Aviation Investigation Final Report

Location:	LOST HILLS, California	**Accident Number:**	LAX99LA283
Date & Time:	August 24, 1999, 23:00 Local	**Registration:**	N999SJ
Aircraft:	Bell UH-1B	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	1 None
Flight Conducted Under:	Part 137: Agricultural		

Analysis

During the takeoff initial climb as the helicopter accelerated through 25 to 30 miles per hour, the 90-degree gearbox fractured through the center of the gearbox case and separated from the tailboom. The pilot was able to slow the spin rate and performed a hovering autorotation. A portion of the tail boom impacted a barbed wire fence as the helicopter settled vertically. Metallurgical examination of the gearbox case fractures disclosed overload features. Internal examination of the gearbox and gears showed that the pinion and gear teeth had disengaged. The disengagement lasted a short period of time. As a result of the disengaged gear and pinion rotating against each other, the gearbox case became overloaded and subsequently separated. The wear patterns on the pinion and gear teeth drive side did not meet the patterns specified in the maintenance manual; the patterns extended off the toe ends and the tips of the teeth. The gearbox, which is an 'on-condition' component, was last overhauled or repaired in 1984. There is no requirement for an internal inspection of the tail rotor gearbox during routine or annual maintenance inspections.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: Failure and separation of the 90-degree gearbox as a result of the disengagement of the pinion and gear teeth. The cause(s) of the pinion and gear disengagement were undetermined.

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: TAKEOFF - INITIAL CLIMB

Findings
1. (C) ROTOR DRIVE SYSTEM,TAIL ROTOR GEARBOX(90 DEG) - DISENGAGED
2. (C) REASON FOR OCCURRENCE UNDETERMINED
3. (C) ROTOR DRIVE SYSTEM,TAIL ROTOR GEARBOX(90 DEG) - SEPARATION

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

Findings
4. AUTOROTATION - PERFORMED - PILOT IN COMMAND

Occurrence #3: IN FLIGHT COLLISION WITH OBJECT
Phase of Operation: EMERGENCY DESCENT/LANDING

Findings
5. OBJECT - FENCE

Factual Information

HISTORY OF FLIGHT

On August 24, 1999, at 2300 hours Pacific daylight time, a Bell UH-1B, N999SJ, experienced a failure and separation of the 90-degree gearbox during the initial takeoff climb and landed hard in a field near Lost Hills, California. The helicopter, operated by San Joaquin Helicopters, Delano, California, was substantially damaged. The airline transport pilot, the sole occupant, was not injured. The aerial application flight was being conducted under the provisions of 14 CFR Part 137 and was originating from the field at the time of the accident. Night visual meteorological conditions prevailed and no flight plan was filed.

The pilot reported that he was in the process of spraying pesticide on a field of pistachio trees, making north-south swath runs and using left pedal turns at the end of each row. He stated that there was a crosswind from the west. On the last run before reloading the helicopter, he felt a high frequency vibration in the tail rotor pedals. As he turned toward the east, the vibration ceased. The pilot reported that he attributed the vibration to the crosswind; he had not experienced any problems with the helicopter prior to the vibration onset.

The pilot landed and the helicopter was reloaded with pesticide and refueled while the engine and rotors were idling. Three ground crewmembers assisted with the fueling and loading of the helicopter. The ground supervisor performed a walk-around inspection of the aircraft, and stated that he didn't notice any fluid leaks or hear any unusual sounds while the helicopter was on the ground.

The pilot took off and was accelerating through effective translational lift when he felt a momentary vibration and heard a "bang." The helicopter yawed to the right and completed two 360-degree turns in a level attitude. The pilot slowed the aircraft and entered a hovering autorotation by rolling the throttle back to flight idle. He reported that the spin did not stop completely but it did slow down.

As the helicopter began a third revolution the tail boom just aft of the horizontal stabilator impacted a barbed wire fence and the helicopter settled vertically to the ground. After landing, the pilot completed a normal shutdown of the engine. As he exited the helicopter, he heard a "thud." He walked around to the tail of helicopter and noticed that the 90-degree gearbox had broken off through the center of the gearbox case. The fracture was at approximately a 30-degree angle and extended from a stud hole near the lower oil sight level glass to a stud hole near the upper oil filler neck. The tail rotor blades and rotating components remained attached to the output quill case section of the gearbox, which had fallen to the ground under the tail boom. The input section of the tail rotor main gearbox remained attached to the tail boom.

TESTS AND RESEARCH

The gearbox and tail rotor rotating components were examined at the Bell Helicopter Textron laboratory in Fort Worth, Texas, under the supervision of Safety Board investigators. A copy of the metallurgy report is appended to this file.

Inspection revealed that the main case fracture extended from two cracks that met near the upper side of the case. The longest part of the fracture extended from the lower stud. The metallurgist inspected the area of the lower stud and concluded that it was a result of overstress. The overstress fracture progressed from the area of the lower stud across the sight glass port and up the case. The fracture then branched from near its upper end and progressed through the oil filler port.

Another crack, also determined by the metallurgist to be overstressing, occurred at the upper stud and progressed to the crack at the oil filler port. A third crack, which did not extend into the main fracture, was found at the oil filler port. This crack extended from the bottom of the upper stud hole toward the top of the filler port.

Microscopic examination with optical and scanning electron microscopes revealed multiple indentations in the thread area for the upper stud. The metallurgist reported that these indentations were made by the stud threads as the stud moved in the stud hole as the fracture progressed toward the oil filler port and the cases were moving apart.

Two studs and a shim plate screw located in the forward portion of the input side of the main case were fractured. The direction of the overstress fractures in the studs and screw were downward.

It was observed that the toe ends of the gear teeth had rotated against the pinion bearing housing after it moved out of position. This contact locally "machined" that area. Imprints of the ends of the gear teeth were also made in the contact area. The metallurgist reported that the imprints appeared to have been made with no rotation of the gear.

Inspection of the gearbox assembly revealed that the pinion and gear had disengaged and the tips of the teeth had been chipped and smeared from rotating against each other while out of mesh. There was no evidence of overheating.

The wear patterns on the drive sides of the pinion and gear teeth drive surfaces did not meet the patterns specified in the maintenance manual; the patterns extended off the toe ends and the tips of the teeth.

The tail rotor pitch change rod that ran through the mast had a rubbed area near the inboard end. The inboard end of the tail rotor mast had contacted the rubbed area. The nut threads and cotter pin at the outboard end had been sheared. The rod was bent.

Inspection of the tail rotor blades' leading edges revealed that they both had indentations near the blade tips. The "red" tail rotor blade displayed debonding of the abrasion strip at the tip block in association with two indentations.

The tail rotor pitch links were measured for length as specified by the maintenance manual. The red pitch link length was found to be 5.48 inches and the white pitch link was 5.42 inches long. The manual specified that the initial length of the pitch links was to be set at 5.42-inches, with one link shortened during the tracking of the tail rotor blades. The manual indicated that one link could be shorter than 5.42-inches, but not longer.

The tail rotor yoke was checked with a coordinate-measuring machine to determine if it had been bent. The angles of the spindles, with respect to each other and to the center of the yoke, were within the engineering drawing requirements. There was no evidence that the yoke had been bent.

ADDITIONAL INFORMATION

Records revealed that the helicopter was manufactured on October 13, 1964, and was subsequently delivered to the Australian military on November 9, 1964. The operator reported that they had purchased the helicopter in 1990. According to the records, it appeared that the last time the gearbox had been overhauled or repaired was in 1984 while in service with the Australian military. According to Bell Helicopters, the gearbox is an "on-condition" component, with no specific replacement or overhaul schedule. The operator's maintenance logs showed that the last annual inspection on the helicopter had been performed on April 24, 1999. At that time, the 90-degree gearbox was inspected as per the annual inspection checklist. The list requires the mechanic to check the gearbox attachment fitting for cracks, corrosion, and security, and to check the gearbox for "oil level, leaks and security, chip detector for security and proper operation, vent for obstruction, drain and service." No internal inspection of the gearbox is required during the annual inspection.

Pilot Information

Certificate:	Airline transport	**Age:**	55,Male
Airplane Rating(s):	None	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 Valid Medical--w/ waivers/lim	**Last FAA Medical Exam:**	February 9, 1999
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	11500 hours (Total, all aircraft), 6500 hours (Total, this make and model), 11000 hours (Pilot In Command, all aircraft), 90 hours (Last 90 days, all aircraft), 38 hours (Last 30 days, all aircraft), 6 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Bell	**Registration:**	N999SJ
Model/Series:	UH-1B UH-1B	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Restricted (Special)	**Serial Number:**	1025
Landing Gear Type:	Skid	**Seats:**	2
Date/Type of Last Inspection:	April 24, 1999 Annual	**Certified Max Gross Wt.:**	8500 lbs
Time Since Last Inspection:	43 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	7856 Hrs	**Engine Manufacturer:**	Lycoming
ELT:		**Engine Model/Series:**	T53-L11B
Registered Owner:	SAN JOAQUIN HELICOPTERS	**Rated Power:**	1200 Horsepower
Operator:		**Operating Certificate(s) Held:**	
Operator Does Business As:		**Operator Designator Code:**	CUFE

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night/bright
Observation Facility, Elevation:	BFL ,507 ft msl	**Distance from Accident Site:**	34 Nautical Miles
Observation Time:	22:56 Local	**Direction from Accident Site:**	120°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	Unknown	**Visibility (RVR):**	
Wind Speed/Gusts:	4 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	210°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29 inches Hg	**Temperature/Dew Point:**	24°C / 14°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:		**Type of Flight Plan Filed:**	None
Destination:		**Type of Clearance:**	None
Departure Time:	22:58 Local	**Type of Airspace:**	Class E

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 None	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 None	**Latitude, Longitude:**	35.609443,-119.899505(est)

Administrative Information

Investigator In Charge (IIC):	Mars, Noelani
Additional Participating Persons:	TOM SANDERS; FRESNO , CA DAVE DOSKER; FORT WORTH , TX
Original Publish Date:	August 14, 2001
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=47206