Aviation Investigation Final Report

Location:	PACIFIC OCEAN, Pacific Ocean	**Accident Number:**	LAX98LA200
Date & Time:	June 16, 1998, Local	**Registration:**	N95MS
Aircraft:	Hughes 369HS	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	2 Fatal
Flight Conducted Under:	Part 91: General aviation - Aerial observation		

Analysis

Witnesses reported that the helicopter took off from the ship, and about 85 agl, it started spinning to the right. The pilot called 'No control, MAYDAY,' on the radio. The helicopter nosed down and impacted the water. The aircraft was recovered, except for the aft portion of the tail rotor driveshaft and tailboom, including the tail rotor gearbox and all tail rotor system rotating components. The wreckage was shipped to the United States for examination. The aircraft had undergone a major overhaul/rebuild and annual inspection following a previous accident on March 11, 1997. After completing 1.4 hours of test flights, the helicopter was then partially disassembled and transported to California, and subsequently shipped to American Samoa. Maintenance personnel in Hawaii reassembled the aircraft, after replacing several parts. The owner of the maintenance facility stated some of the life-limited components were replaced with parts with less accrued total time. He reported that they had to adjust the shim on the tail rotor driveshaft because it was 'way off, too tight.' No test run was performed after reassembly. Examination of the helicopter following recovery revealed the forward tail rotor driveshaft coupling evidenced a fracture and separation. The forward portion of the coupling remained attached at the main transmission output pinion, while the aft portion of the coupling remained attached to the forward end of the tail rotor driveshaft. The coupling bolts evidenced smearing of the bolt heads. Scanning electron microscopy revealed a total of eight fracture surfaces. Six fracture surfaces displayed features consistent with fatigue, although much of the mechanical damage prevented identification of origin locations, and the other two fracture surfaces exhibited features consistent with overstress separation. Further, the coupling is designed with a built-in fail-safe feature that will continue to provide torque transmission in the event that a flex frame leg or bolt fractured. When the fail-safe engages, the unbalance of the coupling increases with a resultant increase in the vibration, alerting the pilot to take the appropriate action and land.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The improper shimmying of the tail rotor driveshaft by maintenance personnel which induced fatigue in the tail rotor driveshaft coupling causing it to fail, which resulted in a loss of tail rotor control. A factor is the failure of the pilot to recognize the warning vibrations indicating impending failure of the coupling.

Findings

Occurrence #1: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: TAKEOFF - INITIAL CLIMB

Findings
1. ROTOR DRIVE SYSTEM,TAIL ROTOR DRIVE SHAFT - OVERTORQUE
2. (C) MAINTENANCE,ADJUSTMENT - IMPROPER - OTHER MAINTENANCE PERSONNEL
3. ROTOR DRIVE SYSTEM,TAIL ROTOR DRIVE SHAFT COUPLING - FATIGUE
4. ROTOR DRIVE SYSTEM,TAIL ROTOR DRIVE SHAFT COUPLING - FAILURE
5. (F) UNSAFE/HAZARDOUS CONDITION WARNING - NOT UNDERSTOOD - PILOT IN COMMAND

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

Findings
6. TAIL ROTOR/ANTI-TORQUE CONTROL - NOT POSSIBLE - PILOT IN COMMAND

Factual Information

HISTORY OF FLIGHT

On June 16, 1998, at 1400 hours local time, a Hughes 369HS, N95MS, collided with the Pacific Ocean approximately 1,000 miles north-northwest of American Samoa following a takeoff from a fishing vessel. The helicopter, operated by the Caribbean Fishing Company, Pittsburgh, Pennsylvania, was destroyed. The pilot commercial pilot suffered fatal injuries. The passenger/observer, who was also the captain of the ship, was not found and is presumed to have suffered fatal injuries. The flight was conducted under the provisions of 14 CFR Part 91 as a tuna spotting operation. Visual meteorological conditions prevailed and no flight plan was filed.

There were 15 crewmembers aboard the vessel when the helicopter crash occurred, 7 of who witnessed the accident and were subsequently interviewed. Copies of their interviews are attached to this file. They reported that it was the first flight of the day for the tuna spotting operation. The witnesses stated that the helicopter took off and reached the altitude of the ship's mast, about 85 feet agl. They reported that the aircraft began "spinning around." One witness heard the pilot call on the radio, "No control, MAYDAY." The helicopter nosed down and impacted the water. At that point, the ship was stopped and speedboats were dropped into the water.

The pilot/mechanic was rescued and died about 15 minutes after being brought onboard the fishing vessel.

The United States Coast Guard continued to search for the missing captain, utilizing five ships and two helicopters. The search was suspended on Friday, June 19, 1998.

The helicopter was recovered, except for the aft portion (approximately the last 3 feet) of the tail rotor driveshaft and tail boom, including the tail rotor gearbox and all tail rotor system rotating components. The wreckage was shipped to the United States for examination.

PERSONNEL INFORMATION

According to the Federal Aviation Administration (FAA) airman records, the pilot held a commercial pilot certificate with an airplane multiengine land and instrument airplane rating. He also had private privileges for airplane single engine land and rotorcraft-helicopter. According to the pilot's employment application, dated May 1998, he indicated that he had 1,120 total hours of flight time, including 626 total hours in helicopters and 260 hours in a Hughes 369HS. He also listed 191 hours of fish spotting. The application indicated that the pilot's last biennial flight review was in May 1997. The pilot held a first-class medical

certificate dated September 26, 1996.

The pilot also performed duties aboard the ship as the helicopter mechanic. The FAA records showed that he held an FAA mechanic's certificate, with both airframe and powerplant ratings, issued on March 17, 1997.

AIRCRAFT INFORMATION

The aircraft had undergone a major overhaul/rebuild and annual inspection following an accident in which a pilot experienced a loss of power and made a forced landing in the water on March 11, 1997. The rebuild/overhaul was completed with an airframe time-since-new of 5,988.9 hours. After completing 1.4 hours of maintenance test flights, the helicopter was then partially disassembled and transported to California, and subsequently shipped to American Samoa.

After arrival in American Samoa, maintenance personnel contracted from a facility in Hawaii reassembled the aircraft. The chief mechanic reported that preliminary external inspection of the aircraft revealed no discrepancies; however, he stated that he had to adjust the shim thickness of the driveshaft because it was "way off, too tight." Some of the life-limited components, including the main rotor blades and tail rotor blades, were replaced with parts with less accrued total time. The tail boom was also replaced.

The aircraft was returned to service on May 18, 1998, with three open discrepancies indicated by the maintenance personnel: track and balance; replace engine TOT harness and calibrate; replace torque line from firewall to gauge. One of the mechanics reported that the discrepancies were left open because parts were not readily available and the ship was scheduled to leave the harbor. No test run was performed. A copy of the maintenance report is appended to this file.

At the time of the accident, the helicopter had accrued a total of 29.4 hours since the overhaul/rebuild, including the 1.4 hours of maintenance test flights.

WRECKAGE AND IMPACT

According to witnesses, the aircraft impacted the water in a right spin, then rolled onto its left side. The left landing gear, including the permanently inflated utility floats, separated from the fuselage. The left struts forward and aft of the landing gear lower attaching flanges exhibited damage. The cockpit windscreen Plexiglas panels were blown out.

DAMAGE TO AIRCRAFT

The aircraft was configured for left seat command and was not equipped with dual flight controls. The collective control system was intact from the left seat collective control stick up to the lower main rotor system flight controls, and continuity was established for that portion

of the system. The cyclic was intact from the left seat cyclic control stick up to the main rotor system lower flight controls. Continuity was established for that portion of the controls. The antitorque control system was intact from the left seat pedals to a fracture of the floor-routed control rod forward of the bungee spring attach fitting/aft rod end bearing. According to the maintenance manual, the directional control bungee spring installed in the accident aircraft was designed for use in the 369D series aircraft.

The main rotor blades evidenced lead/lag excursions and high flapping angles. All strap pack laminates exhibited fracture damage and one main rotor blade separated completely from the main rotor system and was not recovered. A second main rotor blade was separated at the strap pack and partially wrapped around the main rotor mast and upper flight controls.

The pilot and front seat passenger lap belts were intact and evidenced no damage to the webbing or the fuselage attach points. The pilot (left seat) shoulder harness was fully extended from the inertia reel, which was locked. The passenger (right seat) shoulder harness was extended approximately 2 inches and twisted 180 degrees inside the inertia reel, which was locked.

The engine remained intact and evidenced external damage consistent with the effects of saltwater corrosion. A fuel system inspection and vacuum check was not conducted due to the saltwater submersion and corrosion of fuel system components, including the fuel cell.

The tail rotor driveshaft exhibited no rotational damage. The tail rotor driveshaft forward coupling, manufactured by Kamatics Corporation, evidenced a fracture and separation. The forward portion of the coupling remained attached at the main transmission output pinion, while the aft portion of the coupling remained attached to the forward end of the tail rotor driveshaft. The coupling bolts evidenced smearing of the bolt heads. Each fractured coupling section exhibited compression bending of the flanges. The coupling was sent to the Safety Board Materials Laboratory for further analysis. A copy of the metallurgy report is appended to this file.

TESTS AND RESEARCH

One piece of the coupling was attached to the rotor brake disc, while the other piece, from the drive shaft side, was not attached to any neighboring hardware. Two sections of flex coupling were bolted to each piece of the gearshaft coupling and both contained two fractures. Examination revealed that the fractures from the two pieces of driveshaft coupling did not match, indicating that one or more pieces were missing from the coupling.

The coupling flanges were bent on both sides. The forward coupling flange was bent forward, toward the disc, and the aft coupling flange was bent aft, away from the disc.

After cleaning, each fracture surface was visually examined with a stereo microscope, and further examined with a scanning electron microscope. The metallurgist reported that of the

eight total fracture surfaces, five displayed features consistent with fatigue; however, much of the mechanical damage prevented identification of the origin locations. The other three fracture surfaces exhibited features consistent with overstress separation.

According to a representative from the Kamatics Corporation, the tail rotor coupling is designed with a built-in fail-safe feature that will continue to provide torque transmission in the event that a flex frame leg or bolt fractures. When the fail-safe engages, the unbalance of the coupling increases with a resultant one-per-rev vibration at intermediate gearbox frequency, alerting the pilot to take the appropriate action and land. In addition to the metallurgist's findings, the Kamatics representative noted that the fail-safe contact on one side of the coupling was heavier than the other around the circumference, indicating that the tail rotor coupling had experienced multiple fractures over a period of time. He further reported that additional marks due to rubbing wear on the male portion of the fail-safe, and on the flange, indicated that a large axial loading and a large misalignment had taken place.

According to the McDonnell Douglas Parts Manual, the coupling in the accident aircraft (McDonnell Douglas Part Number 369D25501-3/Kamatics Part Number SKCP2361-7) was the correct part for that aircraft. In 1988, McDonnell Douglas changed the dimensional specifications for the manufacture of the Kamatics coupling. Kamatics modified the part to make it approximately 0.06 inch shorter. The McDonnell Douglas Maintenance Manual indicated that either size coupling may be installed in the aircraft; the mechanics are directed to adjust the shim thickness of the driveshaft to account for the difference in length.

The record of sale from Kamatics indicated that they sold and delivered the accident coupling to McDonnell Douglas in 1989. The maintenance facility that performed the aircraft rebuild/overhaul reported that they bought the coupling from a parts vendor in March 1994. The coupling then remained as a stock item until it was installed as a new part in N95MS in 1998.

Pilot Information

Certificate:	Commercial; Private	**Age:**	30,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:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Valid Medical--no waivers/lim.	**Last FAA Medical Exam:**	September 26, 1996
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	1120 hours (Total, all aircraft), 260 hours (Total, this make and model)		

Aircraft and Owner/Operator Information

Aircraft Make:	Hughes	**Registration:**	N95MS
Model/Series:	369HS 369HS	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	1130536S
Landing Gear Type:	Float; Skid	**Seats:**	4
Date/Type of Last Inspection:	May 18, 1998 Annual	**Certified Max Gross Wt.:**	2550 lbs
Time Since Last Inspection:	29 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	6018 Hrs	**Engine Manufacturer:**	Allison
ELT:	Installed	**Engine Model/Series:**	250-C20B
Registered Owner:	CARIBBEAN FISHING COMPANY	**Rated Power:**	415 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:**	Day
Observation Facility, Elevation:		**Distance from Accident Site:**	
Observation Time:		**Direction from Accident Site:**	
Lowest Cloud Condition:	Clear	**Visibility**	12 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	90°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:		**Temperature/Dew Point:**	29°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:		**Type of Flight Plan Filed:**	None
Destination:		**Type of Clearance:**	None
Departure Time:	14:00 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:	1 Fatal	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Fatal	**Latitude, Longitude:**	

Administrative Information

Investigator In Charge (IIC):	Mars, Noelani
Additional Participating Persons:	LOU ZIEGLER; SAN FRANCISCO , CA WARREN SEITZINGER; INDIANAPOLIS , IN JOHN KURTZ; MESA , AZ TIM COLE; TORRANCE , CA
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