

AVIATION OCCURRENCE REPORT

MAIN ROTOR BLADE SEPARATION IN FLIGHT

RUPERT'S LAND OPERATIONS INC.  
HUGHES 369D (HELICOPTER) C-FDTN  
PROVOST, ALBERTA, 14 KM N  
10 DECEMBER 1997

REPORT NUMBER A97W0254

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.

## Aviation Occurrence Report

### Main Rotor Blade Separation in Flight

Rupert's Land Operations Inc.  
Hughes 369D (Helicopter) C-FDTN  
Provost, Alberta, 14 km N  
10 December 1997

Report Number A97W0254

### *Summary*

At about 1400 hours mountain standard time (MST), the pilot of the Hughes 369D helicopter, serial number 370102D, was slinging a rack of seismic equipment bags on a 50-foot lanyard. The pilot had positioned one bag and was entering a hover at about 100 feet above ground level to release another bag. The cyclic control suddenly began to vibrate violently, and the nose of the helicopter pitched down. In an attempt to level the helicopter, the pilot applied full aft cyclic, but the machine descended and struck the ground heavily in a nose-down, left-side-low attitude. The helicopter came to rest laying on its left side, breaking the left cross tubes and left skid tube. The tail boom had separated in flight, and the main rotor blades were curled from ground contact. The fuel tank ruptured and was leaking into the cockpit. Seismic workers called for medical assistance for the pilot, who was dazed, and helped remove him from the wreckage. The pilot was taken by ambulance to a local hospital. Later, seismic workers located a main rotor blade about 1,200 feet south of the accident site.

*Ce rapport est également disponible en français.*

---

<sup>1</sup> All times are MST (Coordinated Universal Time minus seven hours) unless otherwise noted.

## *Other Factual Information*

The Hughes 369D helicopter is equipped with five main rotor blades (Part No. 369D21100-517), which were installed as a set on 17 July 1995. The colour of paint on the blade attachments nuts indicates the respective blade installation location. At the time of the occurrence, the accumulated flight time of the blade assembly was about 2,461 hours, except that the blue blade had 86 hours less because it was out of service for abrasion strip repairs. The blades have a normal service life of 3,530 hours.

The recovered blade (serial no. 009999-H709), referred to as the green blade, had failed and separated from the helicopter because of chord-wise cracking just outboard of the lower blade attachment fitting. The spar, blade skin, and doubler exhibited indications typical of a fatigue-related failure. TSB Engineering Branch examination of this rotor blade revealed that the crack had initiated in the lower inboard doubler and propagated in a chordwise direction through the blade skin and spar. Investigation revealed that a batch of doublers used for production blade assembly were initially rejected as non-conforming yet were subsequently used. The nature of the non-conformance was a break or crease in the curvature of the doubler relative to the blade skin. Such a defect would allow variations in the thickness of the adhesive layer and possible regions of poor bonding during the assembly. In addition to the reduction in load transfer brought about by the adhesive disbonding, stress analysis has shown that the non-conforming doubler can introduce significant residual stresses in the doubler skin following blade assembly.

During the field examination, a similar crack was found in the same location on the blue blade (serial no. 009999-H706). Subsequent examination of the remaining blades by the TSB Engineering Branch revealed that all of them had cracks in the same location; the white blade (serial no. 009999-H708) had a half-inch crack, and the red and yellow blades (serial nos. 009999-H705 and -H707) had micro-cracking.

Examination of the wreckage showed that the metal surface of the pilot's seat pan was displaced downwards, and that the instrument pedestal had broken away from its base mounting and was laying against the remains of the pilot's rudder pedals and the left forward doorpost. The engine continued to run after impact and singed the exposed grass in the area below the exhaust tail pipes. The pilot's door was torn off its hinges, and the left upper plexiglass windscreen was broken during the ground impact. There was no indication found that the main rotor blades had struck the tail boom. The manufacturer's representative indicated that, in previous occurrences involving severe main rotor imbalance, lateral vibration had resulted in failure of the tail boom structure.

Records indicate that the helicopter was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The helicopter's weight and balance was within limits, and the centre of gravity was within the normal range. Entries in the aircraft logs indicate

that Airworthiness Directive (AD) 96-10-09, requiring the examination of the root end fitting, had been carried out during the last 100-hour inspection on 26 November 1997, with no cracks found.

The pilot was certified and qualified for the flight in accordance with existing regulations, and had flown a total of 1,554 hours, of which 1,452 were on a Hughes 369D. The pilot was wearing a helmet and used the full seat-belt and shoulder harness available. He was occupying the left seat, as is normal in a Hughes 369D helicopter. The pilot was hospitalized with a collapsed left lung, minor abrasions to both ankles, and chemical burns to his lower torso and left arm from fuel leakage. He also experienced a sore neck and tail bone.

The occurrence site is located in a rolling, grassy pasture area with occasional small trees and brush. The automatic weather observation system (AWOS) report for Coronation, Alberta, (50 nm southwest of Provost) at the time of the occurrence was sky clear below 10,000 feet, visibility 9 miles, wind from 270 degrees true at 7 knots, temperature -3 degrees Celsius, and dew point -7 degrees Celsius. The weather was not considered a factor in the occurrence.

## *Analysis*

The main rotor blade failed in fatigue and separated from the helicopter under normal service loading. It is likely that the combination of a reduction in load transfer, brought about by the adhesive disbonding, and the significant residual stresses in the doubler skin following blade assembly, caused the onset of the fatigue failure.

The pilot's injury pattern was consistent with the helicopter landing heavily on the left skid. Despite the use of the complete available harness and a helmet, the pilot was subjected to severe left lateral and vertical forces, as evidenced by the downward displacement of the seat pan and damage to the pilot's door. When the helicopter came to rest, the pilot was unable to extricate himself from the wreckage without assistance.

The following TSB Engineering Branch report was completed:

LP 190/97 - Main Rotor Blade Examination

## *Findings*

1. A main rotor blade (green) failed in fatigue, likely because of non-conforming doublers, and separated from the helicopter.
2. Severe vibration from the loss of the main rotor blade resulted in separation of the tail boom.
3. After the tail boom separated, the pilot was unable to maintain control of the helicopter, and it landed heavily.

## *Causes and Contributing Factors*

The pilot lost control of the helicopter when a main rotor blade failed in fatigue and separated from the helicopter, resulting in a severe vibration causing the tail boom to separate.

## *Safety Action*

Examination of the failed main rotor blade parts by the manufacturer resulted in the issuance of two Mandatory Service Bulletins (MSB);

SB 369D-194, on 24 December 1997, requiring visual inspection of the root fitting area at 25-hour intervals on blades that have 1,500 or more hours of operation.

SB369D-195R1, on 23 January 1998, requiring visual inspection of the root fitting area at 25-hour intervals on specific model and serial number blades that have operated 600 or more hours.

The FAA issued two priority letters:

AD 98-01-13, on 31 December 1997, mandating compliance with the inspection requirements of SB 369D-194.

AD 98-03-15, on 29 January 1998, mandating compliance with the inspections requirements of SB 369D-195R1.

*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 10 June 1998.*