



Aviation Investigation Final Report

Location:	Happy Camp, California	Accident Number:	LAX06GA254
Date & Time:	August 4, 2006, 19:47 Local	Registration:	N6156U
Aircraft:	Aviation International Rotors CH-54A	Aircraft Damage:	Substantial
Defining Event:		Injuries:	2 Fatal
Flight Conducted Under:	Part 91: General aviation - Public aircraft - federal		

Analysis

The helicopter experienced an in-flight separation of a tail rotor blade and subsequent separation of the tail rotor gearbox and remaining tail rotor blades while conducting fire suppression operations for the United States Forest Service (USFS). A witness located near the accident site reported that he observed the helicopter over the dip site when the witness heard a "loud bang." He observed the helicopter flying over a stone riverbed toward a bridge when he noticed a large piece fall off the helicopter, later identified as the tail rotor gearbox with three of the four tail rotor blades attached to the hub. The helicopter pitched nose low at an approximate 45-degree nose down attitude while rotating around its vertical axis before impacting the side of the river/shoreline. The tail rotor blade associated with the red spindle separated from the tail rotor. The red tail rotor spindle failed due to a fatigue fracture in the spindle. Among three machined grooves, located on the spindle under a spacer, the fatigue initiated in the groove located closest to the blade (the outboard groove). Fatigue initiated at a single origin associated with a shot-peen pit. Circumferential scratches were observed in the groove areas and on the adjacent journal surface; however, the fatigue crack origin was not associated with these scratches. The journal diameter was also undersize by 0.007 inch, and fretting was observed on the journal surface. The origin was not associated with any particular scratch or other apparent material defect. The groove peak between the middle and inboard grooves was sheared at the trailing side of the red spindle and displaced toward inboard, damage consistent with a tail rotor strike. The total time of the spindle could not be determined as it was not a life-limited component that required serial number and time tracking. The tail rotor assembly underwent an overhaul about 233.6 hours prior to the accident. During the overhaul, the spindles are to be inspected via fluorescent penetrant; however, the overhaul manual did not require the removal of the spacer that covered the groove area where the fatigue cracking initiated unless the spacer was damaged or worn beyond its approved limits. According to the operator, the spacer was not routinely removed at overhaul unless it was damaged or out of dimensional tolerance.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The fatigue failure of tail rotor blade spindle, which resulted in the separation of the blade and tail rotor gearbox.

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: MANEUVERING

Findings

1. (C) ROTOR SYSTEM, TAIL ROTOR BLADE - FATIGUE
2. (C) ROTOR SYSTEM, TAIL ROTOR BLADE - FAILURE, TOTAL

Occurrence #2: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: EMERGENCY DESCENT/LANDING

Findings

3. AIRCRAFT CONTROL - NOT POSSIBLE - FLIGHTCREW

Occurrence #3: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - UNCONTROLLED

Findings

4. TERRAIN CONDITION - ROCK(S)/BOULDER(S)

Factual Information

HISTORY OF FLIGHT

On August 4, 2006, at 1947 Pacific daylight time, an Aviation International Rotors CH-54A, N6156U, was substantially damaged when it impacted terrain following an in-flight separation of a tail rotor blade while maneuvering near a dip site near Happy Camp, California. The Department of Agriculture (USDA), U.S. Forest Service (USFS) was utilizing the helicopter under contract as a public-use firefighting tool [heli-tanker (HT) 790] under the provisions for 14 CFR Part 91. The helicopter was registered to Heavy Lift Helicopters Inc. (HLH), of Apple Valley, California, and the flight crew was employed by HLH. The airline transport pilot (ATP) captain and ATP co-pilot both sustained fatal injuries. Visual meteorological conditions prevailed and a USFS flight plan was filed. The flight was receiving flight following from the USFS dispatch personnel at the time of the accident.

The helicopter was flown to the Happy Camp Complex in Happy Camp, California, on July 29, 2006, to help suppress the Titus Fire. The helicopter was stationed at the Happy Camp helibase where it was maintained and dispatched.

On the morning of the accident, the helicopter went through a series of maintenance and flight tests after having its number 1 engine replaced the night before. The helicopter was returned to service at 1645 by the HLH mechanics and the USFS helicopter manager. The helicopter was then dispatched to the Titus fire where it conducted a number of water drops. After 2.2 hours of flight (at 1902), the helicopter returned to the helibase where it was refueled with approximately 500 gallons and examined by maintenance personnel. The helicopter departed for a second cycle of water drops at 1912 and never returned to the helibase.

The satellite tracking system that the USFS utilizes to provide real-time data on their flights indicated that the helicopter filled its water tanks at a dip site located in the Klamath River near the Independence Bridge. The helicopter conducted one uneventful dip and water drop during the second cycle and was in the process of conducting its second dip when the accident occurred.

A witness located near the accident site reported that he observed the helicopter come in and out of the same dip site that day filling the helicopter's water tanks. The helicopter was located over the dip site when the witness heard a "loud bang." He realized something was wrong with the helicopter and ran down his driveway toward the road that paralleled the river. When he reached the road he observed the helicopter flying over a stone riverbed toward the Independence Bridge. He then noticed a large piece fall off the helicopter, which was later identified as the tail rotor gearbox with three of the four tail rotor blades attached to the hub. The helicopter pitched nose low at an approximate 45-degree nose down attitude while

rotating around its vertical axis. The helicopter impacted the opposite side of the river/shoreline. The witness called the USFS over a radio to report the accident.

PERSONNEL INFORMATION

Captain

The captain held an airline transport pilot certificate with a multi-engine airplane rating, and a commercial pilot certificate with single-engine airplane, rotorcraft-helicopter, and instrument helicopter ratings. He was type rated in the SK-58, SK-61 and SK-64 helicopters. He also held a flight instructor certificate for single-engine, multi-engine, and instrument airplanes. He was issued a second-class medical certificate on December 23, 2005, with a limitation for corrective lenses.

According to the operator's records, the pilot accumulated over 14,000 hours of total flight time. Of those, about 11,210 hours were accrued in helicopters and 4,212 hours were flown in the same make and model as the accident helicopter.

Copilot

The copilot held an airline transport pilot certificate with a rotorcraft-helicopter rating. He was issued a second-class medical certificate on March 22, 2006, with no limitations or waivers.

According to the operator's records, the copilot accumulated about 4,700 hours of flight time in helicopters, of which 278 hours were accrued in the accident helicopter make and model.

AIRCRAFT INFORMATION

The helicopter was originally manufactured by Sikorsky for the U.S. Military as a CH-54A helicopter. The helicopter exited military service and entered civilian service under a restricted category. The type certificate for this model of the restricted category helicopter was then transferred to Aviation International Rotors. Review of the operator's instructions for continued airworthiness for the CH-54A revealed that maintenance/overhaul schedules and procedures were to follow the applicable military manuals. The tail rotor head assembly had an overhaul interval of 1,000 hours, which was to be completed per the Navy's NAVAIR manual 03-95B-106 (the June 1, 1984 version; change 3, dated August 15, 1988).

Review of the maintenance records, flight logs, and USFS daily diaries revealed that the helicopter accumulated a total of 6,191.6 hours on the morning of the accident. On December 22, 2005, the tail rotor hub assembly underwent its 1,000-hour overhaul, which included the fluorescent penetrant inspection of the spindle. The tail rotor hub assembly was installed on the accident helicopter at a total time of 5,958.0 hours, about 233.6 hours prior to the accident. The spindle was not a life-limited component, and therefore, it is unknown as to how many total hours the spindle had been in service.

The tail rotor has four blades on the left side of the helicopter that rotate clockwise (as viewed looking at the left side of the helicopter) about the tail rotor head assembly axis. Each blade is bolted to a sleeve and spindle assembly, which in turn is attached to the tail rotor hub with a shoulder bolt. The spindle is made of a titanium alloy, with 6 percent aluminum and 4 percent vanadium. The exterior of the spindle and sleeve assemblies are each painted a different color: red, blue, black, or yellow. The spindle serial numbers for the accident helicopter were as follows: red F-1560, blue F-308, black F-1938, and yellow FM400.

During assembly of the spindle group, a split ring is put in the center of three grooves (referred to throughout this report as the inboard, middle, and outboard grooves) located on the shank of the spindle. A spacer is then pushed over the spindle from its outboard end (in relation to the axis of rotation) until a step on the inside diameter of the spacer contacts the split ring. Sealant is then applied at the inboard end of the spacer, between the spacer and the spindle shank.

Review of the NAVAIR 03-95B-106 manual (under section 4-29, Shot-Peening) revealed that the spindle is to be fluorescent penetrant inspected and shot-peened at each overhaul. The shot-peening section indicated that bonded components, such as the spacer, are not to be removed during the overhaul unless they are damaged or do not meet the minimum service limits listed in the manual. According to the operator they did not remove the spacer that covered the split ring and the three grooves during each overhaul unless the spacer was beyond its approved limits.

WRECKAGE AND IMPACT INFORMATION

Review of the wreckage at the accident site revealed that the tail rotor gearbox (with three tail rotor blades attached) came to rest at a global positioning system (GPS) measured location of 41 degrees 39.707 minutes north latitude and 123 degrees 26.919 minutes west longitude. The helicopter fuselage, with its two engines, main rotor transmission, and main rotor hub attached, came to rest at a GPS measured location of 41 degrees 39.658 minutes north latitude and 123 degrees 26.895 minutes west longitude (separated from the tail rotor gearbox by approximately 500 feet). Sections of the tail boom were located in the river. The pylon, with the horizontal stabilizer and intermediate gearbox attached were located on the opposite bank from the fuselage.

Examination of the tail rotor system revealed that the blade associated with the red spindle was missing and has not been located at the time of this report's writing. The spindle (part number 65112-07002-047; serial number F-1560) was fractured inboard of where the sleeve assembly would attach to the spindle. The spindle fracture surface was flat in appearance and displayed arch-shaped marks that emanated from one of the edges through about half of the spindle material. It was noted that the location of the fracture would not normally be visible in an assembled component.

The fractured spindle was removed from the tail rotor hub and shipped to the NTSB Materials Laboratory in Washington, D.C. for further examination.

On November 16 and 17, 2006, the NTSB investigator-in-charge, along with representatives from the USFS and HLH examined the wreckage at Plain Parts in Sacramento, California. The examination resulted in verification of continuity through the #1 and #2 engine free turbines, main rotor transmission, and tail rotor drive shaft. In addition, continuity was confirmed through the intermediate and tail rotor gearboxes (both magnetic chip plugs for these gearboxes were free from ferrous debris). Two tail rotor drive shaft bearings were located in the retrieved wreckage. There were no anomalies noted with these two bearings. Six Thomas couplings were located in the wreckage. They were all warped to some extent with one being splayed and shredded.

Approximately 15 feet of tail boom remains missing along with sections of the tail rotor drive shaft, and the red tail rotor blade.

MEDICAL AND PATHOLOGICAL INFORMATION

Autopsies were performed on each pilot by the Siskiyou County Coroner's Office. Neither autopsy revealed any pre-existing medical condition that would have contributed to the accident.

Toxicological tests were conducted on each pilot by the Federal Aviation Administration's (FAA) Civil Aeromedical Institute (CAMI). The captain's toxicological test results were negative for carbon monoxide, cyanide, ethanol and drugs. The copilot's toxicological test results were positive for 12 mg/dL of ethanol in his blood, but a note associated with that finding indicated that, "the ethanol found in this case is from sources other than ingestion." His toxicological test results for carbon monoxide, cyanide and drugs were negative.

TESTS AND RESEARCH

On August 22 and 23, 2006, an engineer from the Safety Board's Materials Laboratory examined the red spindle assembly along with the overhaul supervisor from HLH's repair station and a metallurgist from the Navy's Metallurgical Failure Analysis Department in Cherry Point, North Carolina.

Red Spindle Assembly

The spindle was fractured within the length of the spindle normally covered by the spacer. The fracture surface had a relatively flat region at the trailing side of the spindle with smoothly curving crack arrest marks, which are features consistent with fatigue. The fatigue features emanated from an origin at the trailing side of the spindle, but removal of the spacer was required to further examine the fracture.

The spacer was cut longitudinally at the left and right sides; however, the sealant, located between the spindle and the spacer (at the inboard end of the spacer), prevented removal of the cut spacer pieces. A scalpel knife was utilized to cut the sealant circumferentially until the spacer could be removed by hand. Upon removal of the spacer, it was noted that the split ring was located in the middle groove as specified in the spindle assembly instructions. Almost all of the sealant from the three groove areas remained adhered to the spacer pieces as they were removed from the spindle. Most of the sealant had a gray color, but some areas had a brown-colored sealant. Most of the brown-colored sealant remained adhered to the split ring, but some areas were intermixed with the gray sealant that remained adhered to the spacer and was adjacent to the split ring. Impressions of the inboard groove on the spindle were present in the sealant that remained adhered to the spacer halves. The sealant did not extend past the split ring on the outboard groove.

Examination of the spindle's grooved area revealed that the peak of the material between the middle and inboard grooves was fractured around approximately 180 degrees at the trailing edge side and was displaced inboard toward the hub. At its greatest displacement, the fractured peak covered the inboard groove. The fracture surface for the displaced peak had a shiny smeared appearance that was consistent with an overstress fracture in shear. The outboard portion of the fracture surface was rubbed or damaged consistent with contact with the inner diameter of the split ring.

The inner diameter of the split ring had a region of rubbing damage on the trailing portion of the ring. Some pieces of brown-colored sealant remained attached to the split ring, and in one area, a portion of brown sealant appeared to be covering a portion of the area of rubbing damage. Also, the brown sealant was located in a quadrant of the split ring normally in contact with the surface of an intact groove, thus indicating that the brown sealant adhered to the split ring some time after the groove peak was fractured. The outboard surface of the split ring was worn with a step corresponding to contact with the step change in the inner diameter of the spacer. The outer diameter of the split ring was also worn, particularly at the location of the split.

Closer examination of the sealant revealed that the gray sealant in the area of the spacer had the replicated shape of the fractured groove peak located behind (radially outward from the centerline of the spindle) the replicated shape of the inboard groove, indicating that the gray sealant was applied after the groove peak was fractured.

A portion of the journal (the portion of the spindle with uniform diameter outboard of the split ring grooves) remained at the leading half of the spindle. Shot-peen marks were not observed on the journal surface as required in the spindle engineering drawing. Circumferential scoring marks were observed on a portion of the journal surface at the right leading quadrant of the spindle. Other areas of the journal had a matte appearance that appeared relatively rough at high magnification, features consistent with fretting.

Examination of the grooves showed the presence of shot-peen dimples. However,

circumferential scoring marks and burnishing had removed much of the shot-peen dimples on the flanks of the outboard and middle grooves and on the groove peak between the outboard and middle grooves. Some circumferential marks were observed at the middle of the grooves, but they were not as extensive as those on the flanks of the grooves, and shot-peen dimples remained visible.

A view of the accident spindle groove profile at the leading side revealed relatively sharp corners were present at the groove peaks. A drawing of the groove profile from the NAVAIR 03-95B-106 overhaul manual showed smooth corner radii at each of the groove peaks.

The dimensions of the red spindle in the area covered by the spacer were measured using an optical profilometer. The journal diameter measured 2.7519 inches. According to the overhaul manual drawing, the journal diameter is specified to be 2.7590 to 2.7600 inches after shot-peening. The minor diameter at the middle of the blade-side groove was 2.6587 inches. The typical diameter from the drawing is 2.659 to 2.661 inches. The radius of the blade-side groove was 0.055 inch, while the typical radius shown in the drawing is 0.051 to 0.053 inch.

Closer examination of the red spindle fracture surface revealed that fatigue features emanated from a single origin located in the outer groove valley, slightly offset from the trailing edge, and outboard of the sheared shoulder. The fatigue features emanated inward, intersecting a central cavity in the spindle and continued to emanate toward the leading edge, terminating approximately half way across the diameter. The remainder of the fracture had rough, matte features consistent with overstress fracture. A closer view of the fracture in the vicinity of the origin area showed that the origin was located in approximately the middle of the outboard groove's valley.

The fatigue fracture origin area was further examined using a scanning electron microscope (SEM). The origin was located at a shot-peen pit measuring 0.0048 inch wide and 0.00024 inch deep. The overall surface condition of the outboard groove, adjacent journal surface, and groove peak, toward the leading edge of the spindle displayed circumferential scoring along with shot-peen pits.

Blue, Black, and Yellow Spindle Assemblies

On August 30 and 31, 2006, the NTSB Materials Laboratory engineer, Naval Air Depot metallurgical engineer, and the overhaul supervisor disassembled and examined the blue, black, and yellow spindle and sleeve assemblies at the Navy's Fleet Readiness Center East, located in Cherry Point.

Some impact damage was noted with each of the spindle assemblies prior to disassembly, with the worst being sustained by the yellow spindle assembly. The yellow spindle assembly sustained significant impact damage that displaced the spacer uniformly in an inboard direction. The spacers were cut from each spindle assembly in a manner similar to the red spindle assembly. The split ring was found in the middle groove for the blue and black

spindles, and the peak between the middle and inboard grooves was fractured and displaced inboard around approximately 180 degrees at the leading left side of the spindle for the blue assembly, and at the trailing side of the spindle for the black assembly. The yellow spindle assembly displayed damage to the middle and inboard grooves, which were fractured completely around the circumference of the spindle. The fractures had a smeared appearance consistent with shear overstress in the inboard direction.

The grooved areas for each spindle displayed a smooth radius profile similar to that specified by the overhaul drawing. The blue, black, and yellow spindles displayed a dimpled appearance consistent with shot-peen with no circumferential scratches noted.

The sealant between the spacers and spindles was limited to the area inboard of the grooves and did not intersect the shoulder damage of either of these three spindles, which precluded the possibility of using any sealant impressions to determine whether the damage had occurred before sealant was applied, as in the case of the red spindle. However, the shoulder damage and snap ring groove areas for the three disassembled spindles showed no sign of wear. Also, examination by stereomicroscope showed no evidence of cracks in the snap ring grooves.

Shoulder Bolts and Washers

The spindle assemblies were attached to the tail rotor hub assembly via a shoulder bolt and lock washer. The lock washers for the shoulder bolts were examined and it was noted that each had a stamped part number on the face that mated to the trailing lug of the spindle. All four of the spindles had marks on the trailing lug, around the shoulder bolt hole, that corresponded to the stamped washer part numbers. The red spindle displayed part numbers that were worn relatively deeper than the other spindles.

Additional Spindle Examinations

During the course of the investigation, the Navy's Fleet Readiness Center East representative notified the Safety Board investigators of an incident in which a Sikorsky CH-53D helicopter experienced a tail rotor strike during military use. The helicopter landed safely, and the tail rotor spindles were removed from service and examined at the Fleet Readiness Center East facility. The spindles had the same part number as those used in the accident helicopter. After disassembling the spindle and sleeve assemblies and removing the spacer, three of the four spindles had observable damage in the peak of material between the middle and inboard grooves at the trailing side of the spindle. In one spindle, this peak was sheared around 90 degrees of the circumference. The other two damaged spindles had cracks in the flank of the peak.

It was noted that the spindles did not show any signs of damage until the spacers were removed and the grooved area was examined. It was apparent that a spindle could have been subjected to a tail rotor blade strike, be inspected as per the NAVAIR overhaul manual, and the

underlying groove damage go unnoted before being returned to service.

Additional Spindle Tests

Tests were conducted at the Navy's Fleet Readiness Center East on exemplar spindles to determine if the sheared groove shoulder of the red spindle could have resulted from an assembly error. In each case, the standard assembly procedure detailed in NAVAIR 03-95B-106 was followed to install the spacer onto the spindle, with varying configurations of lock-ring placement and tooling alignment. The process utilizes a hydraulic press and alignment tooling to assemble the spacer over the interference-fit journal and split ring. Though some of the assembly configurations did produce a sheared groove shoulder, they did not resemble the type of shearing that was noted on the red spindle. Due to the force required to install the spacer, the noise it made during assembly, and/or deformation of the spacer with the varying configurations, it did not seem likely that an assembly error could have gone unnoticed.

ADDITIONAL INFORMATION

History of Red Spindle

At the NTSB's request, the operator conducted a review of their maintenance records to determine what history could be established for the red spindle and whether or not it had been involved in a tail blade strike. The operator provided a written summary of their records, which indicated that the tail rotor head (serial number A9-059) was released from the U.S. Army on another helicopter in 1995. In 1996, the tail rotor head was installed on another helicopter and flew about 585.3 hours. In December 2000, the tail rotor head was removed for an early overhaul because management personnel wanted it to fly a full fire season the following year. The December 2000 overhaul was the first record of spindle serial number F-1560 specifically appearing on record (work order 1727). Following that overhaul, tail rotor head A9-059 and spindle F-1560 were put on another helicopter in February 2002, where it flew 940.9 hours before being removed for overhaul. In October 2003, the tail rotor head was overhauled and placed on the accident helicopter (N6156U) with spindle F-1560. As previously mentioned, the spindles were not a life-limited component and therefore records were not required to be maintained specifically for the spindles. The total time accrued on tail rotor head A9-059 was 4,403.8 hours as of the morning of the accident. The first notice of the red spindle serial number was during the December 2000 overhaul. Since that overhaul, the spindle accumulated a total time of 1,174.5 hours of operation.

There was no recording of a tail rotor blade strike noted in the maintenance records for any of the aircraft in which tail rotor head A9-059 was installed.

NAVAIR 03-95B-106 Manual

As previously mentioned in this report, the tail rotor overhaul procedures did not require the removal of the spacer that covers the grooved area of the spindle prior to shot-peening unless

it is damaged or worn beyond limits. The operator indicated that they did not remove the spacer. Discussions with personnel associated with the Navy's Fleet Readiness Center East revealed that they did remove the spacer at each overhaul even though their overhaul manual did not call for the removal of the spacer. When asked why, the Navy personnel indicated that they also overhauled the U.S. Air Force fleet and that the Air Force required the removal of the spacer. Therefore, the Navy fell into the habit of removing the spacer at each overhaul even though it was not required in their manuals. Further discussions with the Navy personnel indicated that other foreign military operators were not removing the spacer at each overhaul.

Since the accident, the Navy revised their tail rotor overhaul manual by adding written instructions to call for the removal of the spacer at each overhaul, and to conduct a dimensional, visual, and fluorescent penetrant inspection of the grooved area. In addition, they have called for any spindle assembly that has a reported tail rotor blade strike to be scrapped.

In addition, the operator revised their overhaul manual to call for the removal of the spacer during each overhaul and to inspect the grooved area. The operator is awaiting final FAA approval on the revisions.

Additional Concerns

A determination of load spectrum for the firefighting mission for which this helicopter was used, as compared to the original design load spectrum, could not be made and was beyond the scope of the investigation. How much the mission's flight loading could lead to differences in the expected fatigue life and crack propagation rates for the part could not be determined.

The fatigue life of titanium components can be affected by the disruption of the shot-peen surface during repair using abrasive materials such as sandpaper and Scotch-bright pads. Therefore, the Navy's repair directives dictate that repaired surfaces be recovered with 100 percent shot-peening following contact with any abrasive material. This policy was implemented in the mid-1980s and is monitored at their repair facilities.

Though the lock washer part number impressions found on the trailing lug face of the spindles were not associated with the fatigue cracking that resulted in the spindle's failure, it was believed that surface damage of this nature could serve as a stress concentrator for fatigue crack initiation in the lug region.

Pilot Information

Certificate:	Airline transport	Age:	58, Male
Airplane Rating(s):	Multi-engine land	Seat Occupied:	Left
Other Aircraft Rating(s):	Helicopter	Restraint Used:	
Instrument Rating(s):	Airplane; Helicopter	Second Pilot Present:	Yes
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	Toxicology Performed:	Yes
Medical Certification:	Class 2 With waivers/limitations	Last FAA Medical Exam:	December 1, 2005
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	June 1, 2006
Flight Time:	14000 hours (Total, all aircraft), 4212 hours (Total, this make and model)		

Co-pilot Information

Certificate:	Airline transport	Age:	38, Male
Airplane Rating(s):	None	Seat Occupied:	Right
Other Aircraft Rating(s):	Helicopter	Restraint Used:	
Instrument Rating(s):	Helicopter	Second Pilot Present:	Yes
Instructor Rating(s):	None	Toxicology Performed:	Yes
Medical Certification:	Class 2 Without waivers/limitations	Last FAA Medical Exam:	March 1, 2006
Occupational Pilot:	Yes	Last Flight Review or Equivalent:	March 1, 2006
Flight Time:	4700 hours (Total, all aircraft), 278 hours (Total, this make and model), 258 hours (Last 90 days, all aircraft), 105 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Aviation International Rotors	Registration:	N6156U
Model/Series:	CH-54A	Aircraft Category:	Helicopter
Year of Manufacture:		Amateur Built:	
Airworthiness Certificate:	Restricted (Special)	Serial Number:	66-18410
Landing Gear Type:	Tailwheel	Seats:	3
Date/Type of Last Inspection:	July 1, 2006 AAIP	Certified Max Gross Wt.:	42000 lbs
Time Since Last Inspection:	19.1 Hrs	Engines:	2 Turbo shaft
Airframe Total Time:	6191.6 Hrs at time of accident	Engine Manufacturer:	Pratt & Whitney
ELT:	Installed, not activated	Engine Model/Series:	JT12A
Registered Owner:	Heavy Lift Helicopters Inc.	Rated Power:	4500 Horsepower
Operator:	Department of Agriculture, U.S. Forest Service	Operating Certificate(s) Held:	

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:		Visibility	
Lowest Ceiling:		Visibility (RVR):	
Wind Speed/Gusts:	5 knots / 8 knots	Turbulence Type Forecast/Actual:	/
Wind Direction:		Turbulence Severity Forecast/Actual:	/
Altimeter Setting:		Temperature/Dew Point:	32°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Happy Camp, CA (36S)	Type of Flight Plan Filed:	Company VFR
Destination:		Type of Clearance:	None
Departure Time:	19:12 Local	Type of Airspace:	

Wreckage and Impact Information

Crew Injuries:	2 Fatal	Aircraft Damage:	Substantial
Passenger Injuries:		Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	2 Fatal	Latitude, Longitude:	41.660831,-123.448333

Administrative Information

Investigator In Charge (IIC): Charnon, Nicole

Additional Participating Persons: Thomas Sanders; Sacramento FSDO; Sacramento, CA
Boise Bingham; U.S. Forest Service; Juneau, AK
Matthew Fox; NTSB; Washington, DC
Richard Proctor; HLH; Apple Valley, CA
Robert VanHorn; U.S. Forest Service; Albuquerque, NM
Lynda Johnson; U.S. Navy Fleet Readiness Center East ; Cherry Point, NC
Roger Durbin; FAA Aircraft Certification Office; Los Angeles, CA
Chinh Vuong; FAA Rotorcraft Directorate; Fort Worth , TX

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Investigation Class: [Class](#)

Note:

Investigation Docket: <https://data.nts.gov/Docket?ProjectID=64282>

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](#).