National Transportation Safety Board
Aviation Accident Final Report

Location:	Avalon, Texas	**Accident Number:**	CEN12LA525
Date & Time:	August 7, 2012, 08:45 Local	**Registration:**	N409SB
Aircraft:	Bell 214ST	**Aircraft Damage:**	Substantial
Defining Event:	Flight control sys malf/fail	**Injuries:**	2 None
Flight Conducted Under:	Part 91: General aviation - Flight test		

Analysis

The helicopter was on its third test flight when the tail rotor 90-degree gearbox broke in two and separated from the helicopter. The crew conducted an autorotation to a field, and the helicopter came to rest on its side. Examination of the helicopter and components revealed that one of the tail rotor's two counterweight bellcranks and associated hardware were missing. Impact marks consistent with a counterweight bellcrank were found at the base of its associated tail rotor blade and on the aft right side of the helicopter. The remaining counterweight bellcrank was in place; however, the cotter pin for the castellated nut was missing. A review of the aircraft maintenance records revealed that the tail rotor assembly had been removed and reinstalled after the installation of test instrumentation. The maintenance records lacked specific details on whether the unit and its components were previously handled as a subassembly or as individual components when the tail rotor assembly was initially removed. Because the records did not indicate whether the unit should be handled as individual parts, the tail rotor was reinstalled as a complete subassembly, meaning that individual components, such as the nut and cotter pin, were not individually inspected before or after reinstallation on the helicopter. Reinstalling the tail rotor assembly in this manner led to the counterweight bellcrank retaining nut not being properly torqued and secured with a cotter pin.

Probable Cause and Findings

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

Maintenance personnel's failure to properly torque the retaining nut and install the cotter pin that secured the helicopter's tail rotor counterweight bellcrank. Contributing to the accident was the lack of detailed maintenance records that documented previous maintenance actions.

Findings

Aircraft	Tail rotor drive shaft - Failure
Personnel issues	Installation - Maintenance personnel
Organizational issues	Maintenance records - Operator

Factual Information

On August 7, 2012, about 0845 central daylight time, a Bell 214ST helicopter, N409SB, experienced a loss of tail rotor authority near Avalon, Texas. The commercial and airline transport pilots were not injured during the precautionary landing, and the helicopter was substantially damaged. The helicopter was owned and operated by Bell Helicopter, Textron, Inc. Fort Worth, Texas, under the provisions of 14 Code of Federal Regulations Part 91 as a research and development flight. Day visual meteorological conditions prevailed for the local flight which operated without a flight plan. The local flight originated from the Arlington Municipal Airport (KGKY), Arlington, Texas at 0815.

According to the pilots the purpose of the flight was to collect data on the helicopter's rotor system. During the flight test, the helicopter completed a right turn and as they were setting up for another test condition, the pilot's heard a "bang," and felt the helicopter yaw. The pilot of the chase aircraft reported that something had departed the tail of the helicopter. The accident pilots then initiated an autorotation to a nearby field; however, helicopter yawed, rolled right, and came to rest on its side.

The helicopter, the tail rotor gear box, and tail rotor blades were recovered and transported back to a Bell facility. Representatives from the NTSB, Federal Aviation Administration (FAA), and Bell Helicopter, then examined the helicopter and components at the manufacturer's facility.

The tail rotor's 90-degree gear box was broken in two; one of the mast's two counterweight bellcranks and associated hardware were missing (and not located/recovered from the accident site); the remaining counterweight bellcrank remained attached. Examination of the remaining counterweight bellcrank, revealed that the assembly was in place, but "loose". The dustcap/grease cover for the remaining counterweight bellcrank was removed, exposing the castellated nut. The examination found that the nut's cotterpin was missing.

Both tail rotor blades' attachments remained in place; both blades had separated outboard of their respective attachments. On the side with the missing counterweight bellcrank, impact marks consistent with the size and shape of a counterweight bellcrank, were found on the edge and base of its associated tail rotor blade, as well as on the right side of the helicopter. The rotor blade was torn in two, with the separation starting near the impact marks at the base of the blade.

Since the accident helicopter was used to collect data on a new rotor system, the tail rotor blades and components had been removed to install test instrumentation. A review of the helicopters' maintenance workbook revealed the temporary re-installation of the instrumented tail rotor section. However, the maintenance entry was not specific as to whether the reinstallation of the instrumented tail rotor assembly was conducted as an assembly or as individual components. The mechanics installing the instrumented tail rotor treated the unit as a complete sub-assembly and not as individual components. The difference meant that the individual components were not assembled or inspected, prior to or after installation onto the helicopter.

The helicopter was on its third flight after the reinstallation of the instrumented tail rotor system and had accumulated about 2.8 flight hours, before the accident.

History of Flight

Maneuvering	Flight control sys malf/fail (Defining event)
Maneuvering	Part(s) separation from AC
Landing	Off-field or emergency landing
Landing-flare/touchdown	Roll over

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	52
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter; Powered-lift	**Restraint Used:**	Unknown
Instrument Rating(s):	Airplane; Helicopter; Powered-lift	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Helicopter; Instrument airplane; Instrument helicopter; Powered-lift	**Toxicology Performed:**	No
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	February 23, 2012
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	6597 hours (Total, all aircraft), 2.7 hours (Total, this make and model), 3918 hours (Pilot In Command, all aircraft), 18.7 hours (Last 90 days, all aircraft), 5.3 hours (Last 30 days, all aircraft), 0.6 hours (Last 24 hours, all aircraft)		

Co-pilot Information

Certificate:	Airline transport; Commercial; Flight instructor	**Age:**	39
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	Unknown
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	Yes
Instructor Rating(s):	Helicopter; Instrument helicopter	**Toxicology Performed:**	No
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	April 17, 2012
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	April 15, 2012
Flight Time:	3100 hours (Total, all aircraft), 2.7 hours (Total, this make and model), 2600 hours (Pilot In Command, all aircraft), 35 hours (Last 90 days, all aircraft), 12 hours (Last 30 days, all aircraft), 0.6 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Bell	**Registration:**	N409SB
Model/Series:	214ST	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	28199
Landing Gear Type:	Tricycle	**Seats:**	18
Date/Type of Last Inspection:		**Certified Max Gross Wt.:**	
Time Since Last Inspection:		**Engines:**	2 Turbo shaft
Airframe Total Time:		**Engine Manufacturer:**	General Electric
ELT:	Installed, not activated	**Engine Model/Series:**	CT7-2A
Registered Owner:		**Rated Power:**	
Operator:		**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KGKY	**Distance from Accident Site:**	
Observation Time:	08:53 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:		**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.96 inches Hg	**Temperature/Dew Point:**	29°C / 19°C
Precipitation and Obscuration:			
Departure Point:	Arlington Muni, TX (KGKY)	**Type of Flight Plan Filed:**	Company VFR
Destination:	Arlington Muni, TX (KGKY)	**Type of Clearance:**	VFR
Departure Time:	08:15 Local	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	2 None	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 None	**Latitude, Longitude:**	32.273887,-96.76583(est)

Administrative Information

Investigator In Charge (IIC):	Hatch, Craig
Additional Participating Persons:	Tony Baumgard; FAA FSDO; Dallas, TX William Sarles; Bell Helicopter, Inc; Fort Worth, TX
Original Publish Date:	March 24, 2014
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=84595