# National Transportation Safety Board
# Aviation Accident Factual Report

| | | | |
|---|---|---|---|
| **Location:** | STITES, ID | **Accident Number:** | SEA00TA013 |
| **Date & Time:** | 11/02/1999, 1118 PST | **Registration:** | N5388V |
| **Aircraft:** | Hiller UH-12E | **Aircraft Damage:** | Substantial |
| **Defining Event:** | | **Injuries:** | 2 Serious, 1 None |
| **Flight Conducted Under:** | Public Aircraft | | |

On November 2, 1999, approximately 1118 Pacific standard time, a Hiller UH-12E helicopter, N5388V, registered to Valley Helicopter Service of Clarkston, Washington, on a public-use fish survey in the Nez Perce Indian Reservation being conducted by the Nez Perce Tribe, experienced an inflight separation of a control rotor near Stites, Idaho. Following the control rotor separation, the helicopter struck power lines while in an emergency descent and subsequently impacted the ground. The helicopter was substantially damaged in the accident. The commercial pilot-in-command of the helicopter and one of the helicopter's two other occupants (both biologists conducting the survey) received serious injuries. The third occupant of the helicopter was not injured. The pilot reported that visual meteorological conditions prevailed and a company visual flight rules (VFR) flight plan had been filed for the flight from Clarkston, Washington, to Grangeville, Idaho.

The pilot reported:

We were performing a Chinook redd fish survey for the Nez Perce Indian Tribe along the Clearwater River....The fish count is made about 100' above the river, so as we approached the town of Stites, I climbed up to about 400' and started to cross over a rural area. As we leveled out at 400' AGL straight and level, we got a severe out of track condition on the main rotor blades. I increased the RPM slightly to see if it would smooth out, but this was not effective and at that time we got a severe lateral gyration that felt like a broken tt [sic] pin or drag strut, but was much more severe.

I dropped the pitch and setup a decent [sic] that gave me the least feed- back and gyration. The out of balance condition was so severe that I felt the engine mounts were about to fail. The engine was running normal and the [tail rotor] controls were effective. Any change out of neutral position on the cyclic control gave the indication of a roll over effect, so I held the cyclic in the neutral position and used the [tail rotor] control to line the aircraft toward an open pasture.

As we descended to about 100' AGL, I noticed a powerline crossing directly across my landing area and rather than make a control change to avoid it, as the helicopter was very

unstable, I decided to hit it square with my skids. The engine was running at this point, and as we hit the lines the helicopter broke through but the lines wrapped around the mast slowing the the RPM and the rate of decent [sic] and we dropped vertically at that point with full collective pitch.

When I pulled pitch we turned 90 degrees but hit level on both skids.... The blades stopped immediately and we evacuated the helicopter....

The control rotor paddle and part of the aluminum cuff was later found where it separated from the aircraft, about...1/4 mile from the landing/ impact site.

An FAA inspector from the Spokane, Washington, FAA Flight Standards District Office (FSDO), who took possession of the separated control rotor following the accident, reported that the control rotor separated at the cuff and trunnion area. The separated control rotor was one of two control rotors on the UH-12E that provide cyclic control to the main rotor disc (mechanical linkage from the cyclic control operates to cyclically vary the angle of incidence of the control rotors, which in turn tilts the main rotor disc in the commanded direction via aerodynamic and gyroscopic forces.)

Component service and maintenance history data furnished to the NTSB indicates that the fractured cuff was installed new in the cuff and trunnion assembly during a 1980 overhaul of the assembly. From 1980 to 1996, the cuff and trunnion assembly was installed on two other helicopters for a total of five different periods of service. A check of the NTSB accident database revealed no accidents involving aircraft registration numbers on which this cuff and trunnion assembly was installed for the corresponding service periods between 1983 and 1996 (records were not available from the Internet for accidents prior to 1983.) The cuff and trunnion assembly was removed from another helicopter and returned to stock on November 24, 1996, according to the component historical service record. Most recently, the cuff and trunnion assembly was indicated as being "rebuilt" by a Valley Helicopter Service mechanic on April 15, 1999, to include a dye check of cuff serial number 10653. The cuff and trunnion assembly was then installed on the accident helicopter in conjunction with its most recent annual inspection, on April 20, 1999. FAA Airworthiness Directive (AD) 97-10-16, which requires inspection of UH-12E control rotor cuffs and spar tubes at 100-hour intervals as well as at annual inspections "to prevent separation of the control rotor blade assembly and subsequent loss of control of the helicopter", was last signed off as complied with on the accident helicopter by the Valley Helicopter Service mechanic on September 6, 1999, at the time of the helicopter's most recent 100-hour inspection, approximately 56 flight hours prior to the accident. According to the records furnished by the operator, at the time of the accident, the fractured cuff had 2,844.6 hours in service since new and 237.8 hours since the April 15, 1999, overhaul or "rebuild." No indication was noted in the maintenance records or on the components that the control rotor blade assembly had been reworked according to Hiller Aviation Service Bulletin 36-1, Revision 3. The life limit of the control rotor cuff, when installed with a control rotor blade assembly that has not been reworked, is 6,860 hours.

The separated control rotor cuff (part number 36124-3, serial number 10653) was sent to the

NTSB Materials Laboratory, Washington, D.C., for metallurgical examination. The Materials Laboratory factual report of this examination (Report No. 00-028, February 2, 2000, attached) reported as follows:

...As received, the outboard portion of the aluminum cuff was still attached to the inboard end of the steel control rotor blade spar by two through bolts (0.25 inch nominal diameter). The cuff was fractured through both holes for the inboard through bolt....

...Initial optical examinations of the separated cuff uncovered fracture features indicative of fatigue emanating from the cuff hole at the head side of the inboard bolt....From the Illustrated Parts Breakdown (IPB) orientation, this would be the upper trailing quadrant of the cuff. The fracture surfaces were partially obscured by heavy black deposits adjacent to the initiation hole. The deposits appeared typical of aluminum fretting products. It was also noted that as-received the cuff was loose on the spar and would move longitudinally an estimated 0.02 to 0.05 inches.

To aid in further examinations, the connecting bolts were removed and the outboard portion of the cuff was disassembled from the shaft....As- received, some pliable sealant material was visible around the nut and washers of the outboard bolt, but none was visible at the head side or at either end of the inboard bolt. Small remnants of sealant were found between the washers of the inboard bolt during disassembly. Each of the through bolts had two rings of fretting and wear on the shanks at locations corresponding to the installed position of the spar. The IPB...shows two...washers used for each bolt (one under each [sic] the head and nut). As assembled, each of the existing through bolts had two washers under both the head and the nut....

Gummy black deposits partially covered the mating surfaces of both the spar and the cuff and a small amount of what appeared to be dried black grease was found at the outboard edge of the cuff. Translucent yellow brown grease was apparent on the inner diameter surface of the spar. The exterior spar surfaces under the deposits were partially covered by green primer paint....there were large areas of the spar where the paint was not present. Large numbers of small corrosion pits were visible in these areas....Close examination found that the pits were consistent with previous corrosion damage and were partially filled by green primer even in those areas without an overall covering of primer. No indications of active corrosion were visible. Measurements with a point micrometer found that some of the larger pits were at least 0.015 inches deep. Fretting was noted on the inboard end of the spar where it contacts the bearing retainer. The corresponding surface of the retainer also showed fretting.

...The fatigue initiated at two locations on opposite sides of the upper inboard hole and ran generally circumferential in both directions....In total, the fatigue regions penetrated about 50% of the cuff cross section....

Closer optical examinations found that the counterclockwise progression initiated at the corner intersection of the hole and the inner diameter cuff surface....At the origin

location, the corner was circumferentially gouged and material scraped away, as if the edge had been unevenly hand chamfered or deburred....The gouge extended most of the way around the hole diameter and showed varying amounts of material removal with only a very small amount of material removed at the other fracture plane. In addition to the circumferential gouge, a sharp-bottomed longitudinal dent or cut was visible at the origin....

The inside edges at the opposite inboard bolt hole and at both outboard holes in the cuff also appeared to have been roughly chamfered but with less material removal. The hole edges at the outer surface were also chamfered but had smoother surfaces....The engineering drawing does not call out an edge detail for these holes. However, Hiller standard practices (HPS 302) are to chamfer or radius all edges.

The clockwise progression initiated at the hole bore....The bore surface was roughly machined as if drilled to final size. The initiation site coincided with a machining step in the bore. The other three bolt holes in the cuff also appeared to have been drilled to final size.

The cuff showed many areas of fretting damage on the inner diameter including the area around the upper inboard hole....Small areas of fretting were also visible on the outer surface where the washers of the through bolt contacted the cuff. However, none of the fretting was directly associated with either origin area....

The Materials Laboratory factual report also indicated that in measurements taken of the through bolt holes in the spar and cuff, both inboard bolt holes on the cuff were found to be 0.0029 inches oversized, compared to engineering drawing specifications. One of the outboard bolt holes on the cuff was also found to be 0.001 inch oversized, and both outboard cuff bolt holes were found to be out-of-round by up to 0.0034 inches. Both inboard bolt holes in the spar were measured to be up to 0.013 inches oversized, and both outboard bolt holes in the spar were measured to be oversized by up to 0.0137 inches. In measurements of the spar and cuff diameters, the spar outer diameter was measured to be 0.0034 inches undersized, and the cuff inner diameter was found to be 0.009 inches oversized at the fracture plane but within engineering drawing specifications about 1.5 inches outboard of the fracture.

AD 97-10-16 requires UH-12E operators to "inspect the blade spar tube and cuff for corrosion or cracks, or elongation, corrosion, burrs, pitting or fretting of the bolt holes, and repair, as necessary, in accordance with the Accomplishment Instructions of Hiller Aviation Service Bulletin No. 36-1, Revision 3, dated October 24, 1979." Hiller Aviation Service Bulletin No. 36-1, Revision 3, describes, among other things, inspection and repair (if necessary) of the control rotor blade assembly. The bulletin directs inspection for corrosion "on the exterior and interior of the spar tube as well as the interior of the control rotor cuff." The bulletin states that the part should be replaced if corrosion exceeds specified limits. The maximum allowable depth of rust or corrosion varies according to the "total combined circumferential length at any given spar tube or cuff", but in no case is a deposit deeper than 0.010 inch permissible. The bulletin specifies a procedure for removing rust spots by polishing the affected area according to specified methods.

The service bulletin directs inspection of "spar tube retention bolt holes for elongation, corrosion, burrs, pitting or fretting", and specifies acceptable parameters and procedures for reaming outboard holes in the event discrepancies are found. The bulletin directs replacement of the control rotor blade assembly if elongation, corrosion, pitting, or fretting of any inboard hole is found. The bulletin also specifies that bolt holes be deburred with 0.010 inch maximum chamfer "paying particular attention to the holes in the interior of the spar tube" if burrs are found. The service bulletin does not contain any instructions to inspect the bolt holes in the control rotor cuff for elongation, corrosion, burrs, pitting, or fretting, and does not specify any parameters or procedures for repairing or deburring bolt holes in the control rotor cuff.

With regard to inspection and repair of the control rotor cuff, Hiller Service Bulletin 36-1, Rev. 3, directs a dye-penetrant inspection of the outer 7 inches of the cuff "paying particular attention to the four bolt holes", and directs replacement of the cuff assembly if cracks are found. The service bulletin states that if the control rotor attach bolts show signs of wear or rust, they should be replaced. The service bulletin also specifies that prior to reinstallation, the spar tube should be protected by lightly coating areas of bare metal with two coats of zinc chromate primer. The service bulletin specifies that the control rotor blade assembly be reinstalled using Lubriplate 630-AA (a tan-colored multi-purpose grease, according to information published on the Internet by the grease's manufacturer, Fiske Brothers Refining Company of Newark, New Jersey), and that after reinstalling the control rotor blade assembly, sealant material should be applied "between bolt head or nut and cuff, covering the edges of the washer for the purpose of preventing moisture from entering the attachment holes in the cuff."

The accomplishment instructions of Hiller Service Bulletin 36-1, Rev. 3, contain a note which states: "The following instructions are Hiller Aviation recommended procedures for accomplishing the changes contained in this bulletin. Deviations from the procedures contained herein are permissible, provided the full intent of the modification is accomplished."

## Pilot Information

| | | | |
|---|---|---|---|
| **Certificate:** | Commercial | **Age:** | 63, Male |
| **Airplane Rating(s):** | Single-engine Land | **Seat Occupied:** | Center |
| **Other Aircraft Rating(s):** | Helicopter | **Restraint Used:** | Seatbelt, Shoulder harness |
| **Instrument Rating(s):** | Airplane; Helicopter | **Second Pilot Present:** | No |
| **Instructor Rating(s):** | None | **Toxicology Performed:** | No |
| **Medical Certification:** | Class 2 Valid Medical--no waivers/lim. | **Last FAA Medical Exam:** | 01/12/1999 |
| **Occupational Pilot:** | | **Last Flight Review or Equivalent:** | |
| **Flight Time:** | 32275 hours (Total, all aircraft), 22000 hours (Total, this make and model), 228 hours (Last 90 days, all aircraft), 87 hours (Last 30 days, all aircraft), 6 hours (Last 24 hours, all aircraft) | | |

## Aircraft and Owner/Operator Information

| | | | |
|---|---|---|---|
| **Aircraft Make:** | Hiller | **Registration:** | N5388V |
| **Model/Series:** | UH-12E UH-12E | **Aircraft Category:** | Helicopter |
| **Year of Manufacture:** | | **Amateur Built:** | No |
| **Airworthiness Certificate:** | Normal | **Serial Number:** | 2099 |
| **Landing Gear Type:** | Skid | **Seats:** | |
| **Date/Type of Last Inspection:** | 10/29/1999, 100 Hour | **Certified Max Gross Wt.:** | |
| **Time Since Last Inspection:** | 57 Hours | **Engines:** | 1 Reciprocating |
| **Airframe Total Time:** | 22137 Hours | **Engine Manufacturer:** | Lycoming |
| **ELT:** | Installed, activated, did not aid in locating accident | **Engine Model/Series:** | VO-540-C2A |
| **Registered Owner:** | JAMES R. POPE | **Rated Power:** | 305 hp |
| **Operator:** | JAMES R. POPE | **Operating Certificate(s) Held:** | On-demand Air Taxi (135) |
| **Operator Does Business As:** | VALLEY HELICOPTER SERVICE | **Operator Designator Code:** | GGVA |

## Meteorological Information and Flight Plan

| | | | |
|---|---|---|---|
| **Conditions at Accident Site:** | Unknown | **Condition of Light:** | Day |
| **Observation Facility, Elevation:** | , 0 ft msl | **Distance from Accident Site:** | 0 Nautical Miles |
| **Observation Time:** | 0000 | **Direction from Accident Site:** | 0° |
| **Lowest Cloud Condition:** | Clear / 0 ft agl | **Visibility** | 50 Miles |
| **Lowest Ceiling:** | None / 0 ft agl | **Visibility (RVR):** | 0 ft |
| **Wind Speed/Gusts:** | Calm / | **Turbulence Type Forecast/Actual:** | / |
| **Wind Direction:** | | **Turbulence Severity Forecast/Actual:** | / |
| **Altimeter Setting:** | | **Temperature/Dew Point:** | 18°C |
| **Precipitation and Obscuration:** | | | |
| **Departure Point:** | CLARKSTON, WA | **Type of Flight Plan Filed:** | Company VFR |
| **Destination:** | GRANGEVILLE, ID | **Type of Clearance:** | None |
| **Departure Time:** | 0930 PST | **Type of Airspace:** | Class G |

## Wreckage and Impact Information

| | | | |
|---|---|---|---|
| **Crew Injuries:** | 2 Serious, 1 None | **Aircraft Damage:** | Substantial |
| **Passenger Injuries:** | N/A | **Aircraft Fire:** | None |
| **Ground Injuries:** | N/A | **Aircraft Explosion:** | None |
| **Total Injuries:** | 2 Serious, 1 None | **Latitude, Longitude:** | |

## Administrative Information

| | |
|---|---|
| **Investigator In Charge (IIC):** | GREGG NESEMEIER |
| **Additional Participating Persons:** | JOHN BIANCO; SPOKANE, WA |
| **Investigation Docket:** | NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov, or at 800-877-6799. Dockets released after this date are available at http://dms.ntsb.gov/pubdms/. |