

## Robinson R22 Beta, G-LEDA

<b>AAIB Bulletin No:</b> 1/2004	<b>Ref:</b> EW/C2003/04/04	<b>Category:</b> 2.3
<b>Aircraft Type and Registration:</b>	Robinson R22 Beta, G-LEDA	
<b>No &amp; Type of Engines:</b>	1 Lycoming O-320-B2C petrol engine	
<b>Year of Manufacture:</b>	1991	
<b>Date &amp; Time (UTC):</b>	27 April 2003 at 1319 hrs	
<b>Location:</b>	Behind Silver Bull Café A10, at Reed near Royston, Hertfordshire	
<b>Type of Flight:</b>	Private	
<b>Persons on Board:</b>	Crew - 1	Passengers - 1
<b>Injuries:</b>	Crew - 1	Passengers - 1
<b>Nature of Damage:</b>	Damaged beyond economic repair	
<b>Commander's Licence:</b>	Private Pilot's Licence	
<b>Commander's Age:</b>	43 years	
<b>Commander's Flying Experience:</b>	200 hours (all on type)	
	Last 90 days - 16 hours	
	Last 28 days - 16 hours	
<b>Information Source:</b>	AAIB Field Investigation	

The flight was planned to land in a client's back garden, at around 300 to 500 ft AGL, as the aircraft approached the downwind leg the pilot heard a loud "grumbling" noise and felt a "twitch" to the left. Assuming the engine had failed, he lowered the collective and entered autorotation, whilst attempting to increase speed to 75 kts. As he turned into wind he raised the collective to flare the aircraft. However, the right hand skid of the helicopter touched the ground first and the helicopter rolled over on its right hand side. The passenger commented that she had observed the clutch light illuminating for a few seconds periodically during the flight.

### Description of the helicopter drive train

The engine rotational power output is transmitted to the main gearbox via two drive belts carried on two 'sheaves' or pulley assemblies. Each belt effectively consists of two 'vee' belts joined together; thus the pulley has four grooves. The belts transmit the drive to a similar pulley assembly immediately above, which is mounted on the main gearbox/tail rotor drive shaft. Thus the belts are designed to act independently and so the drive will continue to be transmitted should one belt fail.

Flexible couplings accommodate alignment changes that occur when the rotor drive is engaged and disengaged. An electric actuator is mounted between the upper and lower pulleys, which raises the upper pulley when the clutch switch on the centre console is set to ENGAGE. Column springs within the actuator sense a compressive load (belt tension) and the actuator operates to maintain the 'vee' belts tension within prescribed limits.

An amber caution 'clutch' light illuminates on the instrument panel whenever the actuator is operating. The clutch light may illuminate for up to 3-4 seconds during normal flight as the actuator re-tensions the 'vee' belts as they become warm and stretch. If the light remains illuminated after 7-8 seconds the pilot should pull the CLUTCH circuit breaker, reduce power and land immediately according to the Pilot's Operating Handbook (POH).

## **Examination of the helicopter**

The wreckage was returned to AAIB for examination with the assistance of a representative from the manufacturer. The helicopter had struck the ground with a high vertical speed slight right skid low, compressing both skids and the cabin seat structure, before rolling onto the right hand side. There was evidence of rotation on both the rotor blades and the helicopter drive train at impact indicating that the engine had still been running.

One of the transmission 'vee' belts was missing, and there was evidence of rubber deposits around the transmission compartment suggesting that the belt had flailed around after it had failed and from which some small fragments of the missing belt were recovered. A search of the area around the accident site did not reveal any more pieces. The remaining belt was still intact and appeared undamaged. No damage was observed on the sheave rims. The actuator was found at a mid position.

There was no evidence of any other pre-impact failures.

The belts are maintained 'on condition' and do not have a finite service life imposed. The helicopter had completed 2132 hrs at the time of the accident, the 'vee' belts had been replaced at 2120 hrs, ie, 12 hours prior to the accident.

## **Discussion**

Belts are manufactured and fitted as matched pairs; as part of the manufacturing process all belts are broken in for five hours at full RPM and tension before shipment. Previous failures have not been associated with belt manufacturing or quality issues. The only consistent factor identified by the manufacturer has been that the failures almost always occur with relatively new belts with less than 50 hours and most with less than 20 hours time-in-service. Initiation is thought to be either a belt strand coming out of a groove or rolling over in a groove, leading to an overload condition which tears the belt apart. The previous problems have been associated with some combination of the following: high or above gross weight power applications (sometimes compounded by turbulence), sheave alignment at installation or alignment shifts caused by initial belt wear in, sheave surface condition (new belts on worn or corroded sheaves), actuator tension out of specification, or excessive belt slack at initial engagement, allowing a belt strand to be outside of the forward or aft groove when tensioned. New belts are soft and tend to grip the sides of the grooves, increasing their tendency to 'climb out' of the sheave.