Aviation Investigation Final Report

Location:	Sequim, Washington	**Accident Number:**	WPR09LA350
Date & Time:	July 15, 2009, 17:30 Local	**Registration:**	N3213K
Aircraft:	BIELAWA ROTORWAY E	**Aircraft Damage:**	Substantial
Defining Event:	Loss of control in flight	**Injuries:**	2 Minor
Flight Conducted Under:	Part 91: General aviation - Instructional		

Analysis

During a stationary low hover of the recently built experimental helicopter, it suddenly and without warning rotated rapidly in a counter-clockwise direction around its longitudinal axis, and immediately impacted the ground. The investigation determined that one of the main rotor blades had failed (disbonded), leading to an immediate loss of control in flight. The composite blade, which was designed specifically for use on one manufacturer's experimental helicopter, was being used on another manufacturer's experimental helicopter, as allowed by its experimental designation. Due to the lack of sufficient engineering, manufacturing, and testing data, the precise initiating factor of the disbonding event could not be determined.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The failure (disbonding) of a composite main rotor blade for undetermined reasons, leading to an immediate loss of control in flight during hover.

Findings

Aircraft	Main rotor blade system - Failure

Factual Information

History of Flight

Maneuvering-hover	Sys/Comp malf/fail (non-power)
Maneuvering-hover	Loss of control in flight (Defining event)
Maneuvering-hover	Collision with terr/obj (non-CFIT)

On July 15, 2009, about 1730 Pacific daylight time, a Rotorway Exec 162F experimental helicopter, N3213K, impacted the terrain at Sequim Valley Airport, Sequim, Washington, while the pilot was in a low hover over a grassy area. The commercial pilot and owner/builder of the helicopter, who was flying from the left seat, received minor injuries. The flight instructor, who was in the right seat, received minor injuries, and the helicopter, which was owned and operated by the commercial pilot, sustained substantial damage. The 14 Code of Federal Regulations Part 91 combination instructional and phase one test flight had been airborne within the confines of Sequim Valley Airport for about 30 minutes. The flight took place in visual meteorological conditions. No flight plan had been filed.

According to both pilots, the flight instructor flew the recently completed kit helicopter solo for its first 30 minutes of flight. During that flight he found the flight control rigging and the center of gravity to be "perfect." After the initial test flight, the two pilots commenced a series of instructional/test hover flights, with the commercial pilot doing most of the flying, and the flight instructor providing instruction and backup. During one of these flights, while the commercial pilot was in a two to three foot stationary hover with the helicopter facing into the wind, the helicopter suddenly rolled violently in a counterclockwise direction around its longitudinal axis, and then "slammed into the ground." At the time the helicopter departed controlled flight both pilots applied full right cyclic, but reportedly the helicopter did not respond to the cyclic inputs. According to the instructor pilot, the whole sequence seemed to take no more than one second. According to both pilots, the rotor rpm was near the middle of the green arc at the time of event initiation (the green arc represents a main rotor speed of 520 rpm plus or minus four percent).

An initial on-site inspection of the helicopter by a Federal Aviation Administration (FAA) Airworthiness Inspector found no structural or flight control system anomalies that would have led to a loss of control in flight. That inspection did reveal that the main rotor blades that were installed on the helicopter were not the bonded metal blades provided by the manufacturer of the kit, but instead were composite blades that the builder/owner had purchased from Canadian Home Rotors (CHR) in October of 2005. These blades were designed specifically for use on the Safari helicopter, a product of CHR, but were permitted to be used on the RotorWay Exec 162F due to its experimental designation.

The on-site investigation determined that both main rotor blades had taken on a permanent

upward bending deflection. On one blade, marked as "A", the deflection started at a location about two feet outboard of its root. On the other blade, marked as "B", the deflection started about four feet from its root. On blade "A" the top skin had disbonded from the bottom skin and the blade spar from a point about 21 inches from its root to a point about 20 inches from its tip (see photo #1). The blade spar itself had fractured at about the same location, with the blade spar and lower skin outboard of that location being retained only by its connection to the brass leading edge weight rod, which extends along the entire length of the blade (see photo #2). On blade "B" the bottom and top skins had disbonded from each other and separated from the blade spar from a point about two-thirds of its span to within about 18 inches of the tip. The most outboard 18 inches of the blade, including the spar, had separated as a single unit (see photo #3). The bottom of both blades contained chord-wise scuff marks from the tip to a point about three feet inboard of the tip. These scuff marks were consistent with the blade tips coming in rotational contact with soil and vegetation.

After the on-site investigation, the FAA Inspector recovered both blades to the NTSB's Seattle, Washington office, where after further inspection by the NTSB Investigator-In-Charge (IIC), the decision was made to send blade "A" to the NTSB's Materials Laboratory in Washington, D.C. for detailed examination and testing (see National Transportation Safety Board Materials Laboratory Factual Report Number 10—025).

The materials laboratory examination determined that the area around the blade root mounting holes did not show any evidence of elongation, distortion, or cracking that would have been consistent with a blade strike of the terrain being the initiating event. It was further noted that the bedding compound used between the blade surface and its attach mounting straps appeared to have cleanly disbonded at the time the blades were unbolted for removal and shipment. The bedding compound did not show any evidence of chord-wise disbonding consistent with a blade impact with the terrain being the initiating event. The examination further determined that the extruded aluminum alloy 6061-T6 blade spar met the manufacturer's specification for chemical composition and heat treatment temper condition.

The laboratory's inspection/test sequence determined that while the helicopter was hovering, air loads brought the blade to a critical point of upward deflection, whereupon a small upward buckle developed in the composite top skin near the root of the blade. This buckle resulted in a small localized disbonding between the top skin and the leading edge spar. With further upward deflection of the blade, the buckle size grew, resulting in the formation of a disbonding crack front that propagated primarily toward the blade tip. Propagation of the disbonding front, and the resultant excess bending of the blade, then resulted in the fracture of the top skin about 20 inches from its root. Almost simultaneously, the blade spar fractured in bending overstress at about the same location. Subsequent contact with the grassy terrain resulted in additional upward and in-plain bending of the spar and bottom skin.

The laboratory was not able to determine with certainty if the rotor blade was manufactured to specifications. This was primarily due to the fact that the only "manufacturing document" provided by the manufacturer (Canadian Home Rotors), entitled Making Safari Composite

Blades, was not sufficiently detailed, and did not contain specifications that were necessary to make that determination (for example, the adhesive thickness for bonding the skins to the blade spar; dimensional tolerances for the trailing edge adhesive fillet; and composite layer thickness). In addition, other disparate engineering documents provided by Canadian Home Rotors did not reveal any mechanical testing of actual rotor blade samples to substantiate engineering calculations and to enhance the understanding of the blade's actual strength, stiffness, and durability. Although the laboratory was able to determine the initiating location and sequence of disbonding, due to the lack of the aforementioned pertinent data, the reason for the failure at that specific location and time could not be determined.

Pilot Information

Certificate:	Commercial	**Age:**	70,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	April 3, 2009
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	April 22, 2008
Flight Time:	1418 hours (Total, all aircraft), 23 hours (Total, this make and model), 1207 hours (Pilot In Command, all aircraft), 14 hours (Last 90 days, all aircraft), 13 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft)		

Flight instructor Information

Certificate:	Commercial; Flight instructor	**Age:**	58
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	Yes
Instructor Rating(s):	Helicopter	**Toxicology Performed:**	No
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	March 3, 2009
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	December 20, 2007
Flight Time:	4229 hours (Total, all aircraft), 2115 hours (Total, this make and model), 4120 hours (Pilot In Command, all aircraft), 101 hours (Last 90 days, all aircraft), 14 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	BIELAWA	**Registration:**	N3213K
Model/Series:	ROTORWAY E 162F	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	Yes
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	6804
Landing Gear Type:	Skid	**Seats:**	2
Date/Type of Last Inspection:	July 14, 2009 Condition	**Certified Max Gross Wt.:**	1500 lbs
Time Since Last Inspection:	5 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	5 Hrs at time of accident	**Engine Manufacturer:**	Rotorway
ELT:	Installed, not activated	**Engine Model/Series:**	162F
Registered Owner:	R L BIELAWA ASSOCIATES INC	**Rated Power:**	150 Horsepower
Operator:	R L BIELAWA ASSOCIATES INC	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:		**Distance from Accident Site:**	
Observation Time:		**Direction from Accident Site:**	
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:		**Temperature/Dew Point:**	21°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Sequim, WA (W28)	**Type of Flight Plan Filed:**	None
Destination:	Sequim, WA (W28)	**Type of Clearance:**	None
Departure Time:	17:00 Local	**Type of Airspace:**	

Airport Information

Airport:	Sequim Valley W28	**Runway Surface Type:**	
Airport Elevation:		**Runway Surface Condition:**	
Runway Used:		**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	2 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Minor	**Latitude, Longitude:**	48.097778,-123.185279(est)

Administrative Information

Investigator In Charge (IIC):	Anderson, Orrin
Additional Participating Persons:	Jennifer Audette; Seattle FSDO; Renton, WA
Original Publish Date:	July 22, 2010
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=74305