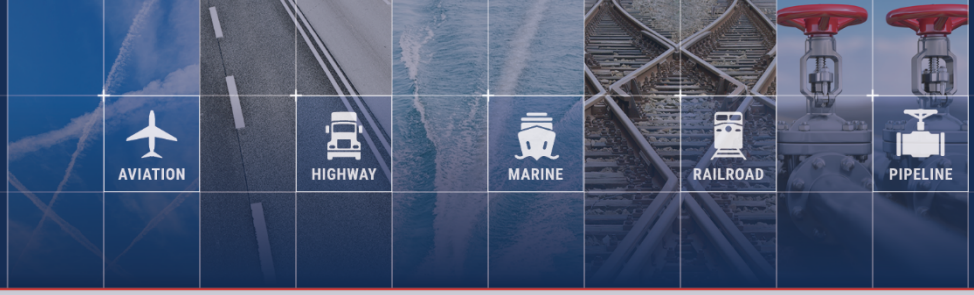

Aviation Investigation Final Report

Location:	Fern Prairie, Washington	**Accident Number:**	WPR24LA319
Date & Time:	September 26, 2024, 15:50 Local	**Registration:**	N9984K
Aircraft:	Bell 206L	**Aircraft Damage:**	Substantial
Defining Event:	Sys/Comp malf/fail (non-power)	**Injuries:**	1 None
Flight Conducted Under:	Part 91: General aviation - Positioning		

Analysis

The pilot reported that, while in cruise flight at about 100 kts and about 1,000 ft above ground level (agl), the helicopter suddenly exhibited a severe vertical oscillation, commonly referred to as a "vertical hop." Believing a catastrophic mechanical failure was imminent, he lowered the collective to initiate an emergency descent. Just before landing alongside a forest road, the pilot raised the collective and slowed the helicopter, and the vertical hop subsided. After landing, the pilot exited the helicopter and observed substantial damage to the tailboom and fuselage.

Postaccident examination revealed the helicopter's tailboom was buckled around its entire circumference. The tailboom buckling was likely the direct result of abnormally high structural loads imposed on the airframe during the vertical hop. This violent oscillation generated dynamic loads exceeding the normal structural design limits of the tailboom, resulting in it buckling about 13 inches aft of the intercostal support, and displacing it downward about 15° and to the right. The full monocoque construction of the tailboom, while robust under normal flight loads, can sustain damage when under the sudden, cyclically-amplified bending forces associated with this type of resonant vibration event.

Although the helicopter's collective lever could be moved with less force than specified by the manufacturer, it is unlikely that the vertical oscillations were due to collective bounce (an interaction between the pilot's arm and the vibration of the airframe that can be exacerbated by low friction clamp force on the collective control) because the pilot did not have his hand on the collective lever when the oscillations started.

About five months before the accident, the helicopter's metal Bell main rotor blades were replaced with composite main rotor blades produced by Van Horn Aviation (VHA). The

underlying source of the vibration itself was likely an aeroelastic interaction between these main rotor blades and the helicopter's nodal beam transmission mount under a specific set of operating conditions. Based on at least 26 similar reports in Bell 206Ls dating back to 2019, VHA identified the triggering conditions as single-pilot operation, low fuel load, and airspeeds above 85 kts, all of which were present in this accident. In addition, out-of-tolerance maintenance conditions, such as main rotor blades configured with forward sweep, increased the likelihood of a helicopter exhibiting hops, and increased the severity of the oscillations when they occurred. Under these conditions, the light helicopter weight and the shift of the center of gravity aft alters rotor system dynamics, allowing a resonant vibration to develop between the rotor blades and the nodal beam mount. When encountered, this vibration can be lessened or stopped by banking, raising the collective, or slowing the helicopter.

About 2.5 years before the accident (or about 2 years before the operator installed the main rotor blades on the helicopter) VHA posted a vertical hop recovery technique on social media and in a newsletter, but did not publish it in their technical library until after the accident. The use of blogs, social media, and a newsletter may have initially been an effective means of alerting operators; however, the lack of a persistent, retrievable reference in VHA's technical library likely precluded operators from learning about the recovery technique if they had not read the newsletter or seen the posts before they were superseded by more recent posts.

According to the pilot, he was not aware of the recovery techniques until after the accident. Had the pilot been aware of and implemented the appropriate recovery techniques, he likely would have been able to prevent the oscillations from reaching a structurally damaging amplitude.

Probable Cause and Findings

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

An aeroelastic interaction between the helicopter's main rotor blades and nodal beam system, which resulted in oscillations that exceeded the design limits of the tailboom. Contributing to the accident was the failure of the main rotor blade manufacturer to adequately publish the appropriate recovery technique for a known flight dynamics issue.

Findings

Aircraft	Main rotor blade system - Capability exceeded
Aircraft	Rotorcraft tail boom - Capability exceeded
Organizational issues	Between groups/organizations - Manufacturer
Aircraft	Main rotor blade system - Related operating info
Personnel issues	Incorrect action selection - Pilot

Factual Information

History of Flight

Emergency descent	Aircraft structural failure
Enroute	Sys/Comp malf/fail (non-power) (Defining event)

On September 26, 2024, about 1550 Pacific daylight time, a Bell 206L helicopter, N9984K, was substantially damaged when it was involved in an accident near Fern Prairie, Washington. The pilot was not injured. The helicopter was operated as a Title 14 *Code of Federal Regulations* Part 91 positioning flight.

According to the pilot, on the day of the accident, he departed in the accident helicopter from the operator's facility near Boring, Oregon, to perform external load work near Toutle, Washington. After the work was completed, the pilot departed the work area to fly back to the operator's facility. The pilot reported that, at departure from the work area, the helicopter had no passengers, about 135 pounds of fuel remaining, and 15 pounds of cargo on board.

The pilot stated that, while en route with his hand off the collective lever and at an airspeed of about 100 kts and about 1,000 ft agl, the "main rotor began a severe vertical hop." Believing the helicopter was encountering a catastrophic mechanical failure, he lowered the collective and initiated an emergency descent. When the pilot slowed the helicopter and raised the collective to arrest the helicopter's descent as it approached a forest road, the vibration subsided. The pilot landed alongside the forest road, exited the helicopter, and observed damage to the tailboom and fuselage. (See figure.)

Figure. Damage to the helicopter's tailboom (Source: JL Aviation).

The helicopter was recovered and subsequently examined at the operator's facility. Examination revealed the tailboom, of full monocoque construction, was buckled around its entire circumference about 13 inches aft of the intercostal support; it was displaced downward about 15° and to the right. The upper aft fuselage adjacent to the engine deck displayed areas of wrinkling and paint flaking. The skids did not appear to be deformed or splayed outward.

Control continuity was established from the cockpit controls to their respective control servos. The collective friction clamp, located under the left front seat, was tested by attaching a spring scale to the collective stick. The collective lever could be moved when 1.8–2.2 lbs of force in the free-play region were applied near the center of the collective grip. The manufacturer's maintenance manual stipulates collective friction clamp force should be 4 to 4.5 lbs. The upper flight controls were disassembled during recovery, precluding a full collective friction measurement. Additionally, the latch bolts had been previously loosened when removing each blade, which precluded the ability to make a blade sweep measurement.

According to maintenance records, on March 30, 2024, the Bell main rotor blades (MRBs) had been removed and replaced with new MRBs in accordance with Supplemental Type Certificate (STC) SR02684LA. The original Bell MRBs were all-metal assemblies consisting of an aluminum alloy main spar, trailing edge, honeycomb core, and skins. The replacement MRBs, manufactured by VHA, were composite assemblies, consisting of fiberglass root and tip blocks, foam core, carbon fiber spar and skin, with Inconel/nickel abrasion strips. At the time of the accident, the MRBs had accrued 348.6 hours in service.

According to the pilot, between March and September 2024, the helicopter was used for several types of seasonal forestry work, which included transportation of cargo and passengers, as well as the operation of electronic equipment installed below the helicopter's nose. About two weeks before the accident, the electronic equipment was removed, after which the operator calculated the helicopter's basic empty weight to be 2359.6 lbs.

STC SR02684LA was issued on August 16, 2018. According to VHA, in September 2019, the operator of a Bell 206L with VHA MRBs reported the helicopter encountered vertical oscillations when in cruise flight with only the pilot aboard. In 2021, the same operator reported that another 206L with VHA MRBs exhibited vertical oscillations during similar operating conditions.

As a result of these reports, on March 22, 2022, VHA released a memo titled "206L Vertical Hops on Lightly Loaded Aircraft." The memo stated:

> In cases where a 206L fitted with VHA main rotor blades is operating light-for example, with only a single pilot on board, less than a full tank of fuel and no cargo-the helicopter can experience a severe vertical hop in turbulent conditions. When initiated by a gust at high speed, this very light aircraft configuration can allow an interaction to occur between the rotor blades and the nodal beam mount. The resulting vertical hop can become very uncomfortable. This seems to be an unusual situation, but if the helicopter gets into this condition the appropriate action is to load the rotor by banking. By loading the disk, the frequency of the system is quickly changed, thereby resolving the issue.

According to VHA, the memo was posted to the news blog on their website's home page and on their social media page. Additionally, it was distributed in a regular email newsletter on April 5, 2022 to subscribers. Records provided by VHA indicated that two recipients of the newsletter were email addresses associated with JL Aviation (JLA), the helicopter operator. Review of archived versions of VHA's website revealed the memo was no longer visible on the website's main page by March 2023. The memo was not redistributed after its initial issuance and was not published in VHA's document library.

According to JLA, they purchased the MRBs in November 2023 and received them in March 2024. At the time JLA received the blades, VHA had received at least 8 reports of vertical oscillations. Employees at JLA stated they were aware of neither the vertical hops memo nor the recovery technique until after the accident.

In September 2025, VHA issued Service Bulletin (SB) 33000-6, "Lightweight, high-speed, vertical vibration recovery and mitigation," and published it to their document library. According to the SB, the reports of vertical oscillations had increased to 15. Of these reports, only the accident helicopter had been damaged, which the SB stated was the result of "the pilot being unaware of the proper recovery technique resulting in prolonged vibration."

The recovery method prescribed by the SB stated that pilots should “immediately reduce speed and load the rotor by increasing collective,” with the caution, “DO NOT lower the collective or enter an autorotation. The vibration will only continue throughout the descent and can potentially result in damage to the aircraft.” An engineer at VHA stated that, although banking had been shown to be effective as a recovery technique, reducing the helicopter’s airspeed had been shown to eliminate the oscillations more quickly.

A flight test report produced by VHA in December 2025 stated that there were no known cases of severe vertical hops when the VHA-prescribed recovery technique was used by the pilot. Conversely, in all documented cases where the oscillations were reported as severe, the pilots had reacted to the onset of the oscillations by reducing the collective, which prolonged or worsened the oscillations. In addition, out-of-tolerance maintenance conditions, such as MRBs configured with forward sweep, increased the likelihood of a helicopter experiencing hops and increased the severity of the oscillations when they occurred. The report noted that severe oscillations had occurred 26 times in 15 different helicopters within a fleet of about 300.

In April 2026, STC SR02684LA was amended to include a Rotorcraft Flight Manual Supplement that contained the recovery technique provided in the SB.

The Bell 206L Maintenance Manual describes the design of the nodal beam system: *“The transmission with the mast, main rotor hub, and blade assembly is supported by and isolated from the fuselage by the transmission mounts (nodal beam) and the transmission restraint. The vertical vibration isolation system is designed to isolate the fuselage from 2-per revolution vibrations and is controlled by the nodal beam spring rate tuned to optimize isolation of the 2-per revolution vibration.”*

Aeroelasticity is the interaction of aerodynamic and inertial forces on elastic structures, such as rotor blades. These interactions can result in such phenomena as flutter, buffeting, and divergence. It can also be a component of transient dynamic response of structural rotor blade components and rotor blade load distribution.

VHA holds two additional type certificates approving the installation of their composite MRBs on Bell 206B helicopters. VHA has not reported any occurrences of vertical hops in 206Bs equipped with their MRBs. According to Bell, the 206B uses pylon support links to mount the transmission on the fuselage rather than a nodal beam.

Pilot Information

Certificate:	Commercial	**Age:**	55,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	4-point
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	January 31, 2024
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	January 28, 2024
Flight Time:	(Estimated) 16702 hours (Total, all aircraft), 15452 hours (Total, this make and model), 16567 hours (Pilot In Command, all aircraft), 273 hours (Last 90 days, all aircraft), 75 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Bell	**Registration:**	N9984K
Model/Series:	206L	**Aircraft Category:**	Helicopter
Year of Manufacture:	1976	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	45054
Landing Gear Type:	None; High skid	**Seats:**	7
Date/Type of Last Inspection:	August 23, 2024 AAIP	**Certified Max Gross Wt.:**	4000 lbs
Time Since Last Inspection:		**Engines:**	1 Turbo shaft
Airframe Total Time:	25607.6 Hrs at time of accident	**Engine Manufacturer:**	Rolls Royce
ELT:	C126 installed, not activated	**Engine Model/Series:**	M250-C20R
Registered Owner:	JL AVIATION INC	**Rated Power:**	450 Horsepower
Operator:	JL AVIATION INC	**Operating Certificate(s) Held:**	Rotorcraft external load (133), On-demand air taxi (135), Agricultural aircraft (137)
Operator Does Business As:	JL Aviation	**Operator Designator Code:**	

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KTTD,25 ft msl	**Distance from Accident Site:**	8 Nautical Miles
Observation Time:	15:53 Local	**Direction from Accident Site:**	216°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	4 knots / None	**Turbulence Type Forecast/Actual:**	Unknown / Clear air
Wind Direction:	320°	**Turbulence Severity Forecast/Actual:**	Unknown / Light
Altimeter Setting:	29.98 inches Hg	**Temperature/Dew Point:**	22°C / 11°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Pigeon Springs, WA	**Type of Flight Plan Filed:**	Company VFR
Destination:	Boring, OR (OR72)	**Type of Clearance:**	None
Departure Time:	15:33 Local	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	N/A	**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	1 None	**Latitude, Longitude:**	45.65406,-122.30411

Administrative Information

Investigator In Charge (IIC):	Whitaker, Kathryn
Additional Participating Persons:	Shawn Kellar; Federal Aviation Administration; Portland, OR Peter Emerson; JL Aviation, Inc.; Boring, OR Mark Stuntzner; Bell Helicopters; Fort Worth, TX Chris Gatley; Van Horn Aviation; Tempe, AZ Robert Potvin; Transportation Safety Board of Canada; Gatineau, Quebec Nicholas Shepler; Rolls-Royce Corporation; Indianapolis, IN
Original Publish Date:	August 20, 2026
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=195230