Aviation Investigation Final Report

Location:	MONTELLO, Nevada	**Accident Number:**	LAX00GA286
Date & Time:	August 3, 2000, 18:55 Local	**Registration:**	N10864
Aircraft:	Bell 206L-1	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	1 Fatal, 1 Serious, 1 None
Flight Conducted Under:	Part 91: General aviation - Public aircraft		

Analysis

During takeoff, prior to transitioning to forward flight, the helicopter rolled violently to the right one complete revolution, impacting the ground inverted and then coming to rest upright on its skids. A passenger in the left, front seat, restrained by a lap belt and partially restrained by a shoulder belt that separated under load, was struck on the helmet and left shoulder by a main rotor blade that swept along the left side of the helicopter and was seriously injured. A passenger in the left rear seat, with a lap belt but without a shoulder restraint available, was partially ejected from the helicopter and was struck by the passing main rotor blade and fatally injured. Six witnesses and the pilot reported the helicopter was hovering at between 2 and 5 feet above the ground before the roll ensued. In the 2-hour period before the accident, a thunderstorm passed west of the accident location and there was a windstorm at the accident location estimated to have been 50 - 60 knots. The main and tail rotor blades were secured during the windstorm. At the time of the accident, the wind was steady on the nose of the helicopter at 5 - 10 knots. None of the witnesses reported observing any dust devils or unsteady wind. The ground surface near the initial hover location, where marks may have been present, was obscured by emergency vehicle movement and rain that fell after the accident and prior to the investigator's arrival on-scene. The investigation and laboratory examination of fracture surfaces did not reveal any evidence of preaccident mechanical failures.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The loss of control in hovering flight and impact with terrain for undetermined reasons.

Findings

Occurrence #1: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: HOVER - IN GROUND EFFECT

Findings
1. (C) REASON FOR OCCURRENCE UNDETERMINED

Occurrence #2: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: OTHER

Factual Information

HISTORY OF FLIGHT

On August 3, 2000, at 1855 hours Pacific daylight time, a Bell 206L-1, N10864, was destroyed when the helicopter abruptly rolled to the right and impacted terrain during hover after takeoff at Montello, Nevada. The helicopter was operated under 14 CFR Part 91 in support of firefighting activities as a public-use aircraft by the United States Bureau of Land Management. One passenger was fatally injured and the other passenger was seriously injured. The commercial certificated pilot was not injured. Visual meteorological prevailed and no flight plan was filed for the positioning flight that was destined for Wells, Nevada.

There were six ground-based crewmembers affiliated with the operation of the helicopter that witnessed the accident. All of the witnesses were together as a group about 50 feet south of the departing helicopter and viewed the helicopter from the left-side perspective. The witnesses provided a consistent opinion that the helicopter was clear of the ground, in a stable hover at 2 to 5 feet above the ground, when it suddenly rolled to the right and crashed. Two witnesses described the rolling maneuver as "hard" and "violent." There was some disagreement about whether the helicopter rolled to the right until inverted and then bounced back to the left back up on its skids, versus rolling to the right one complete revolution to end up upright. Some commented that the flying dirt and debris from the helicopter was confusing. None of the witnesses described the maneuver as a yawing or spinning maneuver, but rather as a roll about the longitudinal axis.

According to two of the witnesses, the witness statements (attached on Elko County Sheriff's forms) were prepared the morning following the accident. One witness said that no one talked much during the bus trip back to Elko or during dinner on the evening of the accident. After dinner this witness went to her room; however, several of the others went to the bar. She did not recall discussing the circumstances surrounding the accident prior to preparing her statement. The second witness said that in the interim between the time of the accident and the time the written statements were prepared, there were "some" but "not a great deal" of discussion among the witnesses regarding there perceived observations.

The helicopter crew supervisor was interviewed August 5, 2000. He reported that, on the day of the accident, he was supervising a crew of about 10 people assigned to place radio repeater equipment in proximity of a fire near Montello. The crew originated in Wells in the morning. The pilot and two crewmen, who were later in the day to be the three persons aboard the helicopter during the accident, flew the helicopter to the helicopter attack (helitack) base at Montello. He and the other support personnel drove to the base. After arrival at the base, two flights were flown during the day to place radio repeaters. About 1600, a high-wind warning was issued and the wind started to blow. The pilot tied down the rotors of the helicopter using

a cap that fit over the rotor tips and tied to the entry steps of the helicopter in front and to the landing gear skid on the right side in back. The wind blew hard for about 2 hours, reaching about 45 mph, and subsided about 1800. About 1830, the wind had dropped to 10-12 knots, and the pilot thought it would be safe to return to Wells. The pilot removed the rotor tie downs and was observed putting them aboard the helicopter and preflighting the helicopter as his two passengers were putting their equipment aboard. When they boarded the helicopter, the pilot was in the right front seat, one passenger was in the left front seat, and the second passenger was in the left rear seat. The helicopter was headed west and the winds were steady from the west at 10 - 15 knots.

The crew supervisor said he thought the engine start and pretakeoff checks seemed normal, and he recalled the pilot advised via the radio they were leaving. The helicopter lifted to a 2- or 3-foot hover and the supervisor looked away. He then heard a noise that he thinks may have been the rotors striking the ground, and, when he looked back, the helicopter was rolling quickly to the right. He recalled seeing one rotor blade strike the left side of the fuselage at shoulder height of the left front passenger and down the left side of the helicopter. The engine sound level seemed to increase. He yelled for his people to call [on the radio] for help and when he looked back at the helicopter it was back upright on its skids, 30 feet north of where it had been, and still headed west. He ran, with others, to the helicopter. The engine was still running but was spooling down as they reached it. The pilot emerged from the aircraft with a look of confusion and disbelief on his face. The left front passenger was unconscious for 5 - 10 minutes and then regained consciousness but was incoherent. The passenger in the left rear seat was unconscious and did not respond to CPR.

The supervisor said he did not recall any side-to-side, fishtailing motion and, during an interview with the Safety Board investigator, used his hand to describe a rolling maneuver. He was certain that the helicopter was hovering clear of the ground and the wind was steady at 10 - 12 knots. Within 1 hour the wind was calm. He said that, after the accident, the rotor blade tie down straps were still on the shelf in the cabin.

In his interview, also on August 5, 2000, the pilot said that on the day of the accident he had flown three flights; one ferry flight to Montello, and two communications missions to place repeaters. There were no discrepancies on the aircraft. The only abnormality he noted was an unexplained "thump" sound heard by him and one other crewmember during the second communication flight. He heard the "thump" and thought that he felt it in the airframe. The winds were gusty and he thought it might have been due to turbulence. After the flight, since there was no mechanic on site, he looked at the rotor head himself but saw nothing unusual.

Between 1500 and 1830, there was a windstorm with wind gusts of 50 - 60 knots associated with a thunderstorm that passed west of their location. The pilot tied down the main and tail rotor blades before the windstorm, and by 1845, the weather was clear enough to return to Wells and the wind had decreased to 5 - 10 knots.

The pilot preflighted the helicopter, untied the rotors, and hooked up the battery that he had

disconnected to prevent inadvertent discharge at the remote location. He said that, after boarding the passengers, the start and pretakeoff checks were normal. He performed a normal hydraulics-off control check. He "picked the helicopter up" to a 3-foot hover height and glanced down at the engine torque gauge that he recalled was at 80 percent torque. Suddenly, the helicopter did a "violent snap roll" to the right coming to rest upright. He estimated the whole event only lasted about 1/4 second. The first thing he recalled was dirt hitting the helicopter and he could not be certain if the helicopter rolled all the way over or not. He was certain he had not yet started his transition to forward flight.

The pilot added that the wind was on the nose of the helicopter at less than 10 knots, there was no yaw associated with the event, it was pure roll, and the engine operated "fine" the entire time. The engine was still running after the accident and he had to shut it off manually. There was no change in audible tone prior to the roll, although he may have heard another "thump" sound similar to the one heard on the earlier flight. He did not recall any movement or abnormal feedback in the antitorque pedals or the cyclic and collective controls prior to the accident.

When the Safety Board investigator inquired about the 1/4-second duration of the event and how brief a time period this is, the pilot emphasized the violent nature of the roll. It was the pilot's opinion that even an abrupt, full right cyclic input could not have produced the rate of roll he experienced.

PERSONNEL INFORMATION

In his interview, the pilot summarized his flying background as follows. He flew in Vietnam in the late 1960's as a helicopter pilot in the U. S. Army and accumulated about 3,000 hours. He flew helicopters in Alaska in 1971 before joining the Kern County (California) Sheriff's Department where he flew co-pilot between 1972 and 1976. He had since flown for the Army Guard, California Department of Fish and Wildlife, and a corporation. He had about 7,000 hours flight time in helicopters and 3,000 hours in fixed wing aircraft. He joined Rogers Helicopters in January 2000, and had since flown about 125 hours in the model 206. He last attended a Bell factory training school for the model 407 in April 1999.

According to the operator's flight time and duty day log, the pilot worked from 0630 to 2030 on Tuesday, August 1, and flew 6.3 hours. On Wednesday, August 2, he worked from 0630 to 1930 and flew 3.3 hours. During his interview, the pilot said that on the day of the accident he worked from 0730 until the time of the accident. According to the aircraft hour meter, he flew 1.4 hours that day. He said that on the day of the accident he felt well and rested and fit to fly.

AIRCRAFT INFORMATION

According to the crew supervisor, no maintenance was performed on the helicopter on the day of the accident. A 100-hour airframe inspection and a 150-hour engine inspection were performed 4 days prior. The helicopter was equipped with high skids.

According to the aircraft maintenance records for the helicopter, there were 29 modifications to the aircraft by Supplemental Type Certificates (STC's). None of the STC's applied to the main rotor, tail rotor, or flight control system. One STC installed a more powerful Allison (Rolls-Royce) 250-C30P engine and another provided for increased power from the -C30P. A third STC applied to a tail boom repair in 1988 involving replacement of one skin section. The other STC's applied to avionics, external lights, lower windshield and window modifications, rappelling hooks, wire strike kit, engine particle separator, a side mount torque indicator, and a water drop tank.

METEOROLOGICAL INFORMATION

The pilot reported that the accident site is at 5,000 feet msl and the temperature was about 80 degree Fahrenheit. Although a thunderstorm had moved through west of the site in the previous 2 hours with associated high surface winds, the weather was now sufficiently clear to the south to permit his VFR flight to Wells. The surface winds were steady from the west at 5 to 10 knots.

None of the witnesses reported observing any dust devils or unsteady wind.

WRECKAGE AND IMPACT INFORMATION

The accident site was near the center of a wide, open, desert valley oriented northeast-southwest. To the east and southeast of the site, the terrain sloped gently downward to the town of Montello, about 1 mile southeast, and a north-south road up the center of the valley. To the west and northwest, the terrain rose gently along an alluvial plain to a mountain range about 5 miles west. The terrain was flat and there were no prominent obstacles near the site. The area was populated by desert shrubs and grasses, typically 12 inches high, although the immediate area of the landing pad had been cleared of vegetation and was level. The landing pad was adjacent to an inactive/decommissioned, unpaved airport/landing strip. The latitude was 41 degrees 16.71 minutes north and the longitude was 114 degrees 12.58 minutes west. The elevation was about 5,000 feet msl. The entire aircraft was present and there was no fire.

At the accident site was a yellow landing pad marker with the number "1." Witnesses identified this pad as the originating location of the helicopter with the helicopter headed west. After the accident, and before the Safety Board investigator arrived, there was rainfall and emergency vehicles had driven over the pad "1" area. Approximately 5 feet east and 25 feet north of the marker was an area of disturbed dirt about 10 inches deep. The shape of the hole resembled the shape of the helicopter engine and transmission cowling and, 10 feet further east and 5 feet further north, was the anticollision beacon light assembly from atop the vertical stabilizer fin, inverted in the ground. West of the area of disturbed dirt about 10 feet was an area of broken Plexiglas resembling cockpit windshield material. Ten feet further north from the area of disturbed dirt was the fuselage, upright on its landing skids, and headed west. The tail cone was severed at two locations aft of the fuselage juncture and was inverted, being held

attached to the forward fuselage by the tail rotor drive shaft. Fifteen feet further north and 35 feet east of the fuselage was the main rotor assembly less the blade tips. The outboard 3 feet of the red blade was located 450 feet northeast of the accident site, and the outboard 3 feet of the white blade was found 525 feet southwest of the accident site.

The fuselage was upright on its skids, inclined about 10 degrees to the right, and 15-degree nose low. The nose was visibly undamaged although the windshield Plexiglas was broken out. There was a skin tear and dent about 4 inches deep in the left doorpost aft of the left front seat at shoulder height. The landing gear skid cross tubes were bent on the right-hand side of the fuselage, and the saddles were cracked where the cross tubes attach to the skid on the left side. On top of the fuselage, the cover over the hydraulic actuators and the engine cowling and air inlet exhibited downward crushing with residual amounts of soil in deep folds. The main rotor mast was severed above the transmission. The shaft end on the transmission was bent about 25 degrees to the left front, and the separation exhibited 45-degree shear lips.

The tail boom was severed at two locations aft of the fuselage/tail boom juncture. Both fractures were approximately 90 degrees to the tail boom axis; the first being about 1-foot aft of the juncture, and the second being about 3 feet forward of the tail rotor gearbox. The tail boom was inverted with respect to the fuselage and the two separated sections of the tail boom remained attached to the fuselage by the tail rotor drive shaft. On the horizontal stabilizer, the left-hand vertical stabilizer was bent inboard about 20 degrees at midspan. There was a paint transfer mark on the underside of the tail boom about 2 feet forward of the tail rotor gearbox, with lateral striations. The color of the transferred paint resembled the white paint on the main rotor blade. The drive shaft was intact, however, the splined ends were pulled out of the transmission and the tail rotor gearbox couplings. The tail rotor blades were each bent inboard about 15 degrees at their midspan. The blades did not exhibit leading edge damage or chordwise striations. The tail rotor gearbox turned freely when rotated by hand, and the magnetic particle plug was clear. The beacon was absent from the vertical fin.

The main transmission rotated freely by hand and the magnetic particle plugs were clear. The transmission mounts were intact, although the fuselage deck structure under the left rear mount was slightly deformed in the downward direction. Several engine mount tubes exhibited compression buckling. The compressor and turbine sections of the engine also rotated freely. The fuel shutoff valve was in the closed position. The fuel, engine oil, and hydraulic fluid were clear, visually free of contamination, and resembled the correct color, feel, and smell for their respective applications.

In the cockpit, metal covers were in place over the collective and cyclic control sockets at the left seat. The left and right front seats were equipped with lap and shoulder belt occupant restraints; however, the rear seats were equipped with lap belts alone. Both front seat shoulder belts separated in the webbing and exhibited a torn apart appearance. The shoulder belts were of the "Y-type" with two torso straps joining into one strap behind the users neck and then the single strap entering an inertia-reel device. The separations both occurred in the single strap area behind the user's neck and before entering the inertial reel assembly. The

strap webbings exhibited wear and sun fading in proximity of the separations. The collective control at the right seat operated freely, and the collective flight control linkage was intact to the swashplate pivot assembly. The left and right cyclic flight control linkages were intact in the cockpit and upward through the "broom closet" to the area of the hydraulic actuators above the cabin.

The three hydraulic flight control actuators were deformed to the right about 25 degrees, and there were numerous bent and severed control rods and rod ends in the left and right cyclic control systems between the hydraulic actuators and the swashplate. The broken/severed control rods and rod ends were removed and sent to the Safety Board Metallurgy Laboratory in Washington, D.C., along with the swashplate and pitch change links for examination. The laboratory report is attached. The hydraulic actuators were sent to Bell Helicopter Textron for examination by the Safety Board.

The main rotor blades remained attached to the rotor hub, as did the rotor mast. The mast shaft exhibited bending and 45-degree shear lips at its separation from the lower portion of the shaft at the transmission/swashplate. The hub swivel was intact and the mast inside the hub did not exhibit any over-travel crippling. The droop stops were intact although one counterweight arm was bent inboard. The red blade pitch change link separated from the swashplate in the threaded area of the rod end fork nearest the swashplate and the rod remained attached to the blade pitch horn. The white blade pitch change link separated from the swashplate by separation of the ear on the swashplate casting. The separated casting surfaces exhibited a smeared appearance. The white blade link was also bent and separated at mid-length and, at the opposite (blade) end of the link, the rod fractured near the end of the threaded portion of the rod end fork. The fractured pitch change links were sent to the Safety Board laboratory for metallurgical examination. The laboratory report is attached.

Approximately 3 feet of the outboard end of each main rotor blade was separated, and the fracture surfaces of both blades exhibited upward bending at the separation. The outboard 33 inches of the red blade tip was found 450 feet northeast of the wreckage and was bent upward 12 degrees at the separation from the inboard portion of the blade. The outboard 35 inches of the white blade was found 525 feet southwest of the wreckage and was bent upward 24 degrees at the separation from the inboard portion of the blade. The red blade tip exhibited more damage and abrasion than the white blade tip and both tips exhibited chordwise striations on the underside of the blade near the tip.

The inboard section of the red blade was swept aft about 5 degrees along its length from the root to the tip, and the trailing edge exhibited four compression buckles at equal spacing. There was also a blue paint transfer mark on the upper surface of the red blade about 5 feet inboard of the tip. The paint transfer striations were chordwise and the color resembled the blue paint of the tail boom. The inboard 6 feet of the white blade was visibly undamaged. Outboard of the 6-foot station, the blade was bent downward about 60 degrees and swept aft about 5 degrees with compression buckles in the trailing edge. Neither blade exhibited any 45-degree (torsional) deformation.

TESTS AND RESEARCH

All three occupants of the helicopter wore military-style flight helmets. The two front occupants were restrained with lap and shoulder belts, and the passenger in the left rear seat was restrained with a lap belt alone. The two helmets and the occupant restraint belts worn by the passengers seated in the left front and left rear seats, along with the lap belt only from the right-front seat from the aircraft, were sent to the U.S. Army Aeromedical Research Laboratory for evaluation. All three lap belt assemblies were tested and sustained loads above the rated load for the belt. Two sections of the shoulder belt of the passenger in the left front seat were tensile tested and broke at 292 and 219 pounds each, versus their rated load of 1,500 pounds. The helmet worn by the left front passenger bore three impact marks; one in the front consistent with contact with impact with the cabin structure, and two marks in the back resembling the shape and color of two separate main rotor blade strikes. The helmet worn by the passenger in the left rear seat had one large impact mark in the lower rear of size and color resembling the main rotor blade.

Flight control system components with fractures were sent to the Safety Board's Materials Laboratory in Washington, D.C. for examination. The laboratory engineer's factual report is attached. The components with fractures were from the area on top of the fuselage over the cabin and in the main rotor mast. The components examined are shown in figure 1 of the report. The report states that the fractures examined exhibited metallurgical features consistent with overstress separation.

The three flight control servos were examined by the Safety Board investigator at the facilities of Bell Helicopter Textron in Fort Worth, Texas, on May 9, 2001. The three servos were all part number 42C42642-1, and were serial numbers RH 1132 (left-hand cyclic), RH 1133 (collective), and RH 1134 (right-hand cyclic). The servos exhibited impact damage to the mounting linkages and rod end fittings; however, the valve bodies, piston chambers, and piston shafts were visibly undamaged. Several hydraulic inlet line fittings were broken off and the hydraulic ports were uncovered. The valve assemblies and piston chambers of each actuator were x-rayed. No foreign objects were visible on the x-rays, and the springs and moving components of the valves appeared visually to be intact and in their proper positions. Each servo was placed on a hydraulic test bench and hydraulic pressure applied. In response to manual operation of the input lever, each valve operated from stop to stop in a smooth, controlled manner over several cycles in both directions at varying rates. The initial exhausted fluid was captured for analysis. The particulate count for some of the fluid exceeded limits for in-service aircraft; however, according to the Bell Helicopter party representative, the 206-series actuator is tolerant of fluid contamination. The Bell Helicopter Textron report of the examination is attached.

ADDITIONAL INFORMATION

The helicopter wreckage was released to Mr. Marvin Rogge, Rogge Insurance Services, on

June 20, 2001.

Pilot Information

Certificate:	Commercial	**Age:**	52,Male
Airplane Rating(s):	Single-engine land; Single-engine sea	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane; 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:**	December 7, 1999
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	9854 hours (Total, all aircraft), 1600 hours (Total, this make and model), 9500 hours (Pilot In Command, all aircraft), 152 hours (Last 90 days, all aircraft), 90 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Bell	**Registration:**	N10864
Model/Series:	206L-1 206L-1	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	45434
Landing Gear Type:	High skid	**Seats:**	5
Date/Type of Last Inspection:	July 31, 2000 100 hour	**Certified Max Gross Wt.:**	4150 lbs
Time Since Last Inspection:	11 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	5532 Hrs	**Engine Manufacturer:**	Allison
ELT:	Installed, not activated	**Engine Model/Series:**	250C-30-F
Registered Owner:	ROGERS HELICOPTERS, INC.	**Rated Power:**	650 Horsepower
Operator:	U. S. BUREAU OF LAND MANAGEM'T	**Operating Certificate(s) Held:**	None
Operator Does Business As:		**Operator Designator Code:**	

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Dusk
Observation Facility, Elevation:	EKO ,5140 ft msl	**Distance from Accident Site:**	77 Nautical Miles
Observation Time:	18:55 Local	**Direction from Accident Site:**	235°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	4 knots / None	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	140°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30 inches Hg	**Temperature/Dew Point:**	72°C / 56°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:		**Type of Flight Plan Filed:**	None
Destination:	WELLS (LWL)	**Type of Clearance:**	None
Departure Time:	18:55 Local	**Type of Airspace:**	Class G

Airport Information

Airport:		**Runway Surface Type:**	Dirt
Airport Elevation:		**Runway Surface Condition:**	Dry
Runway Used:	0	**IFR Approach:**	
Runway Length/Width:		**VFR Approach/Landing:**	

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Fatal, 1 Serious	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal, 1 Serious, 1 None	**Latitude, Longitude:**	41.220252,-114.229064(est)

Administrative Information

Investigator In Charge (IIC):	Parker, Richard
Additional Participating Persons:	KENNETH R KELLEY; RENO , NV ROBERT GALLOWAY; BOISE , ID MATHEW RIGSBY; FORT WORTH , TX MICHAEL A WEBER; INDIANAPOLIS , IN
Original Publish Date:	November 6, 2001
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=49889