

Aviation Investigation Final Report

| Location: | MARSHALL, Wash | nington | Accident Number: | SEA99FA013 |
|-------------------------|--|-----------------|------------------|------------|
| Date & Time: | November 10, 199 | 98, 09:00 Local | Registration: | N752GB |
| Aircraft: | Hiller | UH-12E | Aircraft Damage: | Destroyed |
| Defining Event: | | | Injuries: | 1 Fatal |
| Flight Conducted Under: | Part 91: General aviation - Other work use | | | |

Analysis

While climbing out after takeoff from the helicopter pad located at the pilot's residence/place of business, the bolt that connected the lower end of the upper-firewall lateral cyclic linkage bellcrank to its push rod separated from the aircraft. With the bolt missing from the control linkage, the necessary increase of the angle of attack (cyclic feathering) of the retreating blade (port blade) could not take place. Without this feathering, which is produced by the lateral position of the cyclic, the forward-moving blade (starboard side)produced considerably more lift than the retreating blade. This resulted in an uncontrolled roll to the left and an uncontrolled descent into the terrain.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The loss of the bolt that connects the lateral cyclic linkage push rod to the lower end of the upper firewall-mounted lateral cyclic linkage bellcrank, resulting in an uncontrolled descent into the terrain.

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION Phase of Operation: CLIMB - TO CRUISE

Findings 1. (C) ROTORCRAFT FLIGHT CONTROL, CYCLIC CONTROL ROD - DISCONNECTED -----

Occurrence #2: IN FLIGHT COLLISION WITH TERRAIN/WATER Phase of Operation: DESCENT - UNCONTROLLED

Factual Information

HISTORY OF FLIGHT

On November 10, 1998, approximately 0900 Pacific standard time, a Hiller UH-12E, N752GB, operated by the pilot as a 14 CFR Part 91 repositioning flight, impacted the terrain during climb-out from a helicopter pad located at his residence near Cheney, Washington. Visual meteorological conditions prevailed at the time of the accident, and no flight plan was filed. The aircraft was destroyed, and the commercial pilot, who was the sole occupant, was fatally injured. The aircraft, which was en route to Keller, Washington, is believed to have been airborne for less than one minute prior to the impact.

On the morning of the accident, the pilot was planning to fly to Keller, Washington, where he was to pick up Colville tribal biologist for a kokanee salmon count on the Sanpoil River. Around 0830 that morning, the pilot preflighted the helicopter on the landing pad at his residence/place of business. Around 0845, as the pilot's wife left the residence to go into town, she noticed that her husband was in the aircraft and the engine was running. She reported that at that time nothing sounded or looked abnormal. Although no one else reported seeing the helicopter after that, an individual who lived on adjacent property heard the pilot start the aircraft and perform what sounded to him like a pre-takeoff engine run. According to this witness, because of the close proximity of his property, he had heard and seen the pilot start the helicopter, perform a ground run-up, take off, and depart the area many times over the vears. He said that because he had observed the operation of the helicopter so many times. that even without watching the aircraft, he could tell by the change in engine/rotor sound when the pilot was taking off. This witness reported that both the ground-run and the takeoff sounded normal, but that about 30 seconds after the helicopter lifted off, there was a loud clanking sound for three or four seconds, and then the engine/rotor went silent. Because the witness thought the sound he heard was the main rotor blades striking the pilot's shop building while the aircraft was in a hover near its pad, he did not investigate further. The helicopter, which is believed to have generated the clanking sounds when its main rotor blades impacted the terrain, remained undetected at the crash site until approximately 1015. At that time the aircraft was discovered by the pilot's wife, who had returned from town and was on a horseback ride when she came upon the wreckage.

METEOROLOGICAL INFORMATION

The surface weather observation taken at 0856, at Spokane International Airport, which is located about 12 miles west of the accident site, reported 10 miles visibility, winds 170 degrees at 7 knots, few clouds at 4,000 feet, scattered clouds at 9,000 feet, temperature 2 degrees Celsius, dew point 0 degrees, with an altimeter setting of 29.99 inches of mercury. The individual who heard the aircraft impact the terrain reported that there were scattered clouds

and a light breeze.

WRECKAGE AND IMPACT INFORMATION

The aircraft impacted the ground approximately six miles north of Cheney, Washington, at 47 degrees, 33.29 minutes north, 117 degrees, 29.88 minutes west. It came to rest approximately 220 yards southwest of the helipad from which it departed. The fuselage was found inverted on the east edge of the dirt/gravel road that exits the south end of the pilot's property and connects with South Cheney Spokane Road. The most northerly sign of contact with the ground was a divot in the soft terrain along the east side of the road (see wreckage diagram). The main rotor mast, blades, and paddles were found about 10 feet past this divot, and about 6 feet east of the road. The fuselage was located about 20 feet past the rotor components, and small pieces of the bubble canopy were spread over an area up to 20 feet past the fuselage. Except for the initial small divot (which appeared to have been made by a main rotor blade tip), there were no ground scars that would indicate the fuselage had moved after its initial contact with the ground. The fuselage itself had crushed/shattered the bubble canopy covering the cockpit area, and the longitudinal axis of the helicopter was aligned with a magnetic heading of 232 degrees. The tail boom had torn and partially separated from the main fuselage at the cardan joint, and the forward (large diameter) tail rotor drive shaft had torn from the its attach plate on the front of the joint. The aft driveshaft (small diameter) sheared about one foot aft of the joint, and the cardan joint itself had been driven aft into the tailboom structure. The tail rotor assembly had torn from the tailboom at its attach fitting, but was still attached to the aft drive shaft and the pitch change cables. The fin was still attached to the aft end of the boom, and the tail rotor blades were still attached to their hub. A portion of one tail rotor blade had been torn off at about half its span, and the other was bent aft about 45 degrees just outboard of its reinforcing web. When the drive shaft was rotated by hand, the tail rotor rotated normally, and when the pitch change cables were pulled, the pitch change links rotated the blades in a normal manner.

The middle and upper main-rotor gear box housings had separated from the lower housing, and these housings, along with the main rotor shaft, main rotor hub, both rotor paddles, and both main blades were located about 12 feet to the left (east) of the main wreckage. The entire assembly had impacted soft sandy soil, and the main blades were bowed aft in a relatively continuous arc, and much of their structure had been crushed/accordianed forward toward their leading edge. The soft terrain that was thrown out of the blade impact craters was thrown forward (southwest), indicating a clockwise blade rotation as viewed from above(inverted aircraft). The trailing edge of the "red" blade had split open along its seam for most of its length, and its drag link had failed in overload. The drag link-to-blade attach bolt on the "blue" blade had failed in overload, and the antinodal weight assembly was found to be intact on both blades. Both blades were still attached to their forks. One rotor paddle, which was crushed rearward along the top of its leading edge, had separated from its hub at the paddle-to-hub attach collar. The other paddle, which was still attached to the hub, showed only minor wrinkling along its trailing wedge. Both ballast flyweight arm assemblies and both incidence arms/links were still attached and moved freely. Both the lateral and fore/aft cyclic gearbox-

mounted bellcranks, as well as the collective yoke arm, had fractured. The lateral and fore/aft cyclic push rods, with portions of their associated bellcranks attached, were still connected to the wobble plate. The entire cyclic and collective control linkage system was inspected both at the accident site and later during a teardown inspection in an enclosed hangar. Throughout both systems, there were a number of overload failures of push rods, push rod end eyes, attach fittings, and bellcranks. During the inspection of the cyclic control system, it was found that the lateral cyclic linkage push rod running from the lower firewall bellcrank to the upper firewall bellcrank was not attached to the lower end of the upper bellcrank. Neither the push rod end eye nor either leg of the bellcrank fork had failed, and no associated bolt could be found at the location where that portion of the assembly had contacted the ground. There was no distortion or scarring of the holes through which the bolt passed on either the push rod eye end or the arms of the bellcrank fork. Except for the missing bolt, there was no other indication of pre-impact malfunction or anomaly in the collective or cyclic linkage system.

After being moved to the enclosed hangar, the engine and clutch assembly were disassembled and inspected. All ignition and spark plugs remained attached and intact. The plugs all showed normal wear on their electrodes, and there was no evidence of contamination or unusual lead buildup. Both the oil cooler and oil filter were clean, with no evidence of contaminants or obstructions. There was no evidence of oil loss or any lack of lubrication. Both magnetos were separated from their mounting pads by impact forces and their flanges were fractured. Both magnetos were rotated manually and a spark was produced at every terminal. The crankshaft was free to rotate and mechanical continuity was established from the crankshaft to the valve assemblies and accessory section. Fuel was found in the main fuel line to the carburetor, and a fuel sample was of the correct color and smell for 100 low-lead aviation fuel. No contamination or water was apparent in the fuel. All cylinders and pistons were removed, allowing visual inspection of the crankshaft and camshaft lobes and tappet faces. There was no evidence on any internal component of improper lubrication or heat stress. There was no evidence of any internal failure or anomaly. The clutch assembly, which was found to work normally, was partially disassembled, and there was no indication of any gear or shaft failure, nor was there any evidence of insufficient lubrication.

MEDICAL AND PATHOLOGICAL INFORMATION

Doctor George M. Lindholm, M.D., performed an autopsy on the pilot, and the cause of death was attributed to blunt force impacted injuries as the result of an aircraft accident.

A forensic toxicology examination was performed on the pilot by FAA's Toxicology and Accident research Laboratory, and no carbon monoxide, cyanide, ethanol, or drugs were found in his blood.

ADDITIONAL DATA AND INFORMATION

According to the manufacturer, with a bolt missing out of the lateral cyclic control linkage, the necessary increase of angle of attack (cyclic feathering) on the retreating blade (port side) will

not take place. According to United States Army Field Manual 1-203 (Fundamentals of Flight), without this feathering, in a forward-moving helicopter, the starboard side blade will produce more lift than the retreating blade. This dissymmetry of lift would result in a left-rolling tendency that could not be compensated for.

On March 16, 1999, at Seattle, Washington, the aircraft was released to Barrus and Stiger, a representative of the owner.

Pilot Information

| Certificate: | Commercial | Age: | 54,Male |
|---------------------------|--|------------------------------------|-------------------|
| Airplane Rating(s): | Single-engine land; Single-engine sea | Seat Occupied: | Left |
| Other Aircraft Rating(s): | Glider; Helicopter | Restraint Used: | |
| Instrument Rating(s): | Airplane | Second Pilot Present: | No |
| Instructor Rating(s): | Airplane single-engine; Helicopter | Toxicology Performed: | Yes |
| Medical Certification: | Class 2 Valid Medicalw/ waivers/lim | Last FAA Medical Exam: | December 10, 1997 |
| Occupational Pilot: | Yes | Last Flight Review or Equivalent: | |
| Flight Time: | 9300 hours (Total, all aircraft), 7000 | hours (Total, this make and model) | |

Aircraft and Owner/Operator Information

| Aircraft Make: | Hiller | Registration: | N752GB |
|----------------------------------|------------------------|-----------------------------------|-----------------|
| Model/Series: | UH-12E UH-12E | Aircraft Category: | Helicopter |
| Year of Manufacture: | | Amateur Built: | |
| Airworthiness Certificate: | Normal | Serial Number: | 1752 |
| Landing Gear Type: | Skid | Seats: | 3 |
| Date/Type of Last Inspection: | June 17, 1998 100 hour | Certified Max Gross Wt.: | 3100 lbs |
| Time Since Last Inspection: | 91 Hrs | Engines: | 1 Reciprocating |
| Airframe Total Time: | 8515 Hrs | Engine Manufacturer: | Lycoming |
| ELT: | Not installed | Engine Model/Series: | VO-540-C2A |
| Registered Owner: | DONALD G. BECK | Rated Power: | 340 Horsepower |
| Operator: | | Operating Certificate(s) Held: | None |
| Operator Does Business As: | | Operator Designator Code: | |

Meteorological Information and Flight Plan

| Conditions at Accident Site: | Visual (VMC) | Condition of Light: | Not reported |
|---|----------------------------------|---|-------------------|
| Observation Facility, Elevation: | KGE ,2372 ft msl | Distance from Accident Site: | 12 Nautical Miles |
| Observation Time: | 08:56 Local | Direction from Accident Site: | 280° |
| Lowest Cloud Condition: | Scattered / 4000 ft AGL | Visibility | 10 miles |
| Lowest Ceiling: | None | Visibility (RVR): | |
| Wind Speed/Gusts: | 7 knots / None | Turbulence Type Forecast/Actual: | / |
| Wind Direction: | 170° | Turbulence Severity Forecast/Actual: | / |
| Altimeter Setting: | 29 inches Hg | Temperature/Dew Point: | 2°C |
| Precipitation and Obscuration: | No Obscuration; No Precipitation | | |
| Departure Point: | | Type of Flight Plan Filed: | None |
| Destination: | KELLER | Type of Clearance: | None |
| Departure Time: | 08:59 Local | Type of Airspace: | Class G |

Airport Information

| Airport: | | Runway Surface Type: | |
|----------------------|---|---------------------------|------|
| Airport Elevation: | | Runway Surface Condition: | |
| Runway Used: | 0 | IFR Approach: | None |
| Runway Length/Width: | | VFR Approach/Landing: | None |

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: | 47.430717,-117.620239(est) |

Administrative Information

| Investigator In Charge (IIC): | Anderson, Orrin | |
|--------------------------------------|--|--|
| Additional Participating Persons: | PHIL VITTETOE; SPOKANE, WA | |
| Original Publish Date: | January 11, 2000 | |
| Last Revision Date: | | |
| Investigation Class: | <u>Class</u> | |
| Note: | | |
| Investigation Docket: | https://data.ntsb.gov/Docket?ProjectID=45310 | |

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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.