Aviation Investigation Final Report

Location:	Catano, Puerto Rico	**Accident Number:**	ERA15FA096
Date & Time:	January 10, 2015, 10:32 Local	**Registration:**	N348VH
Aircraft:	ROBINSON HELICOPTER R22 BETA	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of control in flight	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Instructional		

Analysis

The student helicopter pilot was on a solo training flight in the airport traffic pattern. He had completed eight approaches via a right downwind approach to the runway, when the air traffic controller advised him that he was number three for his next approach. About 1 minute later, the student pilot requested a left 360-degree turn. The controller then instructed him to hold at his current location and expect to be number four in sequence. During the next 6 minutes, the controller made three attempts to have the student pilot report the traffic to follow on final approach in sight, and the student pilot advised that it was hard for him to hear the controller's instructions due to wind noise. The controller then advised the student pilot to follow an airplane on short final approach, and the student pilot reported the traffic in sight. About 1 minute later, the controller advised the pilot of another airplane to follow the helicopter on the approach. The airplane pilot observed the helicopter ascend in a series of right, 360-degree turns for about 100 to 200 ft. As it climbed, white smoke consistent with a rapid increase in engine rpm and an engine overspeed trailed the helicopter. When the helicopter climbed to an apex of about 800 ft, the ends of both rotor blades coned upward to where the tips were nearly vertical, consistent with a low rotor rpm condition. The helicopter then entered a right, spiraling descent until it impacted the water.

A postaccident examination of the airframe and engine revealed no evidence of mechanical malfunctions or failures with the helicopter that would have precluded normal operation. The main rotor blade elastomeric teeter stops were missing, consistent with low rotor rpm blade flapping. Although the temperature and dew point were conducive to carburetor icing, its formulation likely would not have allowed the helicopter to climb as high as it did just before the accident. More likely, the student pilot became distracted while he attempted to track other aircraft in the traffic pattern and sequence the helicopter for the approach, which led to his failure to maintain rotor rpm. Toxicological testing performed on specimens from the pilot identified butalbital in liver (1.24 ug/g) and in muscle (0.468 ug/g). Estimated corresponding blood levels were likely below the therapeutic window for butalbital, and unlikely to have been directly impairing at the time of the accident.

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 while maneuvering in the airport traffic pattern, which resulted in the helicopter's uncontrolled descent to the water. Contributing to the accident was the student's distraction with other aircraft operating in the traffic pattern.

Findings

Personnel issues	Aircraft control - Student/instructed pilot
Aircraft	Prop/rotor parameters - Not attained/maintained

Factual Information

History of Flight

Approach-VFR pattern downwind	Abrupt maneuver
Approach-VFR pattern downwind	Loss of control in flight (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On January 10, 2015, at 1032 Atlantic standard time, a Robinson R-22 Beta, N348VH, operated by Vertical Solutions Helicopter Company, LLC, was destroyed when it impacted waters of San Juan Bay, off shore Cataño, Puerto Rico. The student pilot was fatally injured. Visual meteorological conditions prevailed, and no flight plan had been filed for the local flight that originated at Fernando Luis Ribas Dominicci Airport (TJIG), Isla Grande, San Juan, Puerto Rico. The solo instructional flight was conducted under the provisions of 14 Code of Federal Regulations Part 91.

According to the student pilot's flight instructor, the student pilot arrived at the hangar about 0800 and began his preflight inspection of the helicopter. Upon completion of the inspection, they spoke for about 20 minutes about the weather conditions at the airport, whether he had all of his documents on him, how long he would fly and what he would be practicing on the flight. They then wheeled the helicopter outside and the student pilot made final preparations for the flight.

About 0845, the student pilot started the helicopter and about 10 minutes later shut it down and walked to the hanger. He explained that the tower controller had said that his request to make right closed traffic patterns could not be accommodated at that time and to try again later. About 0920, the flight instructor phoned the tower to see if the flight could go and got an affirmative response, so he sent the student pilot back out to continue the flight.

The helicopter departed the ramp about 0930 and remained in the traffic pattern for approximately 1 hour. As the flight instructor was sitting in the hangar, he noticed that it was taking longer than normal since he had heard the helicopter go by. He stepped outside and visually located the helicopter in a left holding pattern south of the airport, which was standard procedure when the tower needed sequencing for other aircraft, then he went back inside. A few minutes later, the flight instructor still had not heard the helicopter, so he went outside again, but was unable to locate the helicopter. He then noticed a ports authority vehicle driving towards the police hangar, and about 1 minute later, he observed one of the police helicopters starting. At that moment, the flight instructor suspected a problem. He then called the control tower controller, who told him that he had seen the helicopter spinning and that it impacted the water by Cataño Point.

According to a pilot of a low-wing airplane that was approaching the airport, about 3 to 4 miles on a straight-in approach to runway 9, with the helicopter number two to land. The tower controller asked the pilot if he had the helicopter in sight, after which, the pilot saw an aircraft about ½ mile ahead, about the 2:30 positon (off the right side) of his airplane. The pilot originally thought he saw a radio-controlled

(RC) helicopter, because it was emitting white smoke from the back, as did the RC helicopters he was used to flying. He then saw it make a series of right 360-degree turns "around the rotor head," with the fuselage vertical, and realized it was a helicopter. While turning to the right, the helicopter climbed 100 to 200 feet, reaching an estimated 800 feet. As it did, the ends of both rotor blades coned upwards to where the blades tips were vertical, with the major bending occurring about ¼ blade span from the ends of the blades.

The witness then saw the helicopter's nose drop; it then entered a descent, and spiraled downward to the right three or four times until it impacted the water. It hit the water heading east, nose and right side down. Upon impact, the tailboom separated from the airframe toward the west.

The witness also recalled that the white smoke he originally saw during the climb emanated from the back of the helicopter to a distance of about 1 ½ tailboom-lengths aft of the boom, and that it dissipated once the helicopter began its descent.

According to a police detective, a witness on the ground in Cataño also saw white smoke emanating from the back of the helicopter. However, instead of the helicopter turning, he saw it swinging from side to side like a pendulum as it descended.

A witness who was interviewed by a Federal Aviation Administration (FAA) inspector reported that he heard the engine shut down twice, and after the second time it shut down, the helicopter descended into the water.

Radar data was received from the FAA; however, it was insufficient to construct an accurate plot of the helicopter's positions and altitudes prior to the accident.

Radio transmissions, as noted in the FAA air traffic control Aircraft Accident Package, included:

At 0948, the pilot advised ready for takeoff. The local (tower) controller issued the wind and a takeoff clearance, which the pilot acknowledged.

At 0951, the pilot reported south of the tower and the controller issued the wind and a clearance for the option. The helicopter subsequently completed a series of eight approaches via right downwind to runway 9 through 1023.

At 1024, the pilot reported south of the tower. The controller issued the wind, an option clearance, and instructions to be number three following a Cessna Caravan on final approach. The pilot advised that he was looking for traffic.

At 1025, the pilot requested a left three-sixty [turn] on the right downwind. The controller instructed the pilot to hold south at his current location and expect to be number four in sequence, which the pilot acknowledged.

At 1031, the controller made three attempts to have the pilot report traffic to follow on final approach in sight. The pilot advised it was hard to hear due to wind. The controller then instructed the pilot to follow a Cessna on short final, and issued the wind and a clearance for the option. The pilot reported traffic to

follow in sight.

At 1032, the controller advised another pilot to expect to follow a helicopter on a right base. That pilot reported the helicopter in sight and later that he saw the helicopter go down in the Cataño area.

There were no further transmissions from the helicopter.

Student pilot Information

Certificate:	Student	**Age:**	59,Male
Airplane Rating(s):	None	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	October 2, 2014
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	91 hours (Total, all aircraft), 91 hours (Total, this make and model), 9 hours (Last 90 days, all aircraft), 1 hours (Last 30 days, all aircraft)		

The student pilot, age 59, held an FAA third-class medical certificate dated October 2, 2014. As of his latest logged flight, on January 9, 2015, the pilot indicated 91.7 hours of total flight time.

Aircraft and Owner/Operator Information

Aircraft Make:	ROBINSON HELICOPTER	**Registration:**	N348VH
Model/Series:	R22 BETA	**Aircraft Category:**	Helicopter
Year of Manufacture:	1992	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	2258
Landing Gear Type:	N/A; Skid	**Seats:**	2
Date/Type of Last Inspection:	December 21, 2014 100 hour	**Certified Max Gross Wt.:**	1369 lbs
Time Since Last Inspection:	10 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	3965 Hrs as of last inspection	**Engine Manufacturer:**	LYCOMING
ELT:	Not installed	**Engine Model/Series:**	O-320 SERIES
Registered Owner:	VERTICAL SOLUTIONS HELICOPTER COMPANY LL	**Rated Power:**	160 Horsepower
Operator:	VERTICAL SOLUTIONS HELICOPTER COMPANY LL	**Operating Certificate(s) Held:**	None

The helicopter was powered by a derated Lycoming O-320 series engine driving a two-blade rotor system. The latest 100-hour inspection was completed on December 21, 2014, at a Hobbs time of 2,735.7 hours. Engine total time at that time was 3,965.2 hours, 1,765.2 hours since overhaul.

A company log, that listed each flight, indicated that as of January 9, 2015, the Hobbs meter indicated 2,745.4 hours. At the time of the accident, the Hobbs meter indicated 2,746.3.

The helicopter had an engine rpm governor. According to the Pilot's Operating Handbook, "the governor maintains engine RPM by sensing changes and applying corrective throttle inputs through a friction clutch which can be easily overridden by the pilot. The governor is active only above 80% engine RPM and can be switched on or off using the toggle switch on the end of the right seat collective. The governor is designed to assist in controlling RPM under normal conditions. It may not prevent over- or under-speed conditions generated by aggressive flight maneuvers."

According to a Robinson Helicopter Company representative, a rapid increase in engine rpm along with a slight overspeed can create white smoke out the exhaust, especially in a higher time engine. This requires the pilot to override (or turn off) the governor." Also, "a rapid increase in engine RPM along with raising the collective will result in a nose right yaw and a quick ascent."

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	TJIG,10 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	10:45 Local	**Direction from Accident Site:**	80°
Lowest Cloud Condition:	Scattered / 2500 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	12 knots /	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	100°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.15 inches Hg	**Temperature/Dew Point:**	27°C / 22°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	San Juan, PR (TJIG)	**Type of Flight Plan Filed:**	None
Destination:	San Juan, PR (TJIG)	**Type of Clearance:**	VFR
Departure Time:	09:30 Local	**Type of Airspace:**	Class C

Weather, recorded at TJIG at 1045, included scattered clouds at 2,500 feet, wind from 100 degrees true at 12 knots, temperature 27 degrees C, dew point 22 degrees C, altimeter setting 30.16 inches of Mercury.
For the ambient temperature and dew point, a carburetor icing probability chart found in FAA Special Airworthiness Information Bulletin CE-09-35 indicated "serious icing [at] glide power."

Airport Information

Airport:	Fernando Luis Ribas Dominicci TJIG	**Runway Surface Type:**	Asphalt
Airport Elevation:	10 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	9	**IFR Approach:**	None
Runway Length/Width:	5539 ft / 100 ft	**VFR Approach/Landing:**	Forced landing;Traffic pattern

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:**	18.456666,-66.098335(est)

The helicopter was recovered from San Juan Bay in the vicinity of 18 degrees, 26.53 minutes north latitude, 66 degrees, 07.16 minutes west longitude. The tailboom was initially not recovered.

The wreckage was subsequently taken to a secure facility where it was examined. Cabin crush patterns were consistent with a nose-down, right-side-down water entry. The doors were not installed for the flight.

The instrument console was found separated from the lower console, but tethered by wires. All five flight instruments had water inside of them. The keyed ignition switch was in the "Both" position and the rotor RPM gage indicated 76%. Other instrument indications moved as the wreckage was moved. The clutch switch was in the "Engaged" position, and the "Master Battery" and "Alternator" switches were in the "On" position.
The cyclic was found jammed in the neutral position with the friction off. The collective was jammed about two-thirds of the way up with the friction off. The left tail rotor control pedal was jammed forward and the right tail rotor control pedal was jammed aft. The removable controls (in case a second pilot was onboard) were found stowed under the left seat.

The fuel mixture knob was jammed in the "Full Rich" position, and the throttle grip was jammed in the "Idle" position. The carburetor heat control was jammed .20 inches up from full down (heat off) position. The carburetor heat control wire sheathing was stretched, and the mounting bracket was separated from the air box. The carburetor heat sliding door was deformed and jammed open 1.7 inches, or about 70% heat on.

Both drive V-belts remained on their sheaves and appeared undamaged. The sprag clutch was operated without any anomalies noted.

The engine cooling fan was bent slightly and the upper half of the scroll sustained impact damage. The lower half of the scroll was not recovered. There was a single scuff mark on the edge of the cooling fan inlet adjacent to the scroll lip and several static contact marks on the leading edge of two of the fins. The exhaust system was bent and deformed with the tailpipe up and around the lower sheave and starter ring gear. The alternator cooling fan was deformed on one side, but with no rotational scoring noted. The alternator belt remained in position. The forward face of the upper sheave had a scuff mark adjacent to the lower frame tube. The aft face of the upper sheave had no contact marks. There were no rotational scoring marks noted at any observed contact points.

The engine did not exhibit any preexisting mechanical anomalies that would have precluded normal operation. Approximately 3 gallons of water and oil were drained from the oil sump. The cooling fan was rotated and crankshaft continuity was confirmed with no anomalies noted to the valve train or accessory gears. Thumb compression and suction were observed on all four cylinders. Visual examination of the rocker arms, push rods, valve caps, valve stems, valve springs and lower spark plugs revealed no anomalies. Both magnetos produced spark after internal components were dried.

All oil lines and fittings were secure with no indications of the oil system being compromised. Visual inspection of the oil screen and oil filter element revealed no debris.

The fuel mixture arm on the carburetor was separated from its shaft and the accelerator pump shaft was

slightly bent. Carburetor removal and disassembly revealed no preexisting anomalies. The float bowl was full of liquid consistent in appearance with 100LL aviation fuel and water. The brass floats were undamaged. The gascolator bowl was also full of liquid consistent with 100LL aviation fuel and a small amount of water. Recovery personnel had also noted a fuel-type sheen on the water's surface and an odor of fuel at the crash site.

The forward flex coupling was undamaged, and the intermediate flex coupling was bent and disconnected at the yoke consistent with overload. The main rotor driveshaft was rotated by hand more than 360 degrees with no anomalies noted. Oil was visible in the main rotor gearbox sight gauge.

One main rotor blade was bent slightly upward about 7 feet from the tip, and bent downward and aft slightly about 3 feet from the tip. It had several creases running mostly chordwise from the trailing edge. The trailing edge was bent upward near the tip. There were no visible contact marks on the leading edge. The pitch control bearing rotated smoothly.

The other main rotor blade was bowed upward at midspan. There were no visible contact marks on the leading edge although there was a scuff mark on the upper skin near the tip that appeared to be yellow paint. The paint could not be matched to specific point on the helicopter; however, the only yellow paint on it was on the main rotor blades. The pitch control bearing rotated with resistance.

Both main rotor blade elastomeric teeter stops were missing, consistent with low rpm blade flapping.

On February 27, 2015, the operator learned that portions of the tail had washed onshore about 2 weeks earlier, and that local police had put them in a storage yard. FAA was then able to take photographs and provide them to the investigation team. Review of the photographs did not reveal any preexisting mechanical anomalies.

Instrument warning panel light bulbs were analyzed for filament stretching (bulb illuminated at impact.) Filament stretching was confirmed by the NTSB Materials Laboratory on three of the six bulbs submitted: the ALT bulb, the GOV OFF bulb and the OIL P bulb. The three that did not have filament stretching were the T/R CHIP bulb, the LOW RPM bulb and LOW FUEL bulb.

Medical and Pathological Information

An autopsy was performed on the pilot at El Instituto de Ciencias Forenses de Puerto Rico, San Juan Puerto, where the cause of death was determined to be "severe body trauma."

Toxicological testing was performed by the FAA Forensic Toxicology Research team, Oklahoma City, Oklahoma. Results noted no ethanol, but did find 1.24 (ug/ml, ug/g) of butalbital detected in the liver, 0.468 (ug/ml, ug/g) of butalbital detected in muscle, and losartan detected in the liver.

According to the FAA Aerospace Medical Research web site, butalbital is a short- to intermediate-acting barbiturate. It is commonly used in combination with other drugs such as acetaminophen and caffeine to treat mild to moderate pain, migraines and tension headaches. Losartan is used in the treatment of

hypertension.

Additional Information

RHC Safety Notice 24: LOW RPM ROTOR STALL CAN BE FATAL

Excerpts include:

"Rotor stall due to low RPM causes a very high percentage of helicopter accidents, both fatal and non-fatal. [It] can occur at any airspeed and when it does, the rotor stops producing the lift required to support the helicopter and the aircraft literally falls out of the sky.

Rotor stall is very similar to the stall of an airplane wing at low airspeeds. As the airspeed of an airplane gets lower, the nose-up angle, or angle-of-attack, of the wing must be higher for the wing to produce the lift required to support the weight of the airplane. At a critical angle (about 15 degrees), the airflow over the wing will separate and stall, causing a sudden loss of lift and a very large increase in drag.

The airplane pilot recovers by lowering the nose of the airplane to reduce the wing angle-of-attack below stall and adds power to recover the lost airspeed. 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.

As with the airplane wing, the blade airfoil will stall at a critical angle, resulting in a sudden loss of lift and a large increase in drag. 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.

When the rotor stalls, it does not do so symmetrically because any forward airspeed of the helicopter will produce a higher airflow on the advancing blade than on the retreating blade."

Administrative Information

Investigator In Charge (IIC):	Cox, Paul
Additional Participating Persons:	Gerardo Hernandez; FAA/FSDO; San Juan, PR Thom Webster; Robinson Helicopter; Torrance, CA James Childers; Lycoming Engines ; Williamsport, PA Gregory Bettis; Vertical Solutions Helicopter Company; San Juan, PR
Original Publish Date:	January 26, 2017
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=90589