



**Final Report
of the Aircraft Accident
Investigation Bureau**

concerning the accident

with the helicopter Robinson R 44, F-GPHS

of 2 July 1996

in Chancy/GE

URSACHEN

Der Unfall ist zurückzuführen auf:

- Autorotation mit Beschädigung des Helikopters;
- Ungenügende Oberflächenbearbeitung und Ausfall eines wichtigen Bauteils im Hauptgetriebe (ring gear clamping).

EMPFEHLUNG

Die im Zwischenbericht geforderte Sicherheitsempfehlung wurde von der "Federal Aviation Authority" sowie vom Bundesamt für Zivilluftfahrt mit der "Airworthiness Directive" Nr. 96-18-22 umgesetzt.

FINAL REPORT

THIS REPORT HAS BEEN PREPARED FOR THE PURPOSE OF ACCIDENT PREVENTION. THE LEGAL ASSESSMENT OF ACCIDENT CAUSES AND CIRCUMSTANCES IS NO CONCERN OF THE ACCIDENT INVESTIGATION (ARTICLE 24 OF THE AIR NAVIGATION LAW)

AIRCRAFT Helicopter, Robinson R 44, S/N 0124, F-GPHS

OPERATOR Private

OWNER Private

PILOT French citizen, born on 1949

LICENCE Private pilot, category helicopter, issued by "Departement Général de l'Aviation Civile" (DGAC)/France, valid until 4 April 1997

FLIGHT EXPERIENCE

Total pilot hours	430	In the previous 90 days	23
On accident type	65	In the previous 90 days	17

PLACE Chancy/GE

CO-ORDINATES 5° 59' E, 46° 9' N **ALTITUDE** 370 m

DATE AND TIME 2 July 1996, 2.33 p.m. local time (UTC + 2)

TYPE OF OPERATION Private VFR-flight

PHASE OF FLIGHT Cruise flight

TYPE OF ACCIDENT Roll-over after emergency landing

INJURIES TO PERSONS

	Crew	Passengers	Others
Fatal	---	---	---
Serious	---	---	---
Minor or none	1	2	

DAMAGE TO AIRCRAFT Sustained substantial damage

OTHER DAMAGE None

HISTORY OF THE FLIGHT

On 2 July 1996 the pilot and his two passengers took off with the refueled helicopter Robinson R 44, F-GPHG, in Bourg Ceyzeriat/France for a local private flight to Annemasse/France. Everything was working properly on this mentioned flight of about 30 minutes of flying time.

After a lunch break the pilot again made a complete external and internal preflight check. No unusual circumstances were visible at the helicopter. Shortly before half past two the pilot took off with his two passengers on the way back. Approximately five minutes after take off in Annemasse, at an altitude of 2'300 ft (1'000 ft/gnd) and at an airspeed of at least 80 kts, vibrations on the helicopter occurred during cruise flight. The vibrations occurred only on the cyclic control stick and on the main fuselage, not on the collective pitch. After less than a minute the vibrations became so severe that the pilot could hardly control the cyclic control stick anymore. He also noted a red warning light on the upper left side of the instrument panel. The pilot then reduced the forward airspeed of the helicopter to 65 kts (autorotation speed) and entered into autorotation (emergency landing). After this action the vibration reduced and later disappeared. During autorotation the engine was still running and the main rotor RPM was within the green arc. The pilot flared the helicopter close to the ground to almost zero forward airspeed and then applied collective pitch. The aft end of the landing gear came into contact with the ground first. Due to the light slope of the terrain the helicopter rolled onto its right side.

All occupants sustained no injuries and were able to leave the substantially damaged helicopter on their own.

FINDINGS

- **The pilot** was a properly licensed private pilot (French license), medically fit and adequately rested to operate the flight. The commanders training on Robinson Helicopter (RHC), particularly on R 44, was good.
- **The passengers** were not in possession of a flight crew license. One passenger was sitting on the front left seat, the other one in the rear row.
- **The helicopter** was French VFR-(Visual Flight Rules) registered and authorised in accordance with the current regulations and all maintenance was carried out. The last 100 hours inspection was made on 12 June 1996, at 507 hours. At the time of the accident the helicopter had a total flight time of 542 hours.
- Additional **facts and preliminary investigations** showed:
 - The helicopter rolled onto its right side in an open field near Chancy/GE Switzerland;
 - The main gearbox oil covered the helicopter's left side, the tailcone and stabilizer leading edge which had been cut off at impact;
 - There was no oil visible in the oil level gauge of the main gearbox, but only metal chips;
 - Removing cowlings and fuel tanks did not show any other discrepancies;

- Removal and partial disassembly of the main gearbox showed metal chips in the sump and a big crack in the gear carrier;

- The cockpit was found as follows:

- the mixture control;
- the carb heat half way pulled out;
- the fuel valve ON;
- the RPM-governor ON;
- the dual control installed;
- the trim position ON;
- the ignition key on BOTH;
- the landing gear undamaged.

- The main gearbox was disassembled on 29 July 1996 and examined at the RHC factory together with the FAA (Federal Aviation Administration) and the Swiss accident investigator.

Disassembly showed the 18 NAS6606-2 bolt clamping the C146-3 ring gear and C268-1 gear carrier had loosened in service. Bolt torque in most cases had dropped to 25 to 50 inch lbs. This torque is equivalent to normal self locking nut drag, indicating no clamping between the ring gear carrier. Surface finish measurements of ring gear clamping surface showed 108 to 120 micro inch finish and a distinct phonograph groove appearance 63 micro inch finish is required.

Severe fretting developed around most bolts holes due to the loss of clamping. A fatigue crack progressed from a severely fretted bolt hole, across the flange, and circumferentially around the gear carrier, separating the gear mounting flange from the center section of the gear carrier. This resulted in a loss of positive drive to the main rotor:

- **Actions taken:**

RHC released Service Bulletin (SB) No 15, dated 2 August 1996, required inspection and modification of R 44 main rotor gearboxes.

The FAA released FAA AD (Airworthiness Directive) 96-18-22 (priority letter, AD) dated 29 August 1996.

By 18 September 1996 the Swiss FOCA (Federal Office for Civil Aviation) adopted FAA AD 96-18-22 as mandatory action.

- Based on **information** from RHC, on 15 R 44-helicopters the gear sets had to be removed from service and on 15 others rework was required due to fretting.

- **Weight and balance** were within their limits all time.

- **The weather** conditions had no bearing on the accident.

ANALYSIS

The technical investigation established that the operation did not cause this accident.

The insufficient surface finish of the ring gear clamping caused the 18 bolts (NAS6606-2) to become loose in normal service. The problems continued with severe fretting around the bolt holes and the growth of a fatigue crack on the gear carrier, until it broke off.

Due to the reason that the ring gear remained partially in mesh with the pinion and the uneven fracture surface allowed probably an intermittent drive, especially to the tail drive shaft. It is most possible that after the flare - when the pilot was increasing collective pitch - , the engine power did not transmit to the main rotor blades.

Rubbing of the separated ring gear against the inner walls of the aluminium transmission case created the large quantity of chips found in the sump.

CAUSE

The accident was caused by a forced landing (autorotation) due to a main gearbox failure as a result of an insufficient surface finish of the ring gear clamping surface.

SAFETY RECOMMENDATION

Actions - from the FAA and SWISS FOCA - have been taken with the priority letter AD 96-18-22.

The investigation has been conducted by Guido Hirni.

Berne, 15 July 1997

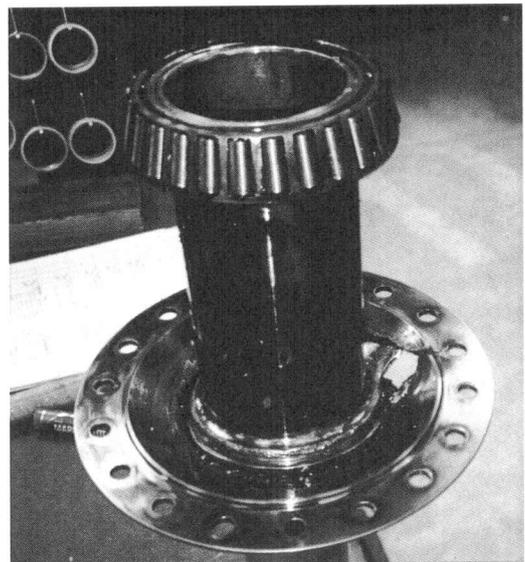
Aircraft Accident Investigation Bureau



Position of the wreckage



Main gearbox oil, left side



Damaged main gearbox

