Aviation Investigation Final Report

Location:	Key West, Florida	**Accident Number:**	CEN19LA174
Date & Time:	June 17, 2019, 19:50 Local	**Registration:**	N1241W
Aircraft:	Robinson R44	**Aircraft Damage:**	Substantial
Defining Event:	Flight control sys malf/fail	**Injuries:**	3 None
Flight Conducted Under:	Part 91: General aviation - Aerial observation		

Analysis

Shortly after departure, the pilot detected rapid vibrations from the tail of the helicopter. While returning to the airport, the mounting bolts that secured the tail rotor gearbox to the tail boom failed, which resulted in the separation of the tail rotor. The pilot lost yaw control of the helicopter, but successfully performed an autorotation to the water below.

A postaccident examination of the mounting hardware between the tail rotor gearbox input cartridge and the tail boom mating flange found that two of the four bolts were missing; both missing bolts came from the right side of the connection. The left side bolts remained secured in place. The missing bolts' holes in the input cartridge were deformed and were out of round. All of the 4 bolt holes on the input cartridge displayed imprints from the bolt threads, with the deepest imprints on the right sides of the holes, consistent with movement between the lug holes and the bolt shanks. All tail boom flange bolt holes were examined and found that the threading was present, not stripped, and locking inserts present.

About 60 hours before the accident, the tail boom assembly was removed and replaced. As part of this maintenance, the tail rotor input cartridge and gearbox would have been removed from the old tailboom and placed on the new tailboom. It is likely that, during this procedure, the right-side mounting bolts were not completely secured to the tail boom casting locking inserts and properly torqued, which resulted in the failure of the right side mounting bolts.

The helicopter was flown earlier that day without incident or indication of impending failure.

Probable Cause and Findings

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

The failure of maintenance personnel to properly secure the right-side tail boom mounting bolts which resulted in the failure of the bolts and an inflight separation of the tail rotor.

Findings

Aircraft	(general) - Failure
Aircraft	(general) - Incorrect service/maintenance

Factual Information

History of Flight

Initial climb	Flight control sys malf/fail (Defining event)
Prior to flight	Aircraft maintenance event

On June 17, 2019, about 1950 eastern standard time, a Robinson R44 helicopter, N1241W, was substantially damaged when it was involved in an accident near Key West, Florida. The pilot and two passengers were not injured. The helicopter was operated as a Title 14 *Code of Federal Regulations* Part 91 revenue sightseeing flight.

In a statement provided by the pilot, he flew the helicopter earlier that day without any unusual indications. He washed and dried the helicopter, inspecting the helicopter as he performed the task. He departed the airport and entered the right crosswind pattern. As the helicopter climbed through 300 ft above ground level, the pilot detected "rapid tail vibrations." The pilot radioed tower and requested a return to the airport. He proceeded back to the airport when he heard a loud pop and felt a "hard" right yaw. Attempts to regain control of the helicopter with the anti-torque pedals were ineffective. He initiated an autorotation, and the helicopter began to yaw to the left. Again, attempts to regain control of the helicopter were ineffective. As the helicopter descended toward the water, the pilot deployed the floats, and landed the helicopter upright on the water without further incident.

Examination of the helicopter revealed that the tail rotor assembly had separated from the tail boom in flight, resulting in substantial damage. The tail rotor assembly was damaged where the tail rotor gearbox input cartridge and tail boom flange mate. Examination of the two surfaces at the National Transportation Safety Board Materials Laboratory revealed all input cartridge lugs and flange pieces were accounted for. The top left side mounting lug had the fractured mating tail boom flange still secured in place via a bolt. The fracture surface was consistent with overstress. The bottom port side of the tail boom flange had the fractured portion of the mating input cartridge still secured in place via a bolt. The fracture surface was consistent with overstress.

The tail boom casting that attaches the tail rotor gearbox to the tail boom had all four locking inserts threaded into the four casting bolt holes. New, unused bolts were obtained and utilized to test the locking capability of the inserts in the tail boom bolt holes. The bolts were hand-tightened, and a torque wrench determined that each bolt reached 35 to 40 in-lbs when halfway threaded, which was the expected range for the drag effect once the locking insert was engaged. After removal and re-assembly, the bolts were fully inserted and torqued to the manufacturer required 240 in-lbs. All the bolt bottom surfaces aligned with the edge of the locking insert, which was about 3 to 4 threads into the hole from the inboard surface. All the bolts locked inside the inserts as designed.

The input cartridge bolt holes were examined and found to be deformed in the holes of the two right side input cartridge mounting lugs which were missing their respective bolts. In addition, they were out of round and had a ridge of material circumferentially around the edge of the outboard face. All the bolt

holes had damage around the inner diameter that appeared to be imprints from the threads of the mating bolts; the deepest imprints were observed on the top right side lug hole. All tail boom flange bolt holes were examined and found that the threading was present and not stripped, although there was some damage observed.

The helicopter was last inspected on May 10, 2019, at a total aircraft time of 1,523.75 hours. At that time, the tail boom was replaced. Replacement of the tail boom would have involved removal of the tail rotor gearbox and reattaching it to the new tail boom. Following the replacement of the tail boom, the pilot reported rapid tail rotor vibrations which required multiple attempts to successfully balance the tail rotor as part of the post maintenance checks. The helicopter had flown about 60 hours since the inspection without any discrepancies.

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	29,Male
Airplane Rating(s):	None	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	3-point
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Helicopter; Instrument helicopter	**Toxicology Performed:**	No
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	May 23, 2019
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	January 8, 2018
Flight Time:	1430.1 hours (Total, all aircraft), 1273.8 hours (Total, this make and model), 1341.1 hours (Pilot In Command, all aircraft), 81.6 hours (Last 90 days, all aircraft), 24.8 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Robinson	**Registration:**	N1241W
Model/Series:	R44 Undesignat	**Aircraft Category:**	Helicopter
Year of Manufacture:	2016	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	2445
Landing Gear Type:	N/A; Emergency float; High skid	**Seats:**	4
Date/Type of Last Inspection:	May 10, 2019 Annual	**Certified Max Gross Wt.:**	2400 lbs
Time Since Last Inspection:	60 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	1584 Hrs at time of accident	**Engine Manufacturer:**	Lycoming
ELT:	C126 installed, activated, did not aid in locating accident	**Engine Model/Series:**	O-540-F1B5
Registered Owner:	Pumpkin Eater Llc	**Rated Power:**	225
Operator:	Air Adventures Helicopters	**Operating Certificate(s) Held:**	Certificate of authorization or waiver (COA)

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KEYW,1 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	19:53 Local	**Direction from Accident Site:**	58°
Lowest Cloud Condition:		**Visibility**	10 miles
Lowest Ceiling:		**Visibility (RVR):**	
Wind Speed/Gusts:	11 knots /	**Turbulence Type Forecast/Actual:**	None /
Wind Direction:	120°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.03 inches Hg	**Temperature/Dew Point:**	28°C / 26°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Key West, FL (EYW)	**Type of Flight Plan Filed:**	None
Destination:	Key West, FL (EYW)	**Type of Clearance:**	VFR
Departure Time:	19:50 Local	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	2 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 None	**Latitude, Longitude:**	24.551666,-81.764442(est)

Administrative Information

Investigator In Charge (IIC):	Aguilera, Jason
Additional Participating Persons:	Brooks Bateman; FAA FSDO; Miramar, FL Thom Webster; Robinson Helicopter Company; CA
Original Publish Date:	March 3, 2022
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=99664