Aviation Safety Investigation Report 199500373

Hughes Helicopters
Hughes 300

14 February 1995

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Aviation Safety Investigation Report

199500373

Occurrence Number: 199500373 **Occurrence Type:** Accident
Location: 6km S Moorabbin Airport
State: VIC **Inv Category:** 3
Date: Tuesday 14 February 1995
Time: 0940 hours **Time Zone** ESuT
Highest Injury Level: Fatal
Injuries:

	Fatal	Serious	Minor	None	Total
Crew	1	0	0	0	1
Ground	0	0	0	0	0
Passenger	0	0	0	0	0
Total	**1**	**0**	**0**	**0**	**1**

Aircraft Manufacturer: Hughes Helicopters
Aircraft Model: 269C
Aircraft Registration: VH-PKK **Serial Number:** 900951
Type of Operation: Miscellaneous Ferry
Damage to Aircraft: Destroyed
Departure Point: Geelong Airport VIC
Departure Time: 0855 ESuT
Destination: Moorabbin VIC

Crew Details:

Role	Class of Licence	Hours on Type	Hours Total
Pilot-In-Command	Commercial	275.0	350

Approved for Release: Wednesday, January 29, 1997

FACTUAL INFORMATION

History of the flight

The pilot was conducting a private ferry flight from Port Campbell, via Geelong, to Moorabbin airport for maintenance to rectify a tail rotor vibration. Six kilometres south of Moorabbin, while the helicopter was cruising at an estimated indicated airspeed of 70 kts at 700 ft, both lugs of a clevis failed on the left centre frame aft cluster fitting. The failure freed the lower end of the left tail boom support strut. This allowed the tail boom to lift into the main rotor, which cut off the tail boom. The helicopter broke up in flight falling into shallow water 50 m from a beach.

Pilot information

The 38 year old pilot was correctly qualified and endorsed to perform the flight. He held a commercial helicopter pilot licence and a class one medical certificate. However, he was not a licensed aircraft maintenance engineer nor did he hold a maintenance authority entitling him to certify for 50-hourly inspections on the helicopter.

Meteorological information

At the time of the accident the weather was fine, there was no significant cloud, there was a light wind and no known turbulence. Weather was not a factor in the accident.

In-flight breakup and impact

When the left tail boom support strut detached from the aft cluster fitting, the tail boom swung to the right and lifted, thereby misaligning the tail boom with the internal tail rotor drive shaft. The forward bulkhead of the tail boom severed the drive shaft. The tail boom lifted high enough for the main rotor blades to cut off the aft section of the tail boom along with the tail rotor gearbox, tail rotor assembly and stabilisers. The static mast snapped due to overload and the main rotor assembly, its drive shaft and about half of the static mast detached from the helicopter. The cabin, engine, main gearbox and landing gear assembly remained together until impact with the sea.

Final impact occurred with the back of the cabin facing the sea. The accident was not survivable.

Engine

Rotational damage to the cooling fan and the starter ring gear confirmed that the engine was still running at impact with the sea. No fault was found with the engine which may have contributed to the accident.

Airframe particulars

The pilot was also the owner of the aircraft. He purchased the helicopter on 8 October 1992. Records show that at the time of purchase, the airframe had accrued 4,130 hours total time in service. Since the purchase, the helicopter had been used primarily for short scenic flights averaging about 15 minutes per flight. At the time of the accident the total time in service for the aircraft was 4,333 hours.

Maintenance history

There was no inserviceability recorded in the maintenance release for the helicopter.

A review of the helicopter's maintenance documentation found that the Civil Aviation Authority's Airworthiness Directive AD/HU269/57 Amendment 1, requiring inspection of the aft cluster fittings for cracks, had been certified in the airframe logbooks five times since 16 July 1988. This airworthiness directive inspection was carried out at intervals shorter than the required 200 hours.

The tail boom, a life-limited component, was replaced at the major inspection on 18 October 1993, at 4,149.9 hours total time in service.

The tail rotor was last balanced approximately 200 flight hours prior to the accident, and the last 50-hourly inspection was certified, by the pilot, on 8 January 1995 at 4,293 hours total time in service.

The pilot had certified for daily inspections on a regular basis up to and including the second-last flight, which occurred on 12 February 1995. (The daily inspection for the final flight had not been signed off.) A pilot's daily inspection, as per the approved Hughes 269C flight manual, requires that the tailboom supports and fittings be visually inspected for cracks, looseness and security. Clevis cracks were not detected during mandatory daily inspections prior to the accident.

Airworthiness Directive AD/HU269/92 required "No Step" placards on the tail boom support struts to warn personnel not to step on them when inspecting the main rotor head assemblies during daily/pre-flight inspections. After the accident, no placards were found on the struts. Notwithstanding the lack of placards, no evidence was found that the support struts were being used as steps.

Aft cluster fitting inspections

Airworthiness Directive AD/HU269/57 Amendment 1 required the inspection of the cluster fittings to be carried out in accordance with Hughes Service Information Notice N-82.3. Note 1 of this airworthiness directive required that improved fittings of -3 designation on all model 269 helicopters be inspected. The compliance was in two steps. Step 1 required a visual examination at each daily inspection and Step 2 required a dye penetrant inspection at intervals not exceeding 200 hours time in service from the last inspection.

However, on page one of the notice, readers were advised that -3 cluster fittings were not subject to the requirements of N-82.3 because these fitting configurations are designed and manufactured with lugs having increased thickness, making them less susceptible to cracks and structural damage.

Also on page four of N-82.3 (within Step 2), a note stated that the -3 fittings do not require paint removal and dye check, unless cracking, deformation or damage is suspected.

As a result of this ambiguity, at the last 200-hourly inspection, the certifying licensed aircraft maintenance engineer only visually inspected the helicopter's aft cluster fittings. His technique was to clean the area to be inspected with aviation gasoline and then, using a magnifying glass, search for evidence of cracking. He found no evidence of cracking.

Soon after this accident, the Civil Aviation Authority issued Airworthiness Directive AD/HU269/57 Amendment 2. This amendment clarified the inspection criteria for cluster fittings on all Australian registered Hughes/Schweizer 269 helicopters. This directive had to be completed within 5 hours of service after 3 March 1995. No record was found of reports of aft cluster fitting lug cracks in the Australian fleet of Hughes/Schweizer 269s since the issue of this amended airworthiness directive.

Metallurgical examination

Examination of the left side aft cluster fitting upper lug identified that it had failed in fatigue. The fatigue crack initiated from multiple origins adjacent to a small area of mechanical damage on the outer surface of the upper lug webbing radius, and propagated across the entire cross section of the lug. The lower lug fitting contained two fatigue fractures growing on different planes as well as an overload fracture.

The observed fatigue striations were evenly spaced, typical of propagation by constant amplitude load, such as vibration load. Striation spacing on the upper lug was smaller than on the lower lug, suggesting that the upper lug fracture initiated first.

On the upper lug fracture surface, 34 faint propagation marks were detected. The marks were distinguishable by thin layers of superficial oxidisation/rust. The examining metallurgist commented that each progression mark may have represented a flight cycle.

No evidence of localised plastic deformation of the lugs was found and no historical evidence was found that the fatigue fracture might have initiated from overload due to abuse.

Staining and discolouration of the paint adjacent to the upper lug indicated that the paint was fractured for some time.

The metallurgist found some evidence that the right side aft cluster fitting had been repainted, but no residue penetrant was detected.

In the opinion of the metallurgist, the upper lug fracture would have been visible for some time during daily inspections.

Vibrations

During the wreckage examination, the tail rotor teeter hinge bearings were found to be worn. The possibility exists that the worn bearings may have caused tail rotor vibrations which may have contributed to the fatigue cracking of the aft cluster fitting.

A part-time pilot who flew the helicopter only 3 days before the accident, was aware of wear in the tail rotor teeter hinge bearings. He stated that a tail rotor vibration was not noticeable in flight through the anti-torque pedals. However, he further stated that a tail rotor vibration could occasionally be felt on the ground with the engine operating at 3,100 revolutions per minute (RPM), the collective fully down and the main rotor spinning at flight RPM. He also stated that occasionally the tail skid could be seen vibrating while the helicopter was ground running prior to takeoff. He advised that he discussed the worn bearings with the pilot/owner.

The manufacturer advised that an excessive tail boom vibration situation was one of the conditions the fitting was subjected to during the testing stages of the product.

Examination of other tail boom components revealed no evidence of being affected by tail rotor vibrations.

ANALYSIS

The accident resulted from in-flight fatigue failure of the clevis lugs on the left aft cluster fitting.

Although the duration of the fatigue failure propagation is not known, the fracture probably initiated in the later stages of the helicopter's operational life and propagated within a relatively short period of time. This assumption is based on the following:

(a) There was an absence of heavy oxidisation on the fracture surfaces.

(b) The faint propagation marks identified on the upper lug surface appeared to have occurred as a result of oxidisation of fresh cracking during and after flight.

(c) The fatigue striations were uniform. The helicopter underwent substantial maintenance about 200 hours flight time before the accident, when the tail boom was replaced. At about that time, the main and tail rotor assemblies were reassembled and balanced. Changes in striation spacing would have been expected as a result of the maintenance performed. No changes were found.

(d) It is considered likely that, had the upper lug been cracked, it would have been discovered by an engineer during the last tailboom replacement.

(e) The helicopter flew only 433 hours within the past 6 years. Within that time five Airworthiness Directive AD/HU269/57 Amendment 1 inspections of the aft cluster fittings had been certified by engineers.

It is possible that an unusual load could have been applied to the aft cluster fitting during past helicopter ground handling, or perhaps during an unrecorded heavy landing, or during tail boom replacement or other maintenance. However, during the subsequent metallurgical examination of the fitting, no evidence of localised plastic deformation of the lugs was found and no historical evidence was found that the fatigue fracture might have initiated from overload due to abuse.

The possibility exists that tail rotor vibration caused by the worn teeter hinge bearing contributed to the accident.

SIGNIFICANT FACTOR

Fatigue cracks progressed undetected in the clevis lugs of the left centre frame aft cluster fitting.

SAFETY ACTION

The Civil Aviation Authority issued Airworthiness Directive AD/HU269/57 Amendment 2, which clarified the requirement to remove paint and inspect the entire cluster fitting using a colour contrast or florescent dye penetrant. Compliance was within 5 hours time in service after 3 March 1995 and thereafter within 200 hours time in service from the last inspection.

The Civil Aviation Authority sent a copy of Airworthiness Directive AD/HU269/57 Amendment 2 to the current aircraft manufacturer, Schweizer Aircraft Corporation.

The manufacturer was also given a copy of Specialist Report 14-95, Metallurgical Examination of Centre Frame Cluster Fittings from Hughes 269C Helicopter.