Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT

A00W0215

POWER LOSS—MECHANICAL MALFUNCTION

CANADIAN HELICOPTERS

EUROCOPTER AS 350BA C-GATX

FORT NELSON, BRITISH COLUMBIA, 90 NM E

02 OCTOBER 2000

Canada

Aviation Investigation Report

Power Loss—Mechanical Malfunction

Canadian Helicopters
Eurocopter AS 350BA C-GATX
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Report Number A00W0215

Summary

The Eurocopter AS 350BA helicopter, C-GATX, serial number 1221, was descending to land at a forestry site to pick up passengers. The pilot heard two loud “bangs”, which were followed by a loss of power. Ground crew heard the noise and observed the helicopter trailing smoke and descending behind trees. The pilot autorotated the helicopter into a swamp, where the helicopter sustained minor damage. No one was injured.

Ce rapport est également disponible en français.

Other Factual Information

The Turbomeca Arriel 1B engine, serial number 4432, was examined before removal from the airframe. All of the power turbine (MO4) blades had departed the hub, damaging the power turbine nozzle assembly and the exhaust duct. Shrapnel damage was evident on the leading edges of the tail-rotor blades and the vertical fins.

The engine is an assembly of five major modules (Figure 1). Modules 2, 3, and 5 had been exchanged with overhauled units from the engine manufacturer about 37 hours before the occurrence. Module 4, the power (free) turbine section, had been in service for about 1200 hours since overhaul.

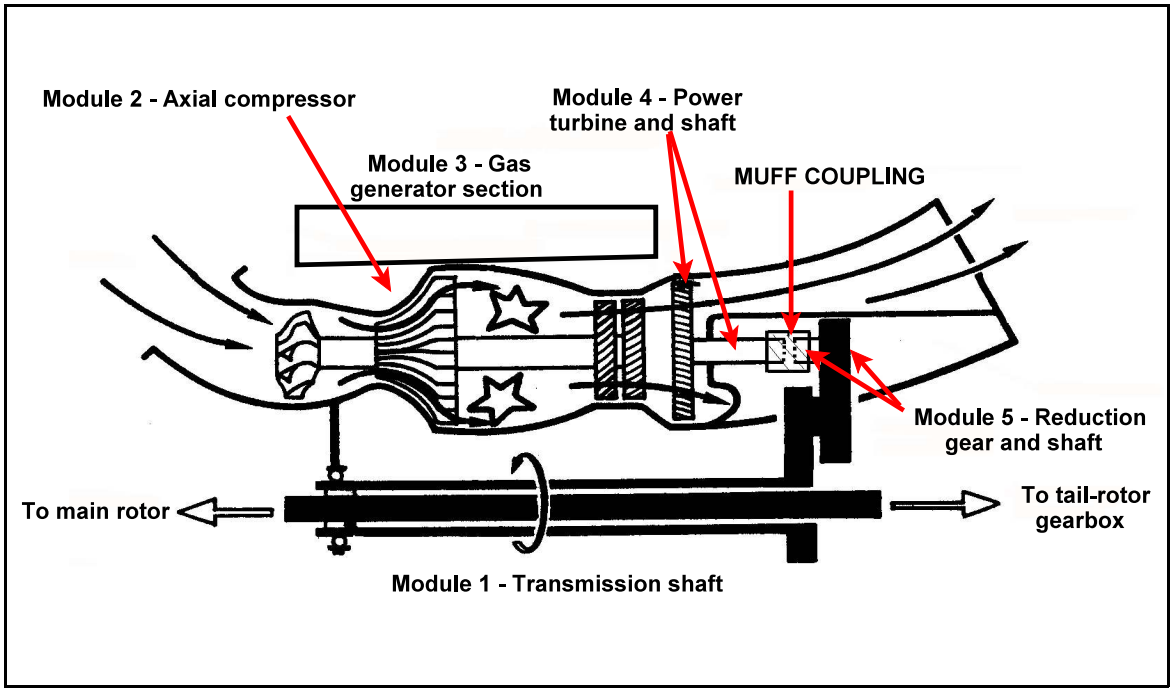

Figure 1 - Engine schematic

It was determined that all the blade root fractures were the result of overload conditions consistent with turbine overspeed. Other rotating components of the engine were undamaged. The muff coupling (part number 029270820) is a splined metal tube that connects and transmits power from the output shaft splined nut of the power turbine section to the input drive pinion splined nut of the reduction gearbox. The muff coupling was found split along its longitudinal

axis. It is a component of the reduction gearbox and was overhauled and inspected about 37 hours before the failure.

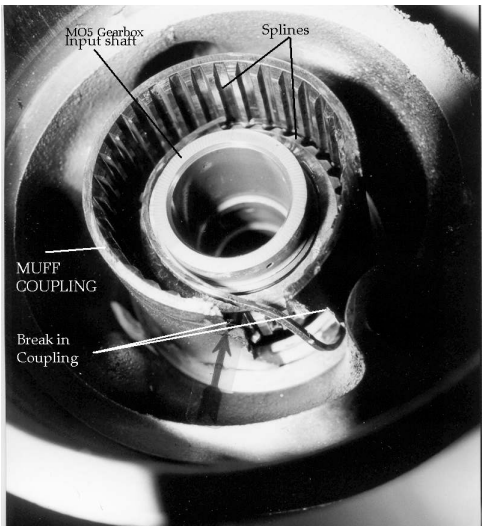

Figure 2 - Muff coupling

Metallurgical examination of the muff coupling at the TSB Engineering Laboratory established that the cause of the failure was the fatigue extension of a crack in the centre section of the coupling. The blocky, intergranular nature of the fracture surface suggests that the crack formed during the quench preceding the nitriding treatment, since a nitride layer was present on the crack surfaces. The manufacturer has advised that the overall nitride layer would mask any existing cracks when checked by magnetic particle inspection (MPI) as the final step of the manufacturing process. The nitride layer would also have resulted in the crack not being detected by MPI during subsequent overhaul inspections since the coupling was placed in service.

The coupling is an “on condition” part and does not have a serial number or a specified time of replacement. Efforts to trace the component’s date of manufacture and batch number were inconclusive because of the lack of a serial number. The manufacturer’s records indicate that the coupling is most probably one of a batch of 94 produced in 1989. There is no method of determining how many of the batch are still in service or if any of the others are defective.

Analysis

Evidence of the nitriding layer through the crack surfaces was an indication that the crack was formed during the manufacturing process, before the final nitriding process and the MPI. Fatigue progression of the crack weakened the coupling until it failed. The nitride layer prevented discovery of the crack by the MPI process.

The couplings are not serialized and could not be traced as to manufacture and service life. Determining if this was an isolated event or if other couplings from the same batch were defective was therefore not possible.

The following TSB Engineering Laboratory Report was completed:

LP 108/00—Engine Failure Analysis.

This report is available upon request from the Transportation Safety Board of Canada.

Findings as to Causes and Contributing Factors

1. The engine lost power when the muff coupling connecting the power turbine to the reduction gearbox failed.

2. The coupling failed because of the fatigue extension of a crack that originated during the manufacturing process.

Findings as to Risk

1. The muff coupling was inadequately inspected at the time of manufacture and at periodic overhauls.

2. The lack of serial numbers on the muff couplings impeded traceability.

Safety Action

The engine manufacturer, Turbomeca, has made the following changes to the manufacturing and inspection processes:

- The bar stock (billets) to be manufactured into couplings now undergo magnetic particle inspection (MPI) for any defects when received, before processing.

- The couplings undergo MPI and eddy current inspection after manufacture and heat treatment, but before nitriding.

- The couplings will now be serial numbered from manufacture.

Turbomeca issued Service Bulletin AC 00132 (08 December 2000) and AC 00135 (14 December 2000) to update criteria in its *Repair Manual*, as per Technical Instruction (TI) 0021 (12 December 2000) issued to all field repair shops to

- replace in-service couplings with new ones at overhaul or repair; and

- ensure that replacement couplings, if not serialized from the factory, are etched with the serial number of the reduction gearbox at installation and recorded on the reduction-gearbox log cards.

Turbomeca has issued a fax to customers, dated 02 February 2001, advising that TI-0021 will be updated to include additional instructions:

- The MPI is to be discontinued in the field.

- The marking of parts will stop when parts with a serial number become available (first delivery of parts, mid-February 2001).

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 04 December 2001.