Aviation Investigation Final Report

Location:	Thompson Falls, Montana	**Accident Number:**	WPR13FA343
Date & Time:	July 27, 2013, 12:55 Local	**Registration:**	N25WH
Aircraft:	ROBINSON HELICOPTER COMPANY R44 II	**Aircraft Damage:**	Substantial
Defining Event:	Loss of tail rotor effectiveness	**Injuries:**	1 Fatal, 1 Serious, 1 Minor
Flight Conducted Under:	Part 91: General aviation - Aerial observation		

Analysis

The helicopter was flying northeast following a line of utility poles for the aerial survey flight. A surviving passenger, who occupied the left rear seat, reported that the helicopter began to rotate in a clockwise direction just before impact. A second surviving passenger, who occupied the left front seat, stated that the helicopter was flying straight and level before it began to spin. He added that, before impact, he heard the low rotor rpm warning horn. The helicopter impacted heavily forested terrain in a steep nose-down, right-bank attitude. At the time of the accident, the helicopter was about 200 lbs below its maximum gross weight. Wind was calculated to be between 2 and 16 knots from the southwest with maximum gusts of about 20 knots near the accident site, which would have resulted in a tailwind condition. Examination of the helicopter did not reveal any anomalies that would have precluded normal operation.

Video footage recorded by a passenger showed the helicopter traveling about 39 knots on a northeasterly heading and at an altitude of about 200 ft above ground level. The groundspeed then began to decay to about 30 knots over a period of about 30 seconds. The helicopter then yawed right, and the groundspeed dropped to 22.6 knots. The helicopter then appeared to develop an uncontrollable right spin, and the video ended with the helicopter crashing into the forest below. It is likely that the combination of the helicopter's high gross weight, the reduction in airspeed, and the tailwind condition led to a loss of tail rotor effectiveness, which resulted in the right yaw from which the pilot did not recover control.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's failure to maintain helicopter control while operating in conditions conducive to a

loss of tail rotor effectiveness.

Findings

Personnel issues	Aircraft control - Pilot
Aircraft	Prop/rotor parameters - Capability exceeded
Environmental issues	Tailwind - Effect on equipment
Aircraft	Airspeed - Not attained/maintained
Aircraft	Maximum weight - Not specified

Factual Information

History of Flight

Maneuvering-low-alt flying	Loss of tail rotor effectiveness (Defining event)
Maneuvering-low-alt flying	Loss of control in flight
Maneuvering-low-alt flying	Collision with terr/obj (non-CFIT)

On July 27, 2013, about 1255 mountain daylight time, a Robinson R44 II helicopter, N25WH, was substantially damaged following a loss of control and subsequent impact with terrain near Thompson Falls, Montana. The helicopter was registered to Zoot Helicopter I LLC, of Bozeman, Montana, and operated by Rocky Mountain Rotors, of Belgrade, Montana. The certified commercial pilot received fatal injuries; one passenger sustained serious injuries, and a second passenger suffered minor injuries. Visual meteorological conditions prevailed for the aerial survey flight, which was being conducted in accordance with 14 Code of Federal Regulations Part 91, and no flight plan was filed. The flight departed the Polson Airport (8S1), about 2 hours prior to the time of the accident. The intended destination was Thompson Falls.

According to the passenger who sustained minor injuries, the purpose of the flight was to photo document the condition of cross-country power lines and their supporting wooden structures. The passenger reported that the pilot occupied the right front seat, his associate, who was operating videotaping equipment, occupied the left front seat, and he occupied the left rear seat taking still photographs. The passenger stated that initially everything was going fine, and that they were about 50 feet from the power lines and about 50 feet above them. However, the helicopter started to rotate in a clockwise orientation, about 4 revolutions prior to impact with terrain. He described the impact attitude of the helicopter as being very steep, nose down, and banked to the right. There was no postcrash fire.

About 6 months after the accident, the left-front-seat passenger, who was assigned to operate the onboard video camera, was interviewed via telephone by the National Transportation Safety Board (NTSB) investigator-in-charge (IIC). The passenger stated that prior to the start of the helicopter spinning it was flying straight and level, and the next thing he remembered was the helicopter impacting a tree. He further stated that prior to impact he heard the Low Rotor rpm warning horn, as he had heard several times [during the starting of the helicopter's engine]. The passenger further stated that prior to the start of the spin, he did not recall any adverse wind conditions.

An NTSB Vehicle Recorder Specialist was able to download recorded data from an onboard Sony Handycam HDR CX550 recorder; the unit was equipped with a Global Positioning System (GPS) receiver. The recorder captured the entire accident sequence. The specialist's review of the data revealed the following:

The helicopter was initially observed operating about 8.5 nautical miles west-southwest of Thompson Falls, Montana, along the Montana Secondary Highway 471. About 1248, the helicopter was circling over a power substation at a groundspeed between 40 to 50 knots, at an altitude of about 3,400 feet mean sea level (msl). About 1250, the helicopter departed the substation and began following a line of utility

poles northeast bound. About 1251, the helicopter was observed in a left-hand circle around a group of utility poles near a creek at an altitude of 3,226 feet msl. At 1251:38, the helicopter departed back to the northeast and continued to follow utility poles at a speed of 42 knots at an altitude of 3,220 feet msl. The helicopter then entered two more circles to the left at 1252:12, at which time its speed varied between 30 to 40 knots. At 1254:26, the helicopter was re-established on a northeast heading along the utility line at an altitude of 3,162 feet msl and a groundspeed of 39 knots; by 1255:00, the helicopter's groundspeed had decayed to 30 knots. At 1255:02, the helicopter began to yaw to the right as its speed further decayed to 22.6 knots at 1255:04. The helicopter completed a 360-degree spin by 1255:06 and continued to spin to the right. The GPS track continued to deviate for the remainder of the recording, and the groundspeed fluctuated below 22.6 knots until the recorded data terminated. Just before impact, the pilot's feet are shown and the left pedal is deflected forward. The helicopter struck trees about 1255:13, then the recording ended.

Pilot Information

Certificate:	Commercial	**Age:**	35
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	3-point
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Helicopter; Instrument helicopter	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	February 13, 2013
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	July 24, 2013
Flight Time:	3200 hours (Total, all aircraft), 376.8 hours (Total, this make and model), 3100 hours (Pilot In Command, all aircraft), 42.5 hours (Last 90 days, all aircraft), 19.3 hours (Last 30 days, all aircraft), 8 hours (Last 24 hours, all aircraft)		

The pilot, age 35, possessed a commercial pilot certificate with ratings for rotorcraft-helicopter and instrument helicopter. He also held a certified flight instructor certificate with ratings for rotorcraft-helicopter and instrument helicopter. Additionally, the pilot held private pilot privileges for airplane single-engine land.

A review of the pilot's personal logbook, together with records provided by the Federal Aviation Regulation (FAR) Part 135 aeromedical company that he was employed by, revealed that about 1 month prior to the accident the pilot had accumulated a total flying time of 3,299.5 hours, of which 376.9 hours were in the same make and model as the accident helicopter.

Records also revealed that the pilot had completed his most recent Federal Aviation Administration (FAA) flight review in accordance with FAR 61.56 on July 24, 2013. The pilot's most recent second-class FAA airman medical certificate was issued on February 13, 2013, with no limitations noted.

Aircraft and Owner/Operator Information

Aircraft Make:	ROBINSON HELICOPTER COMPANY	**Registration:**	N25WH
Model/Series:	R44 II	**Aircraft Category:**	Helicopter
Year of Manufacture:	2004	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	10481
Landing Gear Type:	Skid	**Seats:**	4
Date/Type of Last Inspection:	July 6, 2013 Annual	**Certified Max Gross Wt.:**	2500 lbs
Time Since Last Inspection:	13 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	786 Hrs as of last inspection	**Engine Manufacturer:**	LYCOMING
ELT:	Installed, activated, aided in locating accident	**Engine Model/Series:**	IO-540 SER
Registered Owner:	ZOOT HELICOPTER I LLC	**Rated Power:**	245 Horsepower
Operator:	Rocky Mountain Rotors	**Operating Certificate(s) Held:**	None

The helicopter was a Robinson R44 II, serial number 10481, manufactured in 2004. The operator reported that the helicopter's maximum gross weight was 2,500 pounds, that it seated four, and that it would have weighed about 2,300 pounds at the time of the accident.

The helicopter was powered by a 245-horsepower Lycoming IO-540-AE1A5 engine. The last annual maintenance inspection was conducted on July 8, 2013, at a total airframe and engine time of 786.2 hours. The helicopter had a total of 799 hours at the time of the accident, as it had operated 13 hours since its last maintenance inspection.

The examination of the maintenance records also revealed that on December 27, 2012, at a total airframe time of 778.9 hours, "Fuel bladder tanks installed. Aircraft returned to service." Additionally, the entry noted that this work "Complied with Robinson Helicopter Company SB-78B, using Robinson Helicopter Kit KI-196-2, IAW kit instruction KI-196-2, Revision "B" dated 10 Jan 2011. Revised Weight and Balance."

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	THM8,2426 ft msl	**Distance from Accident Site:**	10 Nautical Miles
Observation Time:	13:02 Local	**Direction from Accident Site:**	65°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	8 knots / 17 knots	**Turbulence Type Forecast/Actual:**	/ Terrain-Induced
Wind Direction:	317°	**Turbulence Severity Forecast/Actual:**	/ Moderate
Altimeter Setting:	29.98 inches Hg	**Temperature/Dew Point:**	88°C / 9°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Polson, MT (8S1)	**Type of Flight Plan Filed:**	None
Destination:	Thompson Fall, MT	**Type of Clearance:**	None
Departure Time:	11:00 Local	**Type of Airspace:**	Class G

An NTSB Meteorological Specialist reported that a review of the available weather in the area of where the accident occurred, included the following:

The National Weather Surface (NWS) Surface Analysis Chart for 1200 MDT depicted that a low pressure center was located at the central portion of Montana's border with Canada. A stationary front extended south-southeastward from the low pressure center into north-central Colorado. Another low pressure center was identified along the eastern portion of the Washington/Oregon border.

Many station models in the accident region depicted clear skies, with winds across the region generally 10 knots or less, with direction variable. Temperatures near the accident site were from the mid-70 degrees F to the mid-80 degrees F, with dew points ranging from about 30 degrees F to 60 degrees F.

A composite radar imagery mosaic at 1300 MDT of the accident region from the National Severe Storms Laboratory's National Mosaic and Q2 System did not identify any areas of reflectivity near the accident site.

An Automated Surface Observing System station (ASOS) named KMLP, was located near the Mullan Pass VOR in Mullan Pass, Idaho, about 8 nautical miles (nm) to the southwest of the accident site at an elevation of about 6,000 feet mean sea level (msl). At 1253 MDT, KMLP reported wind variable at 4 knots, visibility of 10 miles or greater, clear skies, temperature 19 degrees C, dew point 2 degrees C, and an altimeter setting of 30.17 inches of mercury.

U.S. Bureau of Land Management/USDA Forest Service Remote Automated Weather System (RAWS) station THAM8, was located about 10 miles to the east-northeast of the accident site at an elevation of about 2,426 feet msl. At 1302, THAM8 reported a temperature of 88 degrees F, a dew point temperature of 47.9 degrees F, relative humidity of 17 percent, and wind from 317 degrees at 7.8 knots with gusts to 17.4 knots. Feedback from the NWS Office in Missoula, Montana, regarding the THAM8 revealed that

there was no reason to question wind speeds reported at 1302, and that they appeared to be consistent with the increasing westerly winds reported on the day of the accident at similarly sited (valley) stations.

The NTSB Specialist reported that a Weather Research and Forecasting Model (WRF) simulation was run to estimate wind conditions in the area of the accident site at 1300. WRF simulations of the wind identified sustained wind magnitudes of generally between 2-16 knots through the region, with the wind being from nearly the southwest at the accident site. Wind gust simulations yielded a maximum gust magnitude of close to 20 knots near the accident site.

An Area Forecast Discussion was issued at 0930 MDT by the NWS Forecast Office in Missoula for an area that included the accident location. In part, the discussion revealed that a trough moving through British Columbia would flatten the ridge in Idaho and western Montana, with an increase in winds expected during the afternoon as a westerly pressure gradient developed, with afternoon winds approaching 25 knots at times.

A Red Flag Warning was issued at 0402 by the NWS Forecast Office in Missoula for an area east of the accident location effective at 1200. The warning message advised of west winds of 15 to 20 miles-per-hour (mph) with gusts to 30 mph. The warning indicated that winds would begin to increase around mid-day, and peak in the late afternoon/early evening.

The accident pilot did not receive a DUAT, DUATS or Lockheed Martin Flight Services telephone weather briefing prior to the accident flight. It is not known if the pilot received preflight weather information from another source.

(Refer to the NTSB Group Chairman's Factual Meteorology Report, which is located in the docket for this report.)

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Serious, 1 Minor	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal, 1 Serious, 1 Minor	**Latitude, Longitude:**	47.546665,-115.520278

On July 28, 2013, representatives from the NTSB, the FAA, Robinson Helicopters, and Lycoming Motors examined the helicopter at the site of the accident. The examination revealed that the helicopter had impacted heavily forested terrain in a steep nose low, right bank attitude, at an elevation of 2,915 feet msl, and subsequently came to rest on its right side, on a measured magnetic heading of 178 degrees. The impact heading could not be determined. All components necessary for flight were accounted for at the accident site. The helicopter was recovered to a secured location for further examination.

On July 30, 2013, under the supervision of the IIC, an examination of the engine and airframe was conducted at the facilities of a local salvage company located in Belgrade, Montana. The results of the examination failed to reveal any anomalies, which would have precluded normal operation with the helicopter. (Refer to the Summary of Aircraft Examination report, which is located in the docket for this accident.)

Medical and Pathological Information

An autopsy of the pilot was performed at the Montana Division of Forensic Science, Missoula, Montana, on July 29, 2013. The cause of death was listed as "blunt force injuries."

Toxicological testing on the pilot was performed by the FAA Civil Aeromedical Institute's (CAMI) Forensic Toxicology and Accident Research Center at Oklahoma City, Oklahoma. The toxicological tests were negative for alcohol and drugs.

Tests and Research

Examination of Fuel Tanks

On August 29, 2013, under the supervision of an NTSB accident investigator, both the main and auxiliary fuel tanks, along with the instrument cluster, underwent functional testing at the facilities of Robinson Helicopter Company, Torrance, California. The results of the examination revealed the following:

Main Fuel Tank

The main fuel tank, which held a total of 30.5 US gallons, was visually examined. The aluminum skins were dented and/or creased, and the mounting holes were torn away at the edges. Portions of the mounting brackets remained attached to the tank. The tank was temporarily fitted to an exemplar airframe, ensuring proper angles. The instrument cluster was wired to the fuel quantity sending unit, and a warning light was wired to the Low Fuel Warning (LFW) sending unit. With power applied, the Main Fuel Tank Operating Indicator (MFI) read EMPTY, and the LFW light illuminated. Subsequent to 30 gallons of water poured into the tank, the MFI read FULL. When 9.5 gallons was drained, the MFI continued to read FULL. A light tap on the tank resulted in the MFI dropping to just below the 3/4 mark. When the MFI was observed at the 1/2 mark, 14.34 gallons of fuel had been drained, 14.55 gallons remained. When the MFI was at the 1/4 mark, 21.28 gallons had been drained, leaving 7.61 gallons remaining. After draining 24.46 gallons, the LFW light illuminated; 4.43 gallons of fuel remained. When the MFI was at the EMPTY mark and the flow of water stopped, 28.89 gallons had been drained, leaving about 1.11 gallons of unusable liquid in the tank.

Auxiliary Fuel Tank

A visual inspection of the tank, which had a capacity of 17.2 US gallons, revealed that the aluminum skins were dented, which reduced the capacity of the tank, and the mounting holes were torn away at the edges. The tank was temporarily fitted to an exemplar airframe, which insured proper angles. The instrument cluster was wired to a power source and the sending unit. When power was applied, the Auxiliary Fuel Tank Operating Indicator (AFI) read empty. Approximately 17 gallons of water was poured into the tank; the AFI needle read FULL. When the AFI was at the 1/2 mark, 8.80 gallons had been drained, with 8.2 gallons remaining. When the AFI was at the 1/4 mark, 12.91 gallons had been drained, with 4.09 gallons remaining. When the AFI was observed at the EMPTY mark and the flow of water halted, 17 gallons had been drained.

Both fuel quantity sending units, the Low Fuel Sending unit, and both indicators were observed to have functioned within factory specifications.

Additional Information

The FAA Rotorcraft Flying Handbook, publication FAA-H-8030-21, Unanticipated Yaw/Loss of Tail Rotor Effectiveness (LTS), states in part that unanticipated yaw is the occurrence of an uncommanded yaw rate that does not subside of its own accord and, which, if not corrected, can result in the loss of helicopter control. This uncommanded yaw rate is referred to as a loss of tail rotor effectiveness (LTE) and occurs to the right in helicopters with counter-rotating main rotor and to the left in helicopters with a clockwise main rotor rotation. LTE is not related to an equipment or maintenance malfunction and may occur in all single-rotor helicopters at airspeeds less than 30 knots. It is the result of the tail rotor not providing adequate thrust to maintain directional control. The required tail rotor thrust is modified by the effects of the wind. The wind can cause an uncommanded yaw by changing tail rotor effective thrust.

FAA Advisory Circular (AC) 90-95, Unanticipated Right Yaw in Helicopters, dated February 26, 1995 states that the loss of tail rotor effectiveness (LTE) is a critical, low-speed aerodynamic flight characteristic which could result in an uncommanded rapid yaw rate which does not subside of its own accord and, if not corrected, could result in the loss of aircraft control. It also states, "LTE is not related to a maintenance malfunction and may occur in varying degrees in all single main rotor helicopters at airspeeds less than 30 knots."

Paragraph 6 of the AC covered conditions under which LTE may occur. It states:
"Any maneuver which requires the pilot to operate in a high-power, low-airspeed environment with a left crosswind or tailwind creates an environment where unanticipated right yaw may occur."

Paragraph 8 of the AC states:

"OTHER FACTORS...Low Indicated Airspeed. At airspeeds below translational lift, the tail rotor is required to produce nearly 100 percent of the directional control. If the required amount of tail rotor thrust is not available for any reason, the aircraft will yaw to the right."

Paragraph 9 of the AC states: "When maneuvering between hover and 30 knots: (1) Avoid tailwinds. If loss of translational lift occurs, it will result in an increased high power demand and an additional anti-torque requirement. (2) Avoid out of ground effect (OGE) hover and high power demand situations, such as low-speed downwind turns. (3) Be especially aware of wind direction and velocity when hovering in winds of about 8-12 knots (especially OGE). There are no strong indicators to the pilot of a reduction of translation lift. (4) Be aware that if considerable amount of left pedal is being maintained a sufficient amount of left pedal may not be available to counteract an unanticipated right yaw. (5) Be alert to changing aircraft flight and wind conditions which may be experienced when flying along ridge lines and around buildings. (6) Stay vigilant to power and wind conditions."

Robinson Helicopters Safety Notice SN-42, UNANTICIPATED YAW, issued May, 2013, states that a pilot's failure to apply proper pedal inputs in response to strong or gusty winds during hover or low-speed flight may result in an unanticipated yaw. Some pilots mistakenly attribute this yaw to loss of tail rotor effectiveness (LTE), implying that the tail rotor stalled or was unable to provide adequate thrust. Tail rotors on Robinson helicopters are designed to have more authority than many other helicopters and are unlikely to experience LTE. To avoid unanticipated yaw, pilots should be aware of conditions (a left crosswind, for example) that may require large or rapid pedal inputs. Practicing slow, steady-rate hovering pedal turns will help maintain proficiency in controlling yaw. Hover training with a qualified instructor in varying wind conditions may also be helpful.

Administrative Information

Investigator In Charge (IIC):	Little, Thomas
Additional Participating Persons:	William M Thomas; Federal Aviation Administration; Helena, MT Thom Webster; Robinsone Helicopters; Torrance, CA Troy Helgeson; Lycoming Engines; Williamsport, PA
Original Publish Date:	April 22, 2015
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=87586