

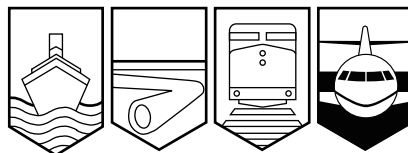
Transportation Safety Board  
of Canada



Bureau de la sécurité des transports  
du Canada

## AVIATION INVESTIGATION REPORT

A04Q0026



### SEPARATION OF MAIN ROTOR ON RUNUP

HÉLICRAFT 2000 INC.

SCHWEIZER 269C-1 (HELICOPTER) C-FZQF

SAINT-HUBERT, QUEBEC

08 MARCH 2004

Canada

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 Investigation Report

### Separation of Main Rotor on Runup

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Saint-Hubert, Quebec  
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Report Number A04Q0026

#### *Summary*

The Hélicraft 2000 Inc. Schweizer 269C-1, registration C-FZQF, serial number 0056, with one pilot on board, was doing ground tests following a 100-hour inspection and replacement of the main transmission gearbox. After the second test to check for leaks and to measure tail rotor vibration, engine rpm was reduced. At this time, the pilot and ground engineer heard a noise. The noise was heard again on the third test. Engine rpm was reduced, but this time the main transmission gearbox stopped turning suddenly and caused the main rotor to separate from its shaft. The main rotor rose to an altitude of approximately 150 feet above ground level and came to rest on the apron of the heliport about 100 feet from the helicopter. The helicopter remained in place and there were no injuries. The accident occurred at 1145 eastern standard time.

*Ce rapport est également disponible en français.*

## *Other Factual Information*

The pilot/aircraft maintenance engineer (AME) was certified and qualified to conduct ground tests in accordance with existing regulations. The aircraft had a total of 3993 hours since it was manufactured in 1997. It was certified, equipped, and maintained in accordance with existing regulations and approved procedures.

The 100-hour periodic inspection and replacement of the main transmission gearbox had just been completed. During the ground tests, the pilot/AME was at the helicopter controls and an AME was positioned outside. The aim of the tests was to verify the operation of all systems and to check for leaks and rotor balance. On the second test, the pilot/AME and the AME heard a noise when the engine rpm was reduced, but could not tell where it originated. On the third test, after about four minutes, they determined that the noise was coming from the main transmission gearbox. The pilot immediately reduced engine power, the main transmission gearbox stopped, and the main rotor separated after the bolts securing the main rotor to the main rotor shaft sheared off. The main transmission gearbox had been in operation for approximately 12 minutes since its last inspection.

Examination of the helicopter and main transmission gearbox after the accident revealed that the input pinion bearings were lacking lubrication. The main transmission gearbox, part number 269A5175-023, serial number S0603, had 2167.2 hours since new. It had undergone a special inspection on 02 February 2004 after a sudden rotor stoppage. AOG Heliservices Inc., an approved maintenance organization with experience working on this type of main transmission gearbox, had completed the special inspection in accordance with manufacturer-approved procedures. That inspection had consisted of a partial disassembly of the main transmission gearbox to visually examine it for dimensions and by non-destructive methods before re-assembly.

When the main transmission gearbox was being reassembled, the input quill bearing housing was assembled incorrectly. It was rotated clockwise 90 degrees in relation to the main transmission gearbox oil inlet and outlet ports. This condition contributed to the blockage of the oil passage feeding the bearings and caused the catastrophic failure of the input quill bearings. This type of failure is known as skewing, where the individual bearings jam together when the bearing cage fails (see Photo 1).



**Photo 1.** Distorted bearing cage

The AME who performed the special inspection and reassembly of the main transmission gearbox was experienced and qualified. He used the current approved procedure described in the maintenance manual and the inspection manual for this component. The instructions for the inspection, reassembly, and safety precautions were clearly described. On reassembly, the AME

must hold the input quill assembly in place, while the base of the main transmission gearbox is pre-heated, with only a short time to finish the assembly. During reassembly, the AME did not line up the bearing lubrication ports.

There was no mechanical means of preventing this omission when assembling the input quill to the main transmission gearbox: only the procedures contained in the manual indicated the precautions to be taken on installation. An independent inspection was carried out, but did not detect the incorrect installation. Research conducted by the Transportation Safety Board (TSB) and the Schweizer Aircraft Corporation on this type of installation error revealed no similar aviation occurrences.

An examination of the main rotor fastening components was done at the TSB Engineering Laboratory. The report concluded that all components met the manufacturer's specifications. However, theoretical strength calculations determined that the force required to shear the main rotor shaft is higher than the force required to shear the six rotor head attachment bolts. Consequently, the rotor can separate from the shaft in the event of a sudden stoppage of the gearbox.

Since 1983, the TSB has investigated two occurrences (Reports A83Q0083 and A95Q0063) involving model 269 helicopters in which there was a sudden stoppage of the main transmission gearbox following lubrication failure. In both cases, the main rotor shaft was severed and the rotor remained fastened to the aircraft. However, neither case was linked to incorrect alignment of the bearing oil ports.

The worldwide fleet of model 269A, B, and C helicopters consists of almost 3000 aircraft with a combined total of 2.25 million flying hours in over 40 years. These helicopters are renowned for their safety and reliability. Schweizer Aircraft Corporation confirmed that it has not had any other occurrences of rotor head bolts shearing off in flight.

The following laboratory report was completed:

*LP 031/04 – Main Rotor and Main Rotor Shaft Examination*

## *Findings as to Causes and Contributing Factors*

1. The input quill bearing housing was not positioned in accordance with the procedures described by the manufacturer; therefore, the flow of oil was obstructed, causing the catastrophic failure of the input quill bearings.
2. Independent inspection did not detect the incorrect reassembly of the main transmission gearbox.

## *Other Findings*

1. There are no mechanical means to prevent an installation error when installing the input quill bearing housing.

2. The force required to shear the main rotor shaft is higher than the force required to shear the six rotor head attachment bolts. As a result, the rotor could separate from the shaft in the event of a sudden stoppage of the transmission, which constitutes a hazard for helicopter occupants and people on the ground.

### *Safety Action Taken*

At the completion of the main transmission overhauls or at sudden stoppage inspections or in any other situations in which the retainer has to be removed, AOG Heliservices Inc. will paint a red witness line on the retainer and on the transmission housing to assure alignment of oil ports. Also, they will run the transmission for fifteen minutes to check that there is oil flow in the transmission and to check for oil leaks at the seal and split line. These changes will be put into their worksheets.

*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 11 January 2005.*

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