



Aviation Investigation Factual Report

Location:	Spokane, Washington	Accident Number:	WPR10FA277
Date & Time:	June 2, 2010, 16:30 Local	Registration:	N522SA
Aircraft:	Robinson R22 Beta	Aircraft Damage:	Substantial
Defining Event:	Loss of engine power (total)	Injuries:	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Instructional		

Factual Information

HISTORY OF FLIGHT

On June 2, 2010, about 1630 Pacific daylight time, a Robinson R22 Beta, N522SA, experienced a main rotor blade strike, which separated the tail boom in flight, while in the landing pattern at Felts Field, Spokane, Washington. Inland Helicopters, Inc., was operating the helicopter under the provisions of 14 Code of Federal Regulations (CFR) Part 91. The student pilot sustained fatal injuries; the helicopter sustained substantial damage to the airframe and main rotor blades (MRB) from impact forces. The local instructional flight departed about 1600. Visual meteorological conditions prevailed, and no flight plan had been filed.

The student pilot flew in the traffic pattern with a certified flight instructor, and made a full stop landing on runway 21L. The instructor determined that the student was competent to continue flying solo, and exited the helicopter. This was the student pilot's fourth solo flight. The student completed about five more touch-and-go landings.

On the accident flight, the student reported downwind to the air traffic control tower (ATCT), and the tower controller stated that he cleared the student for landing. He observed the helicopter on base leg; it appeared to be at a normal altitude and attitude. He did not observe any smoke or anything falling from the helicopter. He looked away for a few seconds; when he looked back up, he did not see it.

Witnesses on the ground observed the helicopter flying the base leg at altitudes similar to what they had observed other helicopters in the past. Several witnesses heard one or two pops. One witness stated that the rotor sounds went silent, and the engine sputtered prior to hearing the popping sounds. Some witnesses saw pieces fly off the helicopter, and then it began to spin clockwise. One witness stated that it was V-shaped before it went nose low, and fell straight to the ground.

PERSONNEL INFORMATION

The 29-year-old pilot held a combined student pilot and second-class aviation medical certificate. It had the limitation that the pilot must wear corrective lenses.

An examination of the pilot's logbook indicated an estimated total flight time of 32 hours. He logged 26 hours in the last 90 days, and 11 hours in the last 30 days. He had completed three previous solo flights as pilot-in-command time for a total of 3.3 hours; all were in this make and model. He received an endorsement from a CFI December 21, 2009, stating that he had received the awareness training for the R22 as specified in SFAR 73. This SFAR specified ground training that discussed low rotor rpm (blade stall), rotor rpm decay, and energy

management among other topics. The SFAR required at least 10 hours of dual flight instruction that included enhanced training in autorotation procedures, engine rotor rpm control without the use of the governor, low rotor rpm recognition and recovery, and effects of low G maneuvers and proper recovery.

AIRCRAFT INFORMATION

The helicopter was a Robinson R22 Beta, serial number 3788. A review of the maintenance logbooks indicated that the helicopter had a total airframe time of 2,600 hours at the annual inspection on January 2, 2010. The last 100-hour inspection was on April 15, 2010, at a Hobbs time of 2,696. The Hobbs meter read 2,790.7 at the accident site.

The engine was a Textron Lycoming O-360-J2A, serial number L-38145-36A. Total time recorded on the engine at the 100-hour inspection on April 15, 2010, was 1,219 hours, and time since major overhaul was 496 hours.

METEOROLOGICAL INFORMATION

The airport weather observation station for Spokane (KGEG) issued an aviation routine weather report (METAR) at 1653 PDT. It stated: wind from 190 degrees at 12 knots gusting to 18 knots; visibility 10 miles; sky 1,700 feet scattered, 3,000 feet broken, 5,000 feet overcast; temperature 15/59 degrees Celsius/Fahrenheit; dew point 12/54 degrees Celsius/Fahrenheit; altimeter 29.70 inches of mercury; and relative humidity 83%.

COMMUNICATIONS

The helicopter was in contact with Felts ATCT on frequency 132.5.

AIRPORT INFORMATION

The Airport/ Facility Directory, Northwest U. S., indicated runway 21 was 4,500 feet long and 150 feet wide. The runway surface was concrete.

WRECKAGE AND IMPACT INFORMATION

Investigators from the National Transportation Safety Board (NTSB), the Federal Aviation Administration (FAA), and Robinson Helicopter Company (RHC) examined the wreckage at the accident scene.

The debris path was along a northerly direction, and encompassed an area about 500 feet long by 200 feet wide. The orientation of the fuselage was an estimated 160 degrees.

The tail boom separated into a couple of pieces. The first identified piece of wreckage in the debris field was the aft end of the tail boom with the tail rotor gearbox and a piece of tail rotor

driveshaft attached. The front part of the tail boom and tail rotor drive shaft separated at a rivet line that was about 2 feet aft of the engine. This piece had an impression along a 45-degree angle that was similar in dimension to a main rotor blade (MRB). One tail rotor blade separated about 4 inches from the blade attachment point.

The main wreckage came to rest in the back yard of a residence on its right side. The cabin area was imbedded in the ground, and the right side of the cockpit was crushed inboard to the centerline of the helicopter. The edge of the house was about 10 feet northeast of the wreckage, and investigators did not identify any damage to it, or a child's plastic play station that was 10 feet west. Likewise, investigators observed no damage on 15-foot-high power/phone line wires that were 7 feet to the north, or an estimated 50-foot-tall tree that was about 30 feet north. All ground scars were immediately below the corresponding component, such as skids, mast, and main rotor blades. The ground scars below the main rotor blades were crisp and distinct, and there was no evidence of rotation.

The ground smelled of aviation gasoline. The gascolator contained a blue fluid that smelled like aviation gasoline; it contained no debris or contamination. The fuel screens in the main and auxiliary fuel tanks were clear. First responders reported that they turned the fuel selector valve to the OFF position.

The carburetor heat control knob was unlocked and pulled out 1.7 inches, which equated to 56% of travel. Investigators established system continuity, but could not operate it because of binding due to crush damage. The carburetor heat slider valve in the carburetor heat box was in the on position. In normal operation, it was pushed closed and pulled open.

The governor OFF light filament was broken, but not stretched. The oil pressure bulb sustained crush damage.

MEDICAL AND PATHOLOGICAL INFORMATION

The Spokane County Office of the Medical Examiner completed an autopsy, and ruled the cause of death as numerous blunt force traumas. The FAA Forensic Toxicology Research Team, Oklahoma City, Oklahoma, performed toxicological testing of specimens of the pilot.

Analysis of the specimens contained no findings for carbon monoxide, cyanide, volatiles, and tested drugs.

TESTS AND RESEARCH

Investigators from the NTSB, Robinson, and the operator examined the wreckage at Discount Salvage, Deer Park, Washington. Detailed examination notes are in the public docket.

Airframe

The flight controls had several disconnects; the fracture surfaces were jagged and angular. Some push pull tubes were buckled.

The intermediate flex coupling was distorted and separated.

The fuel screens in the main and auxiliary fuel tanks were clear.

No preimpact anomalies were detected that would have precluded normal operation of the airframe.

Engine Examination

The starter ring gear showed no signs of rotational scoring. The oil cooler had an impression next to the starter ring gear with the same size and spacing of the teeth on the gear. A similar impression was on the exhaust tailpipe.

Investigators manually rotated the crankshaft. The crankshaft rotated freely, and the valves moved approximately the same amount of lift in firing order. The gears in the accessory case turned freely. Investigators obtained thumb compression on all cylinders in firing order.

Investigators manually rotated the magnetos, and both magnetos produced spark at all posts.

The carburetor sustained crush damage; the fuel screen in the carburetor was clear, and not contaminated. The metal floats exhibited hydraulic crush damage.

The oil filter was clean.

Investigators observed no anomalies that would have precluded normal operation of the engine.

ADDITIONAL INFORMATION

FAA Special Airworthiness Information Bulletin (SAIB) CE-09-35

The FAA published SAIB CE-09-35 on June 30, 2009, regarding carburetor ice prevention.

The SAIB notes that carburetor icing doesn't just occur in freezing conditions; it can occur at temperatures well above freezing temperatures when there is visible moisture or high humidity. It states that icing can occur in the carburetor at temperatures above freezing. Because vaporization of fuel, combined with the expansion of air as it flows through the carburetor (the venturi effect) causes sudden cooling, a significant amount of ice can build up within a fraction of a second. The SAIB contains a graph that illustrates the probability of carburetor icing for various temperature and relative humidity conditions. The conditions encountered in this accident (ambient temperature 59 degrees / dew point 54 degrees

Fahrenheit, 83% relative humidity), were in the area of serious icing at cruise power.

Pilot Operating Handbook (POH)

The R22 POH stated that a carburetor heat assist device was installed on the helicopter. The device correlated application of carburetor heat with changes in the collective setting. Lowering the collective mechanically added heat and raising collective reduced heat. The system included a latch at the control knob to lock the carburetor heat off when not required. The system contained a friction clutch that allowed the pilot to override the system. It instructed the pilot to readjust carburetor heat as necessary following any change in power. The CFI stated that he stressed the importance of using carburetor heat while landing, and the student pilot used it on the landing while the CFI was on board.

Robinson Helicopter Safety Notice SN-25

Robinson revised their SN-25, originally issued in December 1986, in November 1999. It stated that carburetor ice could cause engine stoppage, and was most likely to occur when there was high humidity or visible moisture, and the air temperature was below 70 degrees Fahrenheit. It stated that during descent or autorotation, the pilot should ignore the carburetor air temperature gauge, and apply full carburetor heat. Robinson published a revision to SN-25 in July 2012. It pointed out that carburetor heat may be required on takeoff, and the carburetor heat control knob should be left unlatched unless it was obvious that conditions were not conducive to carburetor ice. It also noted that carburetor ice could form at outside air temperatures as high as 30°Celsius (86° Fahrenheit).

NTSB Special Investigative Report

The NTSB Special Investigative Report "Robinson Helicopter Company R22 Loss of Main Rotor Control Accidents" was adopted April 2, 1996. The Safety Board concluded that the low inertia main rotor blade could diverge from normal rotation to strike the body of the helicopter in just a few revolutions of the blade. This would take less than 0.5 seconds when the blade was operating at a normal rate of 530 rpm.

Robinson Helicopter Safety Notice SN-24

Robinson revised their Safety Notice SN-24, originally issued in September 1986, in June 1994. It noted that main rotor blade stall due to low main rotor revolutions per minute (rpm) caused a very high percentage of helicopter accidents. It pointed out that the stall could occur at any airspeed; the main rotor would stop providing lift, which would lead to an immediate uncontrolled descent. It stated that the main rotor blade airfoil stalls at a critical angle of attack, which results in a sudden loss of lift and a large increase in drag. The increased drag would act like a large rotor brake; this would cause the main rotor rpm to rapidly decrease, which would further increase the rotor stall. As the helicopter fell, upward rushing air would continue to increase the angle of attack on the blades, which were slowly rotating. It stated

that this would make recovery virtually impossible, even with full down collective. It indicated that rotor stall above 40-50 feet would most likely be fatal.

The Safety Notice stated that the main rotor would not stall symmetrically due to the higher speed of the advancing blade. Thus, the retreating blade would stall first; it could dive as it went aft, but the advancing blade was still climbing as it went forward. This could result in a rapid aft tilt to the rotor, which was sometimes referred to as rotor blow-back. As the helicopter fell, the upward flow of air would push the tail surfaces up and the nose down. Combined with the pilot's attempts to pull the nose up by applying aft cyclic, this frequently allowed the main rotor blades to chop off the helicopter's tail. The forces would be too great for the main rotor teeter stops to prevent it.

Robinson Changes

In June 2012, Robinson made changes to the POH. They added "set as required" to the carburetor heat line of the starting engines and run-up checklist, and "adjust carb heat as required" to the takeoff procedure in the normal procedures section of the POH. Additional changes were made to the use of carburetor heat and use of carburetor heat assist sections.

Student pilot Information

Certificate:	Student	Age:	29, Male
Airplane Rating(s):	None	Seat Occupied:	Right
Other Aircraft Rating(s):	None	Restraint Used:	
Instrument Rating(s):	None	Second Pilot Present:	No
Instructor Rating(s):	None	Toxicology Performed:	Yes
Medical Certification:	Class 2 With waivers/limitations	Last FAA Medical Exam:	February 9, 2010
Occupational Pilot:	No	Last Flight Review or Equivalent:	
Flight Time:	32 hours (Total, all aircraft), 32 hours (Total, this make and model), 3 hours (Pilot In Command, all aircraft), 26 hours (Last 90 days, all aircraft), 11 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Robinson	Registration:	N522SA
Model/Series:	R22 Beta	Aircraft Category:	Helicopter
Year of Manufacture:		Amateur Built:	
Airworthiness Certificate:	Normal	Serial Number:	3788
Landing Gear Type:	Skid	Seats:	2
Date/Type of Last Inspection:	April 15, 2010 100 hour	Certified Max Gross Wt.:	
Time Since Last Inspection:	94 Hrs	Engines:	1 Reciprocating
Airframe Total Time:	2790 Hrs at time of accident	Engine Manufacturer:	Lycoming
ELT:	Not installed	Engine Model/Series:	O-360-J2A
Registered Owner:	Richard Carter	Rated Power:	180 Horsepower
Operator:	Inland Helicopters, Inc.	Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	KGEG, 2376 ft msl	Distance from Accident Site:	
Observation Time:	16:53 Local	Direction from Accident Site:	
Lowest Cloud Condition:	Scattered / 1700 ft AGL	Visibility	10 miles
Lowest Ceiling:	Broken / 3000 ft AGL	Visibility (RVR):	
Wind Speed/Gusts:	12 knots / 18 knots	Turbulence Type Forecast/Actual:	/
Wind Direction:	190°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	29.7 inches Hg	Temperature/Dew Point:	15°C / 12°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Spokane, WA (SFF)	Type of Flight Plan Filed:	None
Destination:	Spokane, WA (SFF)	Type of Clearance:	None
Departure Time:	16:00 Local	Type of Airspace:	

Airport Information

Airport:	Felts Field SFF	Runway Surface Type:	
Airport Elevation:	1953 ft msl	Runway Surface Condition:	
Runway Used:		IFR Approach:	None
Runway Length/Width:		VFR Approach/Landing:	Touch and go

Wreckage and Impact Information

Crew Injuries:	1 Fatal	Aircraft Damage:	Substantial
Passenger Injuries:		Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	1 Fatal	Latitude, Longitude:	47.690555,-117.301666(est)

Administrative Information

Investigator In Charge (IIC):	Plagens, Howard
Additional Participating Persons:	James Black; FAA Spokane FSDO; Spokane, WA Thom Webster; Robinson Helicopter Company; Torrance, CA David Valenti; Inland Helicopters, Inc; Spokane, WA
Report Date:	August 14, 2012
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=76204

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available [here](#).