Aviation Investigation Final Report

Location:	KETCHIKAN, Alaska	**Accident Number:**	ANC96FA098
Date & Time:	July 13, 1996, 13:25 Local	**Registration:**	N541SB
Aircraft:	Sikorsky CH-54A	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	1 Fatal, 1 Serious
Flight Conducted Under:	Part 133: Rotorcraft ext. load		

Analysis

The pilot & copilot were on an external load, aero logging operation in a military surplus helicopter, lifting an estimated load of 18,000 lbs. Ground personnel heard a popping sound, then saw the tailrotor begin to slow down as the helicopter began to yaw/spin. It descended to sloping terrain in an area of cut logs. Postcrash exam of the tailrotor drive shaft revealed a separation at the number 5 bearing position. The shaft separation exhibited evidence of high heat & melting of adjoining shaft surfaces. The bearing & its housing were not recovered. The bearing had accrued 505 hrs of service, & was 1 of 2 bearing model numbers that were in use. The bearing was manufactured in 1991, & was purchased by the operator from surplus military supplies. The supplier (of the bearing to the operator) had performed an exterior exam of the bearing & marked 'relubed 10/95' on the bearing box. Exam of the remaining tailrotor drive shaft bearings revealed evidence of low grease fill, water & glycol contamination, & wear patterns consistent with misalignment. In civilian service, the bearing was an 'on condition' part. The operator established a service life of 1,000 hours for aero logging operations. A shelf life for the bearing was not established. The manufacturer indicated the bearing should support a 5 year shelf life. Other operators of the accident helicopter in aero logging reported similar examples of low grease fill & bearing contamination from water in both available models of bearing.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: failure of the number 5 tailrotor bearing. A factor relating to the accident was: the uneven/steep sloping terrain, where the pilot was forced to land. Possible factors were: inadequate handling/labeling of the 'relubed' bearing by intermediate supplyier(s), and/or insufficient shelf life/service limits for military surplus parts.

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: HOVER - OUT OF GROUND EFFECT

Findings
1. (C) ROTOR DRIVE SYSTEM,TAIL ROTOR DRIVE SHAFT BEARING - FAILURE
2. (F) PROCEDURE INADEQUATE - OTHER INSTITUTION
3. (F) INSUFFICIENT STANDARDS/REQUIREMENTS - OTHER INSTITUTION

Occurrence #2: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: HOVER - OUT OF GROUND EFFECT

Findings
4. DIRECTIONAL CONTROL - NOT POSSIBLE

Occurrence #3: FORCED LANDING
Phase of Operation: EMERGENCY DESCENT/LANDING

Findings
5. AUTOROTATION - ATTEMPTED - PILOT IN COMMAND

Occurrence #4: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: EMERGENCY DESCENT/LANDING

Findings
6. (F) TERRAIN CONDITION - NONE SUITABLE
7. (F) TERRAIN CONDITION - MOUNTAINOUS/HILLY

Factual Information

History of the Flight

On July 13, 1996, about 1325 Alaska daylight time, a Sikorsky CH-54A helicopter, N541SB, crashed during aero logging operations, about 16 miles north-northeast of Ketchikan, Alaska. The helicopter was being operated as a visual flight rules (VFR) local area flight under Title 14 CFR Part 133 when the accident occurred. The helicopter, registered to and operated by Silver Bay Logging Company, Juneau, Alaska, was destroyed. The certificated commercial pilot received serious injuries. The copilot, holder of a commercial helicopter certificate, received fatal injuries. Visual meteorological conditions prevailed. The flight originated at a nearby logging camp about 1308.

The operator reported that logging operations were being conducted near Shelter Cove, located in the Tongass National Forest. The helicopter, a surplus military aircraft certificated in the restricted category, was using a 200 foot long external cable to retrieve logs.

The helicopter was operating on its 4th cycle of the day and was hovering above nearby trees over an area of cut logs. Ground personnel, communicating with the pilot by radio, hooked the helicopter's cable to a metal choker cable that was cinched around 2 large logs with an estimated total weight of 18,000 pounds. The helicopter lifted the logs about 60 feet above the ground when a popping sound was heard coming from the helicopter and the tailrotor began to slow down. The helicopter was observed to spin counter-clockwise about 5 complete turns. The pilot released the load of logs from the end of the cable and commented over the radio that "we're going down". Ground personnel dropped to the ground under fallen trees. The helicopter descended toward the ground and the main rotor blades struck a 170 foot high spruce tree, separating the top 20 feet of the tree. The helicopter continued toward the ground and collided with steeply sloped terrain.

The accident occurred during the hours of daylight at latitude 55 degrees, 33.33 minutes north and longitude 131 degrees, 25.09 minutes west.

Crew Information

The pilot holds a commercial pilot certificate with a rotorcraft helicopter rating. He holds private pilot privileges with airplane single-engine and instrument airplane ratings. The pilot holds a type certificate in Boeing Vertol 107, Sikorsky S-61, and S-64 helicopters. The type certificates are limited to VFR only. In addition, the pilot holds a flight instructor certificate with a rotorcraft helicopter rating and a mechanic certificate with powerplant and airframe ratings. The most recent second-class medical certificate was issued to the pilot on March 4, 1996, and contained no limitations.

No personal flight records were located for the pilot and the aeronautical experience listed on page 3 of this report was obtained from information contained in the pilot/operator report submitted by the operator. According to the report, the pilot's total aeronautical experience consists of 7,985 hours, of which 5,060 hours were accrued in helicopters and 500 hours accrued in the accident helicopter make and model. In the preceding 90 and 30 days prior to the accident, the report lists a total of 125 and 60 hours respectively.

The copilot held a commercial pilot certificate with a rotorcraft helicopter rating. The most recent second-class medical certificate was issued to the pilot on January 25, 1996, and contained no limitations.

No personal flight records were located for the copilot and the aeronautical experience listed on Supplement E of this report was obtained from information contained in the pilot/operator report submitted by the operator. According to the report, the pilot's total aeronautical experience consisted of 850 hours, of which 100 hours were accrued in the accident helicopter make and model as second-in-command. The copilot's duties during aero logging operations include monitoring the engine and hoist gauges and recording the total turns and log weights.

Aircraft Information

The helicopter's tailrotor drive system consists of 6 individual drive shaft segments between the main rotor transmission and the intermediate gear box. A seventh shaft is positioned between the intermediate gearbox and the tailrotor gearbox that is mounted at the top of the tail boom pylon. Each of the 6 drive shaft segments are connected to each other by a coupling flange that is bolted to the aft end of each shaft. A stack of stainless steel discs, know as a Thomas coupling, is utilized to permit flexing of the drive shaft segments and is installed between the coupling flange and the aft end of each drive shaft segment. A Thomas coupling is comprised of between 16 to 22 steel discs separated by isolators. The coupling flange has a splined center section that mates to the forward splined end of the next drive shaft segment.

The forward end of each drive shaft segment has a splined shaft that is inserted into the adjoining coupling flange. Just aft of the splines is a polished bearing surface where a support bearing is installed. The support bearings are pressed onto the drive shaft, over the splines, and onto the bearing surface. The bearings are installed in a bearing support housing that incorporates a viscous vibration dampner between the bearing and the housing. The bearings are retained in the housing by a snap ring on either side of the bearing. The bearing support housings are attached to the upper surface of the tail boom. The bearings are lubricated with Mobilgrease 28 lubricant. The normal amount of grease (by weight) in a bearing is between 4 and 6 grams or between 30 to 50 percent.

The operator utilized temperature sensitive tape applied to each bearing housing as indicators of bearing heat. In addition, the helicopter's crew chief took periodic temperature readings from each bearing housing by using a hand held, laser temperature sensor that measured

temperature readings while the helicopter was running. The bearings and housings were part of every turn-around inspection and bearing temperatures were hand checked immediately following a shut-down of the helicopter.

The helicopter maintenance records indicate that a vibration was apparent in the airframe on July 9, 1996. The crew chief for the helicopter reported the pilot commented about a medium to high frequency vibration. An inspection revealed 6 discs of the number 7 tail rotor drive shaft segment's Thomas coupling were cracked. The coupling was replaced and in addition, an inspection of the intermediate tail rotor gear box revealed 3 slivers of metal. A serviceability inspection of the intermediate gear box was completed on July 11, 1996, and the helicopter was returned to service.

On the date of the accident, the crew chief reported the pilot again commented about a vibration. A reinspection of the number 7 drive shaft revealed a slight bow in the alignment of the shaft. An adjustment of the shaft reduced the vibration. Following the completion of the first logging cycle of the day, the pilot reported the vibration was a higher frequency than the previous occasion. Following the completion of the second cycle, the helicopter was shut down and the crew chief conducted a visual and hand inspection of the aircraft with no unusual results.

After lunch, the pilot flew the third cycle of the day and he commented that the vibration was barely being felt. The pilot landed for fuel and an inspection was conducted while the helicopter was running. The crew chief inspected the tail rotor bearings by a hand and visual inspection of the bearing housings. The crew chief did not notice any signs of grease splattering on the tail boom adjacent to the bearing housings. The helicopter then departed on the 4th cycle of the day. The accident occurred during the 7th turn of the cycle, about 17 minutes after the last inspection.

Telephone conversations with former pilots of the helicopter revealed a concern about the vibration in the helicopter. One pilot reported previous movement of the number 5 tail rotor bearing within its housing, including migrating of the bearing beyond the snap ring that normally retained the bearing in the housing.

The operator reported that the drive shaft bearings were part number SB1111-105. The tail rotor bearings had accrued the following hours in service: Number 1; serial number B449-01022: 849.6 Number 2: serial number B449-01679: 329.7 Number 3: serial number B449-04132: 329.7 Number 4: serial number B449-04146: 329.7 Number 5: serial number B449-00942: 505.4

The operator reported that the accident helicopter may use either a SB1111-105 or a SB1111-3 bearing for the tailrotor drive shaft. The -105 tailrotor bearings are normally an "on condition" part when used on civil aircraft. For aero logging applications, the operator established a 1,000 hour life limit on the -105 bearings. The -3 bearings have a life limit of 500 hours that is specified in the military overhaul manual.

The number 5 bearing, positioned between the number 5 and number 6 drive shaft segment, was purchased in a lot of 9 SB1111-105 bearings from the U.S. Government as surplus items at a Defense Reutilization and Marketing Region (DRMR) sale in San Diego, California, about 2 years prior to the accident. The bearing was purchased "as is" by the Marsell Bearing Company, Fallbrook, California. The Marsell Company reported that the bearing was packaged in its original "Fafnir" box and bore the date of 1992. The company did not keep any records of the precise date of purchase nor was any record made of the serial numbers of each bearing.

On November 2, 1994, the number 5 bearing, again as a lot of 9 SB1111-105 bearings, was purchased from Marsell Bearing by the Aero Independent Bearing Company, Inc., Sun Valley, California. Aero Independent Bearing reported that the bearing was visually inspected for any apparent defects. This included an inspection for corrosion, workmanship, mount marks, and rotating motion to insure the bearing was of a new, unused condition. Lubricating grease (Mil Spec, Mil-G-11796) was applied externally as a preservative and the bearing was resealed in secure packaging. They applied a sticker to the bearing box that indicated "relubed 10/95". The Aero Independent Bearing inspection did not include disassembly, repacking of internal grease, or weighing of the bearing to determine its grease fill state.

On October 16, 1995, Silver Bay Logging purchased a lot of 9 SB1111-105 bearings from Aero Independent Bearing. The purchase included the accident helicopter's number 5 tailrotor drive shaft bearing. The bearing was packaged in its original box. The bar code label for the bearing was retained with the maintenance records. On January 12, 1996, the bearing was installed on N542SB, where it accrued 233.3 hours of operation in the number 5 tailrotor drive shaft position.

On May 2, 1996, bearing serial number B449-01687, installed in the number 5 tailrotor position on N541SB (the accident helicopter), was removed after accruing 409.3 hours. According to the maintenance log, this bearing was removed due to the bearing seal separating from the bearing housing. The number 5 bearing along with the number 6 drive shaft from N542SB was removed and installed on N541SB, (the accident helicopter), where it accrued an additional 272.1 hours until the accident.

The helicopter had accumulated a total time in service of 4,362.3 hours, 670.3 hours since the operator began logging operations. The operator was issued a type certificate by an FAA Designated Airworthiness Representative (DAR) on June 29, 1994, after obtaining the helicopter from the military and completing a conformity inspection that is specified in Federal Aviation Regulations (FAR) Part 21.25. An operating certificate for external load operations (FAR Part 133) was issued to the operator on July 15, 1994. The operator obtained a special airworthiness certificate in restricted category for the accident helicopter on July 11, 1995. The helicopter, a military version of the Sikorsky S-64, has an external load capability of 20,000 pounds. The operator reported that an average turn of logs weighed about 14,000 pounds.

The helicopter was maintained according to a continuous airworthiness inspection program.

The last Phase Two inspection was conducted on July 10, 1996, 13.2 hours before the accident. The left engine had accrued a total time in service of 2,206.9 hours of operation. The right engine had accrued 2,571.3 hours of operation. Both engines were inspected 670.3 hours before the accident.

Meteorological Information

Witnesses at the accident site reported that the weather conditions were clear; visibility, 15 miles; temperature, 60 degrees F; wind, calm.

Wreckage and Impact Information

The National Transportation Safety Board investigator-in-charge (IIC) examined the airplane wreckage at the accident site on July 14, 1996. The main fuselage of the helicopter was observed at the point of rest on a magnetic heading of 260 degrees in an area of cut logs located in a small ravine about 1,400 feet mean sea level. The nose of the helicopter was pointed uphill on about 30 degree sloping terrain. (All heading/bearings noted in this report are oriented toward magnetic north.)

The main fuselage, consisting of the cockpit, engines and main rotor transmission, fuel tanks and landing gear, separated from the tail boom about fuselage station 471. The right main landing gear strut was separated at the upper attach point and the fuselage come to rest about a 45 degree angle to the right. The bottom of the fuselage was crushed upward and around about a 4 foot wide tree stump near the aft end of the fuselage. The cockpit, normally suspended from the upper attach point about fuselage station 136 at the forward end of the fuselage, was folded aft about 180 degrees and curled toward the left side of the fuselage. The lower right front corner of the cockpit exhibited upward and inward crushing.

The tail boom was about 25 feet downslope from the fuselage and oriented about 90 degrees to the left side of the fuselage. The vertical pylon and tail rotor assembly were folded in a forward direction about 45 degrees and were lying under the tail boom. The horizontal stabilizer was attached to the pylon.

The instrument panel and overhead control panel including the engine controls were torn and twisted away from their respective mounting points. Positions of controls and instrument readings are contained in Supplement C and D of this report.

Examination of fire warning annunciator light bulb filaments installed in the instrument panel revealed no stretched filaments. The master caution annunciator light bulb filaments were not stretched.

Tailrotor drive shaft segments 3, 4, 5, and 6, were torn off the upper surface of the tail boom and located on the ground between the tail boom and the fuselage. Drive shaft segments 1 and 2 remained attached to the fuselage. The number 2 shaft segment exhibited rotational

score marks around the shaft along its length. The number 2 drive shaft flange and Thomas coupling were completely broken. The number 2 bearing and housing along with its tail boom attach fitting remained attached to the number 3 drive shaft segment. The number 3 bearing Thomas coupling between the number 3 and 4 drive shaft segments was extensively torn and deformed, but one bolt remained attaching the two segments. The number 4 and 5 drive shaft segments were still attached at the number 4 bearing with the flange and Thomas coupling only exhibiting minor damage.

The number 5 drive shaft segment had a 3 inch round hole about 8 inches aft of the forward end of the shaft. The edges of the hole were curled inward and torn. The number 5 drive shaft segment was separated about 2 feet forward of the aft end of the shaft. The separation exhibited flattening of one side of the shaft and the edges were oriented about 45 degrees from the longitudinal axis of the shaft.

A separation was noted between drive shaft segments number 5 and 6 at the point where the number 5 bearing is installed. The point of separation was around the bearing mounting surface of the number 6 drive shaft. The forward splined portion of the number 6 shaft that mates to the number 5 shaft coupling flange was still installed in the coupling flange with its retaining nut and locking cotter pin installed. The Thomas coupling was bent slightly, but remained bolted between the number 5 drive shaft and the coupling. The forward end of the separated number 6 drive shaft, and the aft end of the number 5 drive shaft coupling, displayed rotational deformation, scratch marks and melting of the fracture surfaces. The paint adjacent to the fracture on each drive shaft segment was darkened and blistering of the paint was noted around the aft lip of the bearing mounting surface of the number 6 shaft. According to the National Fire Protection Association (NFPA), aircraft paints discolor at 600 degrees F and blisters at 800 to 850 degrees F. The visible portion of the bearing mounting surface of the number 6 drive shaft exhibited a dark blue to black color.

The number 5 bearing, including its bearing housing and viscous dampner, was not located. The upper surface of the tail boom exhibited about a 12 inch gouge forward of the bearing housing mounting position under the rotational path of the coupling flange/Thomas coupling of the number 5 drive shaft. The gouge extended on each side of the bearing mounting position perpendicular to the drive shaft. Two parallel gouges were located aft of, and on either side of, the number 5 bearing mounting position under the rotational path of the rivets of the forward end of the number 6 drive shaft. The number 5 bearing mount was torn away where the mounting bolts would secure the bearing housing to the tail boom.

The number 6 drive shaft segment remained attached to the intermediate gear box at the aft end of the shaft. The number 7 drive shaft segment between the intermediate gear box and the tail rotor gear box was fractured about midspan. Temperature sensitive tape, installed on the bearing housings was discolored at 100 degrees F and not discolored at 125 degrees F.

Tailrotor control continuity was established from the cockpit to the gearbox. The tailrotor gear box was broken away from its mounting points on the pylon. The tailrotor blades remained

attached to the gearbox and exhibited outward bending about 45 degrees near midspan. The blades did not exhibit any leading edge impact damage but had extensive trailing edge tearing and destruction of the blade pockets. The tailrotor pitch beam assembly that normally rotates with the tailrotor blades and transmits pitch changes to the blades, was crushed inward against the gear box housing. No rotational scoring was noted at the point of beam to gear box contact. Dirt and wood were noted packed around the outboard face of the gear box.

The main rotor blades were all separated about 2 feet outboard of their respective attach points on the rotor hub. Portions of the main rotor blades were scattered throughout the wreckage site. The rotor head was able to be turned in the direction of normal rotation, and locked when turned opposite the normal direction.

Continuity of the collective and cyclic flight controls was established to the main rotor. The copilot's collective control mechanism was torn from the aircraft. The upward limit stop, normally installed in a horizontal position, was bent upward about 90 degrees.

The chip detector plugs in the tail rotor gear box and the intermediate gear box were clean. The screen installed in the intermediate gear box was free of contaminants.

The number 1 engine case appeared undamaged. The first stage compressor blades exhibited moderate foreign object damage (FOD) from dirt and brush. The compressor and free turbine turned freely with no evidence of metalizing or spattering. The fuel control unit's actuating arm could not be moved due to impact damage along the helicopter's actuating linkage. The input shaft was positioned 1/16 inch from the full military power stop. When the fuel control was uncoupled from the damaged linkage, the fuel control arm moved freely through full travel.

The number 2 engine was broken free of its forward engine attach point. It exhibited a rupture of the engine compressor case at the front flange of the diffuser case. The number 1 bearing was fractured and the bearing roller cage, minus its rollers, was found deformed in an oval shape next to the engine. The first and second stage compressor blades received FOD damage from dirt and brush. The third, fourth, and fifth stage compressor blades received rotational damage that included fractured compressor blades and FOD. The second stage stator was damaged by FOD. The third and fourth stage stator vanes and inner shroud were missing. The fifth stage stator was damaged by FOD. The free turbine rotated freely with no evidence of metalizing or spattering. The fuel control unit's input arm was fractured but, the shaft was against the full military power stop.

Medical and Pathological Information

The Alaska State Medical Examiner, 5700 E. Tudor, Anchorage, Alaska, did not conduct a postmortem examination of the copilot.

Survival Aspects

Both pilots were issued flight helmets by the operator. Neither was wearing their helmet.

Tests and Research

The helicopter's annunciator panel was removed and sent to the NTSB's Materials Laboratory, Washington, D.C., for examination. The examination revealed none of the light bulb filaments in the panel were stretched. Several were broken, but not stretched.

The separated ends of the number 5 and 6 tailrotor drive shaft segments were also sent to the Materials Laboratory. That examination revealed a fracture separation just before the male spline index of the number 6 drive shaft. The fracture surfaces were heavily deformed consistent with rubbing together after separation. The original microscopic fracture features were totally obliterated by post separation damage. Energy dispersive x-ray spectroscopy analysis of the fracture surface revealed peak levels of lead particles along with elements of the shaft material. A cross section of the deformed fracture surface material revealed 3 different areas of hardness that decrease with increasing distance from the fracture surface.

The Torrington Company, Fafnir Bearing Division, Torrington, Connecticut, manufactured the tail rotor bearings utilized on the accident helicopter. According to Torrington records, the number 5 bearing was manufactured on October 23, 1991, as part of a group 230 bearings supplied to the U.S. Department of the Navy.

Drive shaft bearings (numbers 1,2,3, and 4) still installed in their respective support housings, were removed from the accident helicopter and sent to the FAA's Windsor Locks, Connecticut, Manufacturing Inspection District Office (MIDO). An FAA inspector from the MIDO supervised an inspection of the bearings at the Torrington Company.

The Torrington Company reported the 4 bearings conformed to their metallurgical and chemical design specifications. Each bearing conformed to their dimensional specifications with some ball variations which were attributed to operational use. Bearing numbers 1, 2, and 3, exhibited varying amounts of misalignment. The number 1 bearing had migrated from its proper position in the bearing housing. Bearing numbers 1 and 3 were each missing 1 of 2 snap rings.

The bearings contained Mobilegrease 28 lubricant. Lubricating grease had migrated to the exterior of each bearing. Evidence of grease contamination in the form of outgassing was found in each bearing. The operator provided samples of cleaning materials utilized around the helicopter for comparison to the evidence of grease contamination. None of the supplied samples were found in the grease. Analysis of the contamination revealed water and/or glycol in each bearing. The operator reported any use of glycol as a de-icing agent would have been applied during winter months from a heated, hand pumped, and low pressure sprayer.

The bearings contained the following amounts of grease and debris: Number 1) 2.8860 grams; number 2) 3.4026 grams; number 3) 4.7532 grams; number 4) 3.5778 grams.

Two balls in the number 4 bearing exhibited evidence of microspalling. The thin dense chrome (TDC) plating had been worn off several of the ball paths.

Additional Information

The accident helicopter may use either a SB1111-105 or a SB1111-3 bearing for the tailrotor drive shaft. The Torrington Company reported that the SB1111-3 bearing was produced between 1972 and 1987 for the Sikorsky Helicopter Company for use on various helicopters. In 1987, the SB111-105 bearing was designed by Sikorsky for improved corrosion resistance that included a thin dense chrome plating to the ball path. In 1992, The Fafnir Division sold the bearing manufacturing to The Split Ballbearing Company.

The Torrington Company reported that they were not aware of any Sikorsky Helicopter Company, military, or Erickson Helicopter Company, shelf life data on the subject bearings, but their own test data indicated the grease in the bearing would support a 5 year static shelf life under reasonable storage conditions.

The level of proper grease lubrication in a bearing is confirmed by weight.

The Sikorsky Helicopter Company reported that their historical data included 2 reports of bearing problems from military service which involved excessive bearing play and broken bearing cages.

The Sikorsky Helicopter Company no longer owns the type certificate for the civil version of the accident helicopter. The current type certificate holder for the civil aircraft version of the accident helicopter (S-64) is Erickson Helicopters, Central Point, Oregon. They reported they had experienced serviceability problems with -105 bearings and were developing an improved bearing for use on civil aircraft. They also indicated the -3 bearing has a 1,000 hour life limit or 1 year of service. They were not aware of any civil operators using the -105 bearing.

During the investigation, other operators of CH-54 helicopters provided historical and service information concerning the use of the SB1111-3 and SB1111-105 bearings. Columbia Helicopters, Aurora, Oregon, reported they were in possession of numerous -3 bearings in which the grease levels appeared to be low. They also indicated they only use -3 bearings and found the number 5 bearing on their CH-54 helicopter had water in the bearing, low grease level, and ratcheting. The bearing was removed after 480 hours of service. They did not find any grease on the tail boom of their helicopter adjacent to the bearing housing.

At the request of the NTSB IIC, Columbia Helicopters sent one of their inventory of -3 bearings, serial number 0620, to the Torrington Company for examination. The examination revealed a mix of grease types. The grease had a brown appearance. Lube on the right side of the bearing cavity was sparse with only 4 of the ball pockets containing grease. The amount of grease on the right side seal was 0.2365 grams. The amount of grease on the left side seal

was 0.4428 grams, with more grease present in the left side of the bearing cavity. The total grease weight was 3.8074 grams. The bearing bore was found to be oversized by 0.000488 inch.

Wreckage Release

The Safety Board released the wreckage, located at Juneau, Alaska, to the owner's representatives on July 25, 1996. The annunciator panel and portions of the number 5 and 6 tail rotor drive shafts were retained by the Safety Board for examination until their release on February 28, 1997.

Pilot Information

Certificate:	Commercial; Flight instructor; Private	**Age:**	34,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Helicopter	**Toxicology Performed:**	No
Medical Certification:	Class 2 Valid Medical--no waivers/lim.	**Last FAA Medical Exam:**	March 4, 1996
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	7985 hours (Total, all aircraft), 500 hours (Total, this make and model), 6190 hours (Pilot In Command, all aircraft), 125 hours (Last 90 days, all aircraft), 60 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Sikorsky	**Registration:**	N541SB
Model/Series:	CH-54A CH-54A	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Restricted (Special)	**Serial Number:**	68-18433
Landing Gear Type:	Tricycle	**Seats:**	2
Date/Type of Last Inspection:	July 10, 1996 Continuous airworthiness	**Certified Max Gross Wt.:**	42000 lbs
Time Since Last Inspection:	13 Hrs	**Engines:**	2 Turbo shaft
Airframe Total Time:	4362 Hrs	**Engine Manufacturer:**	P&W
ELT:	Installed, not activated	**Engine Model/Series:**	JFTD12A-4A
Registered Owner:	SILVER BAY LOGGING CO.	**Rated Power:**	4500 Horsepower
Operator:		**Operating Certificate(s) Held:**	
Operator Does Business As:		**Operator Designator Code:**	

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**	15 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	0°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:		**Temperature/Dew Point:**	16°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	SHELTER COVE , AK	**Type of Flight Plan Filed:**	None
Destination:		**Type of Clearance:**	None
Departure Time:	13:08 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:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 Fatal, 1 Serious	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal, 1 Serious	**Latitude, Longitude:**	55.610633,-131.579589(est)

Administrative Information

Investigator In Charge (IIC):	Erickson, Scott
Additional Participating Persons:	JIM VUILLE; JUNEAU , AK PAUL A KERSTETTER; ANCHORAGE , AK ALAN L GABRIELSON; TORRINGTON , CT PHIL KEMP; JUNEAU , AK
Original Publish Date:	October 31, 1997
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=2757