Aaron
Additional Participating Persons:	David Keenan; FAA; Washington , DC Keri Wright; Paradise Helicopters; Kailua-Kona, HI Jack Johnson; Rolls Royce; Indianapolis, IN
Original Publish Date:	January 30, 2024
Last Revision Date:	January 31, 2024
Investigation Class:	Class 3
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=105233