AAIB Bulletin No: 3/96 **Ref: EW/G95/11/06** **Category: 2.3**

Aircraft Type and Registration:	Robinson R22 Beta, G-MFHL	
No & Type of Engines:	1 Lycoming O-320-B2C piston engine	
Year of Manufacture:	1988	
Date & Time (UTC):	12 November 1995 at 1150 hrs	
Location:	Nash's Farm, Godstone, Surrey	
Type of Flight:	Private (Training)	
Persons on Board:	Crew - 2	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Severe damage to main rotor, main rotor mast, tail rotor and tail cone	
Commander's Licence:	Private Pilot's Licence with Instructor Rating	
Commander's Age:	57 years	
Commander's Flying Experience:	6,840 hours (of which 3,515 were on type) Last 90 days - 176 hours Last 28 days - 60 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and examination of the helicopter	

The instructor had been briefing the student on ground effect, translational lift, the 'avoid' curve and actions in the event of engine failure at various combinations of height and speed. The first part of the flight detail was then used to demonstrate translational lift, engine failures in the hover and after takeoff and the height required to regain autorotation speed after engine failure at zero airspeed.

The helicopter then left the circuit for practice engine failures in the local area. At 1,400 feet (QNH) the instructor performed the HASELL checks and, with the student in control, initiated a practice autorotation into the prevailing wind. The instructor states that the student's entry into autorotation was normal and that he turned right by some 30°, selecting a suitable grass field. At about 600 feet agl the instructor told the student to recover, rotor speed (N_R) was adjusted to 100 to 104% and engine RPM to 90%. The instructor states that the student's recovery was smooth and that carburettor heat control was reset to about 1 inch extension; engine power was at some 24 inches Hg of manifold pressure and the airspeed at 60 kt, with the helicopter climbing. The instructor estimates that the helicopter gained 100 to 200 feet in the climb.

At this point the crew heard a sudden noise (apparently heard as a 'bang' by a witness on the ground), followed by the helicopter yawing violently and the low rotor speed (N_R) horn sounding. The instructor immediately took control and entered autorotation: the airspeed was 60 kt but the rotor speed decayed to some 70%. The only field available for landing was cultivated, with power lines in the undershoot and obstructions in the overshoot. A small application of collective pitch was sufficient for the helicopter to clear the power lines and at the beginning of the flare the rotor speed was about 90%. The windspeed was about 5 kt and the instructor estimates that the final ground speed was between 5 and 10 kt; the helicopter touched down with skids level and ran straight for some 15 feet but the right skid then 'dug in' and the helicopter tipped forward and to the right. Both main rotor blades struck the ground before the helicopter settled back onto its skids. The instructor and the student were able to exit normally and there was no fire or injury.

The instructor, who has flown over 3,000 hours on the R22 type, confirms that he would always apply full carburettor heat with manifold pressure below 18 inches Hg and this complies with the manufacturer's instructions. In the case of a practice autorotation, this application of carburettor heat would be done during the HASELL checks, several seconds before the entry into the autorotation. The instructor further comments that the violence of the yaw motion and the rapid loss of rotor speed were consistent with a sudden and total loss of power, rather than a slow power reduction.

After the accident the helicopter was removed to a maintenance organisation. Some eight weeks later an attempt was made to run the engine, using fuel still in the tanks. The engine installation had not been disturbed since the recovery other than to check the oil filter, which was clear of debris, and to cut the drive belts to ensure that the engine would not drive any part of the helicopter's damaged dynamic system. The engine started on the second attempt and ran smoothly; operation of the carburettor heat control gave the normal drop in engine RPM, as well as an increase in the carburettor air temperature, and selections of the left and right magnetos each gave reductions of some 75 RPM. The exact cause of the power failure could not, therefore, be determined: the conditions (temperature +14°C, no low cloud, moderate humidity) were not particularly conducive to carburettor icing but there have been a number of instances of carburettor icing causing sudden power loss rather than just rough running of the engine.

The instructor stresses that, with over 3,500 hours in R22s, mostly instructing, he estimates that he has supervised between 6,000 and 9,000 practice autorotations in a wide range of weather conditions. During this time he believes that he has not suffered problems with carburettor icing and that, with correct full application of carburettor heat before the lowering of the collective lever into autorotation, carburettor icing will not occur. This view is supported by the CFI of a nearby flight training organisation which uses several R22 helicopters.

In discussion with the AAIB, the instructor made two further comments relating to flight safety. One concerned the fact that, although the field selected by the student during the practice autorotation was suitable for a forced landing, this field was no longer available after the power failure and the actual forced landing had to be made into a less suitable field. The other comment concerned the rapidity of rotor speed decay with the loss of engine power in the climb; this subject is discussed extensively in the recent CAA Paper 95009 'Enhanced Warning and Intervention Strategies for the Protection of Rotor Speed following Power Failure'.