

AVIATION OCCURRENCE REPORT

**TAIL ROTOR TRANSMISSION SEPARATION
NORTHERN MOUNTAIN HELICOPTERS LTD.
HUGHES HELICOPTER 369D C-GPDH
MESSALINKA CAMP, BRITISH COLUMBIA
10 MAY 1994**

REPORT NUMBER A94P0084

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

Shortly after take-off, the Hughes 369D helicopter developed a severe tail rotor vibration. The pilot immediately began a descent to position the aircraft for a precautionary landing. At about 75 feet above the ground, the tail rotor assembly fell off, causing the helicopter to suddenly pitch nose down and yaw to the right. The pilot entered an autorotation and landed without injury or further damage.

Other Factual Information

The pilot landed at the Messalinka Camp to deplane one of his three passengers, and then took off again for his next destination. He climbed to about 300 feet and had started to level the helicopter when he felt a severe vibration in the tail rotor pedals. The pilot immediately commenced a steep descent and reduced the airspeed to about 60 knots to prepare for a precautionary landing.

At about 75 feet above the ground, the helicopter pitched nose-down and yawed to the right. The pilot rolled off the throttle, entered autorotation, and landed in a clearing without further damage. Neither the pilot nor his passengers were injured.

The tail rotor and tail rotor transmission had separated from the helicopter in flight, and all damage to the helicopter was a result of the separation. One tail rotor blade had struck the lower vertical stabilizer repeatedly before the transmission disengaged. The aft tail boom and the horizontal stabilizer were also damaged.

The tail rotor transmission was located a substantial distance from the helicopter, along with two pieces from one of the tail rotor blades. None of the segments of the fractured blade (S/N 5021) retained any portion of the leading edge abrasion strip.

The tail rotor blades were originally designed and manufactured without leading edge abrasion strips. In-flight erosion of the leading edges, however, had resulted in an unacceptably short service life. Subsequently, the manufacturer engineered a modification that allowed the installation of an abrasion strip on each blade leading edge.

This modification improved the service life of the blades, but introduced a problem of tail rotor imbalance if a portion of the abrasion strip separated from the blade. In response, the manufacturer issued Service Information Notices DN-130-2 and DN-179, and the Federal Aviation Administration issued Airworthiness Directives (AWD) AD 85-18-02R1 and AD 92-22-14. The notices and directives require either inspections or modifications designed to prevent abrasion strip separation. The most recent AWD (AD 92-22-14) requires the addition of rivets to provide a secondary failsafe method of attachment of the tail rotor blade abrasion strip. There is also a requirement for operators to conduct daily pre-flight inspections and 100-hour inspections of the abrasion strip.

The required AWDs had been embodied on the accident aircraft, and the operator had completed the daily visual inspection before the accident flight.

From an examination of the transmission and rotor blades it was concluded that:

1. The forced landing was necessitated by the in-flight separation of the tail rotor abrasion strip from tail rotor blade S/N 5021.
2. The abrasion strip to tail rotor failed adhesively, between the adhesive and the abrasion strip. Loss of the strip caused a massive imbalance which resulted in separation of the tail rotor transmission assembly from the helicopter.
3. There was no evidence of improper torquing of the tail rotor transmission mounting fasteners. Stud fractures were the result of rapid, low-cycle, fatigue cracking.
4. The cause of the abrasion strip bond failure was not established. No single cause factor relating to bond design, installation processing or operating environment could be identified.
5. The mandated daily visual inspection did not detect a bond separation before in-flight separation occurred.
6. The addition of rivets to the tail rotor blade abrasion strips did not provide a fail-safe method of attachment.

Analysis

The bonding and rivets securing the abrasion strip to one tail rotor blade released and allowed the abrasion strip to separate from the blade. Without the weight of the bonding strip, the tail rotor blades were out of balance, and the severe vibration caused by this imbalance tore the tail rotor assembly from the helicopter.

It was not determined what caused the bonding and rivets to release; however, it is apparent that the addition of these rivets did not provide the anticipated fail-safe protection against abrasion strip separation.

The following Engineering Branch report was completed:

LP 71/94 - Tail Rotor Gearbox Separation.

Findings

1. The abrasion strip on one tail rotor blade failed adhesively, and the retaining rivets pulled free, allowing the abrasion strip to separate from the blade.
2. The loss of the strip caused a tail rotor blade imbalance which resulted in separation of the tail rotor transmission assembly from the helicopter.
3. There was no evidence of improper torquing of the tail rotor transmission mounting fasteners.
4. The tail rotor transmission retaining studs had fractured as the result of rapid, low cycle, fatigue cracking.
5. The operator had completed the daily visual pre-flight inspection of the tail rotor blades.
6. All applicable AWDs had been complied with.
7. The cause of the failure of the abrasion strip bond was not determined. No single cause factor relating to bond design, installation, or operating environment could be identified.

Causes and Contributing Factors

The bonding securing the abrasion strip to a tail rotor blade released, and the retaining rivets pulled free, allowing the abrasion strip to separate from the blade. The vibration set up by this imbalance tore the tail rotor assembly from the helicopter. It was not determined what caused the bonding and rivets to release.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson, John W. Stants, and members Gerald E. Bennett, Zita Brunet, the Hon. Wilfred R. DuPont and Hugh MacNeil, authorized the release of this report on 28 February 1995.