



National Transportation Safety Board Aviation Accident Final Report

Location:	Long Beach, CA	Accident Number:	WPR17LA211
Date & Time:	09/20/2017, 1309 PDT	Registration:	N7514S
Aircraft:	ROBINSON HELICOPTER R22	Aircraft Damage:	Substantial
Defining Event:	Hard landing	Injuries:	1 Serious
Flight Conducted Under:	Part 91: General Aviation - Instructional		

Analysis

During the final phase of a crosswind landing approach, the solo student pilot felt the helicopter shudder and heard the low rotor rpm horn sound. Instead of applying corrective control inputs, he immediately initiated an autorotation. He did not raise the collective control during the flare, as required, and the helicopter then landed hard and rolled over.

Postaccident examination did not reveal any preimpact anomalies with the airframe or engine that would have precluded normal operation, and the engine appeared to be operating at the time of ground impact.

Airframe vibration during the final phase of a landing approach is not an unusual phenomenon, and a low rotor rpm warning under high-load conditions (such as when landing with a crosswind) can also occur if rotor speed and engine power are not properly managed. The pilot improperly decided to initiate an autorotation instead of applying corrective control inputs to address the vibrations and improperly performed the landing flare.

Probable Cause and Findings

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

The student pilot's failure to maintain rotor rpm during the crosswind landing approach and his subsequent improper decision to initiate an autorotation instead of applying corrective control inputs after the helicopter experienced normal airframe vibration. Also causal was his failure to raise the collective during the landing flare, which resulted in a hard landing.

Findings

Aircraft	Prop/rotor parameters - Not attained/maintained (Cause)
Personnel issues	Use of equip/system - Pilot (Cause) Decision making/judgment - Pilot (Cause) Incorrect action performance - Pilot (Cause)
Environmental issues	Crosswind - Effect on operation

Factual Information

History of Flight

Landing-flare/touchdown	Miscellaneous/other
Autorotation	Attempted remediation/recovery Hard landing (Defining event)
Landing-landing roll	Roll over

On September 20, 2017, at 1309 Pacific daylight time, a Robinson R22 Beta helicopter, N7514S, landed hard and rolled over following an autorotation at Long Beach Airport (Daugherty Field), Long Beach, California. The student pilot sustained serious injuries, and the helicopter sustained substantial damage. The helicopter was registered to Spitzer Helicopter LLC, and operated by Revolution Aviation, under the provisions of Title 14 *Code of Federal Regulations* Part 91 as an instructional flight. Visual meteorological conditions prevailed, and no flight plan had been filed. The local flight departed Long Beach about 1305.

The student departed earlier in the morning with his instructor from their operational base in Santa Ana, California. They planned to fly to Long Beach Airport, where the instructor would disembark, and the student would perform a series of solo maneuvers and flights in the traffic pattern. After arriving at Long Beach and landing on helicopter pad 1 they performed a pedal turn, to determine how the helicopter would perform with the left crosswind, and then departed for a flight in the traffic pattern. After landing, the instructor got out of the helicopter, and waited on the grass area adjacent to the pad. From there he watched the student perform a series of low hovering maneuvers, all of which progressed uneventfully. The other helicopters in the area had by then departed, and the student and instructor agreed that the student should depart and perform one circuit in the traffic pattern and land on pad 3, which was a larger pad that the student was more familiar with.

The departure and landing were uneventful, and once on the ground, the student and instructor gave each other the "thumbs-up", and the student departed for another flight in the pattern. The instructor reported that the flight appeared normal, and during the landing approach the descent path and speed were appropriate. However, as the helicopter approached the pad, it started to slow down. He thought the student was going to land just short of the pad, however the nose then began to yaw to the left and right by a few degrees, and the helicopter suddenly began to descend. He described the descent as rapid and uncontrolled, as if the helicopter had lost all lift. The helicopter then hit the ground slightly left-side-low and rolled onto its right side.

The student recounted similar observations, reporting that as he approached to within about 40 ft of the pad, the helicopter started to shudder, and then the low rotor RPM horn sounded. He reacted by immediately lowering the collective and initiating an autorotation. Just prior to striking the ground, he pulled back on the cyclic, but did not apply any collective control. He stated that he did not hear any unusual engine sounds, and he did not specifically look at the engine and rotor tachometer during the event, which transpired very quickly.

Student Pilot Information

Certificate:	Student	Age:	41, Male
Airplane Rating(s):	None	Seat Occupied:	Right
Other Aircraft Rating(s):	None	Restraint Used:	3-point
Instrument Rating(s):	Helicopter	Second Pilot Present:	No
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Class 3 Without Waivers/Limitations	Last FAA Medical Exam:	07/27/2017
Occupational Pilot:	No	Last Flight Review or Equivalent:	
Flight Time:	(Estimated) 45 hours (Total, all aircraft), 45 hours (Total, this make and model), 43 hours (Pilot In Command, all aircraft)		

The student pilot held a third-class aviation medical certificate issued on July 27, 2017. Following the accident, he reported 45 total flight hours, all in helicopters, including 2 hours of solo flight time.

Aircraft and Owner/Operator Information

Aircraft Make:	ROBINSON HELICOPTER	Registration:	N7514S
Model/Series:	R22 BETA	Aircraft Category:	Helicopter
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Normal	Serial Number:	3333
Landing Gear Type:	Skid;	Seats:	
Date/Type of Last Inspection:	08/25/2017, Condition	Certified Max Gross Wt.:	1369 lbs
Time Since Last Inspection:	20 Hours	Engines:	1 Reciprocating
Airframe Total Time:	1390.66 Hours at time of accident	Engine Manufacturer:	LYCOMING
ELT:	Not installed	Engine Model/Series:	O-360 J2A
Registered Owner:	SPITZER HELICOPTER LLC	Rated Power:	0 hp
Operator:	Revolution Aviation	Operating Certificate(s) Held:	None

The helicopter was manufactured in 2002 and equipped with a Lycoming O-360-J2A engine, serial number L-37717-36A. On May 9, 2012, both a helicopter overhaul and engine rebuild

were completed. A 100-hour inspection was completed on August 25, 2017, about 20 flight-hours before the accident. During the inspection, the engine's no. 1 cylinder was removed due to low compression, repaired, and re-installed. At the time of inspection, the airframe and engine had accumulated 1,370.4 flight hours since overhaul/rebuild.

The most recent maintenance event was for an inspection following a rotor blade overspeed (<114 %). The inspection was completed on September 8, 2017, about 10 flight hours before the accident.

The helicopter was equipped with a governor system which was designed to maintain engine speed by sensing changes and applying corrective throttle control inputs through a friction clutch. The system could be overridden by the pilot through manual throttle manipulation. The governor switch was found in the "ON" position at the accident site.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	KLGB, 31 ft msl	Distance from Accident Site:	1 Nautical Miles
Observation Time:	2019 UTC	Direction from Accident Site:	150°
Lowest Cloud Condition:	Clear	Visibility	10 Miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	9 knots /	Turbulence Type Forecast/Actual:	/
Wind Direction:	170°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	29.89 inches Hg	Temperature/Dew Point:	23° C / 17° C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Long Beach, CA (LGB)	Type of Flight Plan Filed:	None
Destination:	Long Beach, CA (LGB)	Type of Clearance:	VFR
Departure Time:	1305 PDT	Type of Airspace:	Class D

A special aviation routine weather report was issued immediately after the accident. It indicated wind from 170° at 9 knots. Pad 3 is oriented east-west, and the left traffic pattern was in use, therefore the helicopter would have encountered an almost direct left crosswind during the landing approach.

Airport Information

Airport:	LONG BEACH / DAUGHERTY FIELD / (LGB)	Runway Surface Type:	Asphalt
Airport Elevation:	60 ft	Runway Surface Condition:	Dry
Runway Used:	H3	IFR Approach:	None
Runway Length/Width:	300 ft / 35 ft	VFR Approach/Landing:	Forced Landing

Wreckage and Impact Information

Crew Injuries:	1 Serious	Aircraft Damage:	Substantial
Passenger Injuries:	N/A	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	1 Serious	Latitude, Longitude:	33.819722, -118.151389

Tests And Research

The helicopter was recovered from the accident site and examined by the NTSB investigator-in-charge and technical representatives from Robinson Helicopter Company (RHC). A complete examination report is contained within the public docket.

Drivetrain and flight control continuity was established, and the engine did not exhibit any indications of catastrophic failure.

The engine spark plugs displayed dark gray deposits consistent with normal operation, and normal wear signatures when compared to the Champion AV-27 chart. The crankshaft was rotated by hand using the engine cooling fan, and mechanical rotational continuity was established throughout. All valves and their associated rockers moved freely and about equal amounts, cylinder compression was obtained on all four cylinders in proper firing order, and sparks were observed at each spark plug lead.

The upper frame sustained crush damage, causing the upper sheave to meet the frame tubes adjacent to the clutch actuator. Rotational scoring was observed on the outer radius of the sheave with corresponding scoring to the frame tubes. The scoring damage was consistent with engine operation at the time of impact.

The governor controller was tested at the facilities of RHC in accordance with the factory calibration and functional test specifications. The unit passed all tests.

Additional Information

The FAA Helicopter Flying Handbook (FAA-H-8083-21A) discusses the transverse flow effect as follows:

"As the helicopter accelerates in forward flight, induced flow drops to near zero at the forward disk area and increases at the aft disk area. These differences in lift between the fore and aft portions of the rotor disk are called transverse flow effect. This increases the angle of attack (AOA) at the front disk area causing the rotor blade to flap up, and reduces AOA at the aft disk area causing the rotor blade to flap down. Because the rotor acts like a gyro, maximum displacement occurs 90° in the direction of rotation. The result is a tendency for the helicopter to roll slightly to the right as it accelerates through approximately 20 knots or if the headwind is approximately 20 knots.

Transverse flow effect is recognized by increased vibrations of the helicopter at airspeeds just below effective translational lift (ETL) on takeoff and after passing through ETL during landing. To counteract transverse flow effect, a cyclic input to the left may be needed."

The handbook also states that during normal landing approaches, "helicopters require near maximum power to land because the inertia of the helicopter in a descent must be overcome by lift in the rotor system."

The sections of the Pilot's Operating Handbook (POH) which describe procedures for power loss at all altitudes, and autorotation's to power recovery, all instruct the pilot to raise the collective just before touchdown to cushion the landing.

Regarding activation of the stall warning horn and caution light, the POH states the following:

"A horn and an illuminated caution light indicate that rotor RPM may be below safe limits. To restore RPM, immediately roll throttle on, lower collective and, in forward flight, apply aft cyclic...."

Neither the pilot nor the operator submitted a Pilot/Operator Aircraft Accident Report (NTSB Form 6120.1/2).

Administrative Information

Investigator In Charge (IIC):	Eliott Simpson	Report Date:	11/15/2018
Additional Participating Persons:	Stephen Parrent; Federal Aviation Administration FSDO; Long Beach, CA Thom Webster; Robinson Helicopter Company; Torrance, CA		
Publish Date:	10/04/2019		
Note:	The NTSB did not travel to the scene of this accident.		
Investigation Docket:	http://dms.nts.gov/pubdms/search/dockList.cfm?mKey=96052		

The National Transportation Safety Board (NTSB), established in 1967, is an independent federal agency mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available [here](#).