

Robinson R22 Beta, G-CHYL, 7 February 1997

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Aircraft Type and Registration:	Robinson R22 Beta, G-CHYL
No & Type of Engines:	1 Lycoming O-320-B2C piston engine
Year of Manufacture:	1989
Date & Time (UTC):	7 February 1997 at 1400 hrs
Location:	White Waltham Airfield
Type of Flight:	Private
Persons on Board:	Crew - 2 - Passengers - Nil
Injuries:	Crew - None - Passengers - N/A
Nature of Damage:	Drive train component damage
Commander's Licence:	Private Pilot's Licence (Helicopters)
Commander's Age:	27 years
Commander's Flying Experience:	342 hours (of which 340 were on type) Last 90 days - 43 hours Last 28 days - 23 hours
Information Source:	Air Accident Report Form submitted by the pilot and examination of defective parts by AAIB

On the morning of the incident, a normal pre-flight inspection(Check A) had been carried out by the pilot, whose intention had been to position the helicopter to Blackpool from White Waltham. The weather was overcast with the visibility varying and so the pilot decided to undertake a flight, with an instructor on board, to check the weather. This was deemed unsuitable for the intended flight and some 3 hours later it was decided to make a second check flight, again with an instructor on board. The helicopter was started, run up and, with the normal pre-departure checks completed, lifted into the hover. An unusual smell was then noticed by the crew, which they assumed to be coming from the cabin heater. As all engine indications were normal, the flight was continued and the transition from the hover to forward flight was uneventful with the helicopter levelling off at height of 800 feet. After the helicopter had accelerated to 70 kt an acrid smell became apparent in the cockpit followed, a short time later, by a noise described as a 'klunk'. By this time the smell had become more intense and control was passed to the instructor who immediately turned the helicopter back

towards the airfield, advised ATC of the situation and, as the turn was completed, entered autorotation. A powered recovery was made to the hover at 10 feet to 15 feet agl where the clutch warning light illuminated, and remained on, followed by a power train failure light, a rotor low RPM warning light and horn, but with increasing engine RPM. The helicopter was immediately landed at a low forward speed whilst the pilot transmitted a 'Mayday' call, and it was then shut down and vacated. The Airfield Fire Service were quickly on the scene and extinguished the smoking upper sheave bearing, but there was no fire.

Subsequent examination of the helicopter by maintenance personnel, and later by the AAIB, revealed the upper sheave bearing, Assembly No. A184-3, to have overheated and failed. This bearing is mounted on the main gearbox/tail rotor drive shaft adjacent to the large diameter pulley (sheave) which is driven by two dual 'V-belts' from the engine. It reacts loads from the drive belts when tensioned by a linear actuator, to which it is attached, and which extends to raise the upper sheave whenever the clutch switch on the centre console is set to 'engage'. This effectively forms a clutch between the engine and drive train (Figure 1), but is separate from the freewheel clutch. Tensioning loads applied by this actuator are limited by load sensing switches, which are set at manufacture, and which switch the actuator off when the belts are tensioned to a predetermined value. A caution light on the instrument panel illuminates whenever the actuator is operating, either engaging, disengaging or re-tensioning the belts, and does not extinguish until the belts are either correctly tensioned, or completely disengaged. During rectification it was established that this actuator was serviceable, and the helicopter manufacturer has no record of any failure modes or actuator rigging problems that have contributed to previous known upper sheave bearing failures. However, as a precaution, the maintenance organisation repairing G-CHYL replaced the lower sheave bearing as this item appeared to have been running 'slightly hot'.

The upper bearing in this application has a life of 2,000 hours (or 10 years calendar time): the failure on G-CHYL occurred at 1,066 hours (8 years). The bearing has eight 0.5 inch diameter balls, retained in a two-piece bronze cage, and is grease-lubricated and 'sealed for life', the seals being made from synthetic rubber. Due to the high temperatures generated during this failure, neither the grease nor seals were available for examination. However, the condition of the balls, three of which were grossly deformed, and the lack of long term damage to the inner and outer races indicated that a lack of lubrication had probably precipitated the relatively sudden overheating and consequent failure of the bearing. There was evidence that the outer race had rotated within its housing. Collapse of this bearing, or the lower sheave bearing, will lead to a loss of drive from the engine to the main and tail rotors. For comparison, a mid-life upper sheave bearing (which had not failed) from another Robinson R22 was examined. This bearing was disassembled and found to be in very good condition. It was evident that the seals had been effective in excluding dirt and moisture to maintain the quality of the grease.

During recent years, the manufacturer has examined five A184-3 bearing assemblies returned from service with signs of overheating due to lack of lubrication. Two of these remained functional and one resulted in a hard landing, but with no injuries. The outcome of the other two failures is not known. The manufacturer is in the process of developing a re-lubrication method and intends to issue a Service Letter which will require the bearing to be re-lubricated at 100 hour intervals.