Aviation Investigation Final Report

Location:	CROSSETT, Arkansas	**Accident Number:**	FTW97LA264
Date & Time:	July 13, 1997, 05:50 Local	**Registration:**	N83701
Aircraft:	Bell 47G-3B-1	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	1 Serious
Flight Conducted Under:	Part 91: General aviation - Positioning		

Analysis

The pilot (plt) said that during flight, he 'heard and felt flutter in the tail rotor.' He began an emergency descent, & about 25' above power lines, the helicopter (hel) began yawing (spinning) to the right. After 7 to 9 'revolutions,' the plt 'pulled pitch' to cushion impact. The hel landed hard in a ditch & was damaged (fuselage was bent & tail boom was twisted). An exam revealed the forward portion of the tail rotor drive shaft was disconnected from the transmission. The disconnect was due to an increase in distance between the forward & aft female couplings of the shaft. The increased distance was due to a fractured longeron tube on the upper left side of the fuselage center frame. The tube extended aft from airframe station -2.0 (where the left side engine Lord mount was bolted to the center frame) to the tube cluster at station -50.99. The fracture was not readily visible due to the tube's location behind a crop-spraying tank. Further exam revealed the crack was due to fatigue that originated at the toe of a weld for a gusset. Heavy corrosion & pitting on the fracture surface suggested the crack had been developing for some time. Records showed the center frame was manufactured as part of the hel; the hel was originally delivered as a U.S. Army TH-13T on 10/31/68.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: failure of maintenance personnel to perform an adequate inspection of the fuselage center frame and detect a fatigue fracture of a longeron tube on the upper left side of the center frame, which resulted in a disconnect of the tail rotor drive shaft from the transmission, loss of yaw (anti-torque) control, and a subsequent hard (emergency) landing. A related factor was the lack of suitable terrain for a forced landing.

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: DESCENT

Findings
1. (C) FUSELAGE,LONGERON - FATIGUE
2. (C) FUSELAGE,LONGERON - CRACKED
3. (C) MAINTENANCE,INSPECTION - INADEQUATE - OTHER MAINTENANCE PERSONNEL
4. (C) ROTOR DRIVE SYSTEM,TAIL ROTOR DRIVE SHAFT - DISCONNECTED

Occurrence #2: FORCED LANDING
Phase of Operation: EMERGENCY DESCENT/LANDING

Findings
5. AUTOROTATION - PERFORMED - PILOT IN COMMAND

Occurrence #3: HARD LANDING
Phase of Operation: EMERGENCY LANDING

Findings
6. (F) TERRAIN CONDITION - DITCH
7. (F) TERRAIN CONDITION - NONE SUITABLE

Factual Information

On July 13, 1997, at 0550 central daylight time, a Bell 47G-3B-1 helicopter, N83701, was substantially damaged during a forced landing following a loss of tail rotor drive near Crossett, Arkansas. The airline transport rated pilot, the sole occupant, was seriously injured. The helicopter was registered to and operated by the pilot who was doing business as Prentice Aviation, Inc., of Bokchito, Oklahoma. Visual meteorological conditions prevailed and no flight plan was filed for the Title 14 CFR Part 91 local positioning flight that originated at 0545.

In a written statement and during a telephone interview conducted by the NTSB investigator-in-charge, the pilot reported that on July 12, 1997, during an aerial application flight in the helicopter, he was completing a climbing left turn when he "heard a pop and felt a very slight bump." He flew back to the heliport, landed, inspected the helicopter checking "all motor mounts, cables, rotor head, tail rotor drive shaft and tail rotor," and found no discrepancies. Following a 5 minute test flight during which the helicopter "ran and flew like always," he made "another ten or more" aerial application flights that day.

According to the pilot, the next morning, after performing a pre-flight inspection of the helicopter, he took off at 0545 and climbed to "about 500 feet" MSL. Approximately 5 minutes into the flight, he "heard and felt a flutter in the tail rotor which lasted about 2 seconds." He "immediately" started a descent and informed his ground crewman by radio that he was going to land at a heliport he had in sight which he had worked out of previously. The helicopter was "flying smooth and normal" as the pilot entered a left descending turn to set up for the landing. While passing approximately 25 feet above a power line, the helicopter "made a HARD turn to the right and continue[d] turning." The pilot initially "held pitch" in order to remain clear of the power line, and then after passing the power line, "lowered the collective." He estimated that the helicopter made "3 revolutions above the power lines" and "4 to 6 more revolutions" during the autorotation. Upon seeing the ground, he "pulled pitch," and when the helicopter "hit the ground," he "realized the engine was still running and the blades were still rotating."

According to the FAA inspector who traveled to the scene of the accident, the helicopter came to rest in a ditch. The inspector reported that the tail boom was twisted, the skid crossover tubes were broken, and the bottom longerons of the fuselage were bent. He further reported that the forward tail rotor drive shaft was found disconnected from the transmission.

Following the on site examination by the FAA inspector, the helicopter was moved to Campbell Helicopter Service, a maintenance facility in Vivian, Louisiana. On July 24, 1997, another FAA inspector traveled to Vivian, removed the forward tail rotor drive shaft, P/N 47-644-232-13, and the aft female coupling for the shaft, P/N 47-644-130-11, from the helicopter, and forwarded these parts to the NTSB investigator-in-charge (IIC). The IIC hand-carried the parts to the facilities of Bell Helicopter in Fort Worth, Texas. Following initial examination of the parts, the

IIC requested that Campbell Helicopter Service personnel remove the tail rotor output quill assembly, P/N 47-620-631-35, which contained the forward female coupling for the forward tail rotor drive shaft, from the transmission and forward this part to the NTSB. When the quill assembly was received, the IIC hand-carried it to the facilities of Bell Helicopter.

Inspection of the parts revealed that the forward male coupling of the shaft had been operating on the aft third of the mating splines of the forward female coupling. The aft ends of all but one of the splines had fractured at the aft retainer ring groove. According to the Bell metallurgist, the fractures were a result of overstress. Wear had occurred on the aft internal retainer ring as a result of contact by the aft side of the male coupling.

The shaft and couplings were reassembled with the male couplings on the shaft centered in the wear patterns on the female couplings, and the distance between the faces of the female couplings was measured at 22.1 inches. According to the Bell Manual of Maintenance and Overhaul Instructions for the model 47G-3B-1, the distance between the faces of the female couplings should measure 21.75 plus or minus 0.030 inches. For a detailed description of the examination of these parts refer to the attached Bell Helicopter Engineering Laboratories report dated October 13, 1997.

At the request of the IIC, Campbell Helicopter Service personnel reexamined the helicopter in an attempt to discover the reason for the discrepancy in the 21.75 inch dimension. Their inspection revealed a fracture in a longeron tube on the upper left side of the helicopter's center frame. This fracture was not readily visible during earlier inspections of the helicopter due to its position behind the chemical tank mounted on the left side of the fuselage. The fractured tube extended aft from the tube cluster at station -2.0, where the center frame bolted to the left engine Lord mount, to the tube cluster at station -50.99. An 8 inch section of the tube, containing the fracture, was saw-cut from the center frame, forwarded to the NTSB, and hand-carried by the IIC to the facilities of Bell Helicopter.

Examination of the fracture by the Bell metallurgist revealed that it was a result of fatigue cracking. The fatigue cracking originated on the inboard side of the tube at the toe of a weld for a gusset. The metallurgist reported that relatively heavy corrosion and corrosion pitting had occurred on the fracture surface. For a detailed description of the examination of the fractured tube refer to the attached Bell Helicopter Engineering Laboratories report dated November 6, 1997.

The mechanic who sawed the section of tube from the center frame reported that the data plate on the frame identified it as a P/N 47-322-241-143 with S/N L31-1859. Research by Bell Helicopter indicated that this center frame was manufactured September 14, 1968, and delivered on a TH-13T helicopter to Fort Stewart, Georgia, on October 31, 1968. The TH-13T helicopter had the military serial number 67-17128 and the Bell Helicopter serial number 3835. The FAA airworthiness certificate listed the serial number of the accident helicopter as "3835 (67-17128)."

Examination of the helicopter's maintenance records by FAA inspectors revealed no evidence of any uncorrected maintenance discrepancies. According to one inspector, the "maintenance logbooks were in order and all time change components were within time change limits." The most recent annual inspection was performed on December 16, 1996, at a total time of 5,053 hours. The last logbook entry was dated June 2, 1997, at a total time of 5,124 hours, and stated, in part, "performed general maintenance on aircraft. Changed the engine oil." The FAA inspectors calculated that, when the accident occurred, the helicopter had accumulated a total time of 5,175 hours.

Review of the periodic inspection checklists in the Bell Manual of Maintenance and Overhaul Instructions for the model 47G-3B-1 revealed that the following item was listed for the 100 hour inspection:

Inspect all structural tubing and fittings for cracks, cuts, bends, corrosion, distortion and damage. Inspect protective coating on all tubing and refinish if necessary.

Pilot Information

Certificate:	Airline transport; Commercial	**Age:**	44,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane single-engine; Instrument airplane	**Toxicology Performed:**	No
Medical Certification:	Class 2 Valid Medical--no waivers/lim.	**Last FAA Medical Exam:**	July 8, 1996
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	19530 hours (Total, all aircraft), 5258 hours (Total, this make and model)		

Aircraft and Owner/Operator Information

Aircraft Make:	Bell	**Registration:**	N83701
Model/Series:	47G-3B-1 47G-3B-1	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Restricted (Special)	**Serial Number:**	3835
Landing Gear Type:	Skid	**Seats:**	3
Date/Type of Last Inspection:	December 16, 1996 Annual	**Certified Max Gross Wt.:**	2950 lbs
Time Since Last Inspection:	122 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	5175 Hrs	**Engine Manufacturer:**	Lycoming
ELT:		**Engine Model/Series:**	VO-435
Registered Owner:	WALTER L. PRENTICE	**Rated Power:**	275 Horsepower
Operator:		**Operating Certificate(s) Held:**	
Operator Does Business As:	PRENTICE AVIATION, INC.	**Operator Designator Code:**	TDZG

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Dawn
Observation Facility, Elevation:		**Distance from Accident Site:**	
Observation Time:		**Direction from Accident Site:**	
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	0°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:		**Temperature/Dew Point:**	22°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	(NONE)	**Type of Flight Plan Filed:**	None
Destination:		**Type of Clearance:**	None
Departure Time:	05:45 Local	**Type of Airspace:**	Class G

Airport Information

Airport:		**Runway Surface Type:**	
Airport Elevation:		**Runway Surface Condition:**	
Runway Used:	0	**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 Serious	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Serious	**Latitude, Longitude:**	33.119609,-91.959625(est)

Administrative Information

Investigator In Charge (IIC):	Snyder, Georgia
Additional Participating Persons:	CURTIS L WEEDMAN JR.; LITTLE ROCK , AR DAVID C DOSKER; FORT WORTH , TX
Original Publish Date:	June 26, 1998
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=20278