Robinson R22 Beta, G-TTHC

AAIB Bulletin No: 3/99 Ref: EW/G99/01/09 Category: 2.3

Aircraft Type and Registration:	Robinson R22 Beta, G-TTHC
No & Type of Engines:	1 Lycoming O-320-B2C piston engine
Year of Manufacture:	1989
Date & Time (UTC):	9 January 1999 at 1434 hrs
Location:	Bristol Airport (Lulsgate), Somerset
Type of Flight:	Private
Persons on Board:	Crew - 1 - Passengers - 1
Injuries:	Crew - None - Passengers - None
Nature of Damage:	Damage to transmission component
Commander's Licence:	Private Pilot's Licence (Helicopters)
Commander's Age:	32 years
Commander's Flying Experience:	670 hours (of which 642 were on type) Last 90 days - 75 hours Last 28 days - 26 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and examination of the failed component by the AAIB

At a height of approximately 400 feet agl after lift-off, following apparently normal pre-departure checks, the pilot became aware of a strong burning smell which he thought was an electrical fire. After switching the alternator OFF he informed ATC, orbited right and prepared to land on a taxiway. During the ensuing hover, both the engine and rotor speed indications increased above their yellow arcs and the helicopter began to descend. However a successful run-on landing was accomplished and both occupants vacated the helicopter after the engine had been shutdown, the battery switched OFF and the rotor brake applied. The Airport Fire Service, which was in attendance at this time, reported that there was no sign of fire.

Examination of the helicopter by the pilot, maintenance personnel and later by the AAIB, found that the 'upper sheave bearing', Assembly No A184-3, had 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. The bearing reacts loads from the drive belts when these are tensioned by a linear actuator which extends to raise the upper sheave whenever the clutch switch on the centre console is set to 'Engage'. This mechanism effectively forms a clutch between the engine and drive train but is separate from the freewheel clutch. Tensioning loads applied by the actuator are limited by load sensing switches, which are factory set, and which turn the actuator OFF when the belts are tensioned to a pre-determined value. A caution light on the instrument panel illuminates whenever the actuator is operating, ie when either engaging, disengaging or re-tensioning the belts, and does not extinguish until the belts are either correctly tensioned or completely disengaged. During subsequent rectification, it was established that this actuator was serviceable. The helicopter manufacturer had no record of any failure modes or actuator rigging problems which have contributed to previous known upper sheave bearing failures.

The upper bearing in this application has a life of 2000 hours, or 10 years calendar time. This failure occurred approximately 1600 hours after the bearing had been fitted at build in 1989. The bearing has eight 0.5 inch diameter balls, retained in a two piece bronze cage, and is grease-lubricated but sealed for life, the seals being made from synthetic rubber. Due to the high temperatures generated during this failure, neither the grease, balls or seals were available for examination. However, the lack of evidence of long term damage on the inner and outer races indicated that a recent loss of lubrication had probably precipitated the relatively sudden overheating and consequent failure of the bearing. Collapse of this bearing, or the lower sheave bearing, leads to a loss of drive from the engine to the main and tail rotors which may initially increase engine speed, with a decay in rotor speed. A mid-life upper sheave bearing (which had not failed) from another R22 helicopter was examined for comparison. This bearing was in very good condition, and 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 some A184-3 bearing assemblies returned from service with signs of overheating due to lack of lubrication. As a result of associated findings, the manufacturer developed an in-service method for re-lubricating these bearings which involves the insertion of grease under the bearing seals, using a syringe. A related Service Letter was issued in 1997 which required such bearings to be re-lubricated in this way at 300 hour, or 3 yearly, intervals. This had recently been accomplished for the first time on the subject bearing, which had operated since fitment in 1989 without such replenishment, since there was no associated requirement. A similar bearing failure was reported in AAIB Bulletin 4/97.