Aviation Investigation Final Report

Location:	Fulton, Missouri	**Accident Number:**	CEN19FA009
Date & Time:	October 17, 2018, 14:21 Local	**Registration:**	N923SH
Aircraft:	Robinson R22	**Aircraft Damage:**	Destroyed
Defining Event:	Fuel related	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Instructional		

Analysis

The pilot was conducting a solo cross-country flight in the helicopter as part of his instruction to obtain his rotorcraft rating. The intent of the flight was to fly solo cross-country to perform touch and go landings at another airport. About 36 minutes after departing on the flight, the helicopter impacted terrain. One witness reported that he saw the helicopter flying and heard the engine stop. He stated that the helicopter began to lose altitude and began to spin in a downward spiral. Another witness reported that he observed the helicopter flying toward him with its nose pointed downward about 45°. He stated that the blades were turning slowly and that the helicopter was making a circular motion along its axis, but not a spiral, as it flew toward the ground.

The helicopter impacted terrain in a nose-low, left-skid-down attitude. Examination of the airframe and engine did not reveal any mechanical pre-impact anomalies. The main rotor blade damage was consistent with low rotor rpm at the time of impact, and the low rotor rpm caution light filament was stretched, consistent with the light being illuminated at the time of impact. Examination of the rotating engine components did not reveal any evidence consistent with rotation at the time of impact. The carburetor heat control in the cockpit was found unlocked and found in the "on" position. According to a carburetor icing probability chart, the atmospheric conditions about the time of the accident were conducive to moderate icing at cruise power settings and serious icing at descent power settings. Thus, it is likely that the helicopter experienced a loss of engine power due to carburetor ice accumulation. Although the carburetor heat was found in the on position, it is likely that the pilot applied the carburetor heat to address the loss of engine power but it was too late and at too low an altitude to restore engine power.

Following the loss of engine power, the main rotor rpm would have rapidly begun to deteriorate unless the pilot immediately reduced collective and entered an autorotation. Given the signatures of low rotor rpm present at the site, it is likely that the pilot failed to initiate the autorotation in a timely manner, which allowed the main rotor rpm to deteriorate to the extent that the main rotor stalled and the pilot would be unable to recover.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:
A total loss of engine power due to carburetor icing, the pilot's delayed application of carburetor heat, and the pilot's delay in entering an autorotation following the loss of engine power, which resulted in a main rotor stall due to low rotor rpm and an uncontrolled descent into terrain.

Findings

Personnel issues	Delayed action - Pilot
Environmental issues	Conducive to carburetor icing - Effect on operation
Environmental issues	Conducive to carburetor icing - Response/compensation
Aircraft	Prop/rotor parameters - Not attained/maintained

Factual Information

History of Flight

Maneuvering	Fuel related (Defining event)
Maneuvering	Loss of engine power (total)
Maneuvering	Loss of control in flight

On October 17, 2018, about 1421 central daylight time, a Robinson R22 Beta helicopter, N923SH, was destroyed when it was involved in an accident near Fulton, Missouri. The pilot was fatally injured. The helicopter was operated as a Title 14 *Code of Federal Regulations* (CFR) Part 91 solo instructional flight.

According to the operator, the pilot had been receiving instruction toward his rotorcraft-helicopter rating. The intent of the flight was to fly solo from Moscow Mills, Missouri, to Columbia Regional Airport (COU), Columbia, Missouri, and perform touch-and-go landings at COU. The helicopter departed Moscow Mills about 1345 and impacted terrain about 36 minutes later while on a direct route to COU.

One witness reported that he saw the helicopter flying and heard the engine stop. He stated that the helicopter began to lose altitude and spin in a downward spiral. Another witness reported that he observed the helicopter flying toward him with its nose pointed downward about 45°. He stated that the blades were turning slowly and that the helicopter was making a circular motion along its axis, but not a spiral, as it flew toward the ground. There were no distress calls from the pilot and no radar information was available for the flight.

Pilot Information

Certificate:	Commercial	**Age:**	47,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 Without waivers/limitations	**Last FAA Medical Exam:**	September 20, 2017
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	October 16, 2017
Flight Time:	(Estimated) 638 hours (Total, all aircraft), 77 hours (Total, this make and model), 36 hours (Last 90 days, all aircraft), 9 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

The pilot had a rotorcraft endorsement for solo flight in the R22 helicopter.

Aircraft and Owner/Operator Information

Aircraft Make:	Robinson	**Registration:**	N923SH
Model/Series:	R22 Beta	**Aircraft Category:**	Helicopter
Year of Manufacture:	2005	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	3864
Landing Gear Type:	N/A; Skid	**Seats:**	2
Date/Type of Last Inspection:	October 8, 2018 Annual	**Certified Max Gross Wt.:**	1369 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	6455.8 Hrs as of last inspection	**Engine Manufacturer:**	Lycoming
ELT:	Not installed	**Engine Model/Series:**	O-360-J2A
Registered Owner:	Spitzer Helicopter Llc	**Rated Power:**	145 Horsepower
Operator:	HeliSat LLC	**Operating Certificate(s) Held:**	None

According to information provided by the operator, the helicopter departed Moscow Mills with 28 gallons of fuel onboard. Information published by the manufacturer indicated that the helicopter consumed between 7 and 10 gallons of fuel per hour.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	COU,889 ft msl	**Distance from Accident Site:**	14 Nautical Miles
Observation Time:	13:54 Local	**Direction from Accident Site:**	80°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	14 knots /	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	330°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	30.42 inches Hg	**Temperature/Dew Point:**	18°C / 2°C
Precipitation and Obscuration:			
Departure Point:	Moscow Mills, MO (None)	**Type of Flight Plan Filed:**	None
Destination:	Columbia, MO (COU)	**Type of Clearance:**	None
Departure Time:	13:45 Local	**Type of Airspace:**	Class E

According to a carburetor icing probability chart, the atmospheric conditions were conducive to moderate icing at cruise power settings and serious icing at descent power settings.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	38.85889,-91.909446(est)

The helicopter wreckage was found in a grassy area in a slight depression in the Potowatami recreational area near Fulton, MO. Initial examination of the wreckage at the accident site showed evidence that the helicopter impacted in a nose-low, left-skid-down attitude. Most of the helicopter wreckage was found resting on its left side, in a 6-foot-wide, 2-foot-deep crater. Portions of the wreckage were partially embedded in the dirt. All components were identified at the accident site, with small pieces of debris and plexiglass from the windscreen located within 30 ft of the main wreckage.

Damage to the main rotor blades was consistent with low rotor rpm at the time of impact. The low rotor rpm annunciator light was examined with a 10x magnifier and showed stretched filaments consistent with it being illuminated at the time of impact. Examination of the airframe components, flight controls, and main and tail rotor drive systems did not reveal any mechanical pre-impact anomalies.

The carburetor heat control in the cockpit was unlocked and bent flush with the console about 1 inch up (in the "on" position). The carburetor heat slider valve was about 1.4-inches open at the carburetor. The main fuel tank was severely impact-damaged and ruptured. A small amount of fuel was present in the auxiliary tank. The carburetor was disassembled, and the float bowls were wet but contained no fuel.

The engine was successfully rotated from the crankshaft to the gearbox. Thumb compression was confirmed on all four cylinders. Engine continuity was confirmed from the crankshaft to the engine accessory gears to the fan. The dowel pin (locator pin) on the crankshaft gear was not sheared. There were both imprint marks and score marks on the oil cooler from the starter ring gears. The score marks were slightly angled and aft of the imprint marks. There were imprints on the cooling panels adjacent to the ring gear on the engine right (aircraft left side). There was no evidence of contact between the alternator fan and the engine, and no evidence of rotational scoring marks on the fan or fan scroll. There was a dent on the left side of the upper frames adjacent to the upper sheave, but no evidence of rotational scoring. No mechanical pre-impact anomalies were observed during the engine examination.

Medical and Pathological Information

The Boone/Callaway County Medical Examiner's Office, Columbia, Missouri, performed an autopsy of the pilot. The pilot's cause of death was multiple blunt force injuries. No significant natural disease was noted.

The FAA's Forensic Sciences Laboratory performed toxicology testing on the pilot's tissue samples. The toxicology tests were negative for drugs and ethanol.

ADDITIONAL INFORMATION
Robinson Helicopter Company Safety Notice SN-24, "Low RPM Rotor Stall Can Be Fatal," stated:

Rotor stall is very similar to the stall of an airplane wings at low airspeeds. As the airspeed of an airplane gets lower…the angle of attack of the wing must be higher for the wing to produce the lift required to support the weight of the airplane…The same thing happens during rotor stall with a helicopter except it occurs due to low rotor RPM instead of low airspeed. As the RPM of the rotor gets lower, the angle of attack of the rotor blades must be higher to generate the lift required to support the weight of the helicopter…Even if the collective is not raised by the pilot to provide the higher blade angle, the helicopter will start to descend until the upward movement of air to the rotor provides the necessary increase in blade angle of attack…The increased drag on the blades acts like a huge rotor brake causing the rotor RPM to rapidly decrease, further increasing the rotor stall. As the helicopter begins to fall, the upward rushing air continues to increase the angle of attack on the slowly-rotating blades, making recovery virtually impossible, even with full down collective.

Administrative Information

Investigator In Charge (IIC):	Lemishko, Alexander
Additional Participating Persons:	Thom Webster; Robinson Helicopters; Torrance, CA David Johnson; FAA FSDO; Kansas City, MO Troy Helgeson; Lycoming Engines; Williamsport, PA
Original Publish Date:	December 3, 2020
Last Revision Date:	
Investigation Class:	Class 2
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=98512