ACCIDENT

Aircraft Type and Registration:	Montgomerie-Bensen B8MR, G-BIPY
No & Type of Engines:	1 Rotax 532 piston engine
Year of Manufacture:	1994
Date & Time (UTC):	11 October 2009 at 1532 hrs
Location:	Near Little Rissington Airfield, Gloucestershire
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	64 years
Commander's Flying Experience:	10,000+ hours (of which 14 were in autogyros) Last 90 days - 13 hours Last 28 days - 4 hours
Information Source:	AAIB Field Investigation

Synopsis

A student autogyro pilot was carrying out his first solo circuits. On the base leg of his second circuit, there was a loss of control and the aircraft fell to the ground. No evidence was found of any pre-existing aircraft defects and the reason for the loss of control was not determined.

History of the flight

On the day preceding the accident, the student pilot had carried out three one-hour sessions of solo training, consisting of wheel balancing and short hops along the runway under the supervision of his instructor. At the end of the third session he asked his instructor if he considered that he was ready to fly solo in the circuit. The instructor replied that, all being well, he could probably go solo the next day, a Sunday.

The following morning, the weather was not suitable for flying but by 1400 hrs the weather had improved and the instructor told the student that if he was able to complete a successful session of practice engine failures then he would be able to go solo. The student carried out a number of practice engine failures along Runway 22 and the instructor was satisfied with what he saw. Accordingly, he decided to send the student on his first solo circuit. Before doing so, he gave him a pre-solo briefing, advising him about the circuit area, local noise sensitive areas and that the airspeed should be kept to a maximum of 50 kt.

The instructor observed the flight from within his car, which was positioned close to the runway. There were

two other people in the car with him, one of whom also witnessed the accident. The instructor watched the pilot take off and carry out a successful solo circuit. On completion of the landing the pilot applied power and took off again for a second circuit. This surprised the instructor somewhat because he was expecting the pilot to fly just one circuit, although he had not specifically briefed him to do so.

The instructor became concerned when, on the second circuit, he saw the aircraft fly beyond the point on the base leg where he would expect it to start a descent. He saw it continue on, through the extended centreline of the runway, towards a noise sensitive area. He called the pilot on the radio and advised him that he was going in the wrong direction. There was no answer from the pilot but at that point the instructor saw the autogyro start to turn and enter a sudden and steep descent, pitching nose down and dropping about 100 ft. It appeared to recover partly but then fell out of control and the instructor realised that it must have crashed off the airfield. He, and several others from the airfield, went to search for the aircraft but were unable to locate it.

A local resident had seen and heard the autogyro flying towards his house. When it was about a third of a mile away (500 m) he saw it descend out of control; he described seeing it tumbling and heard the engine note increase slightly. He ran to his vehicle and drove across fields to where he thought the autogyro had come down. After an extensive search of some 30 minutes he drove down the side of a field and came across the wreckage in long grass. It was apparent that the pilot had not survived the accident and the witness directed the emergency services towards the site.

Pilot information

The pilot was a retired professional pilot, having flown large jet aircraft for most of his working life. Since his retirement in 1999 he had maintained a Private Pilot's Licence, flying a few hours each year, mostly on a Wilga light fixed wing aircraft. His last recorded flight in a fixed wing aircraft was in August 2008. During 2008 he also had three flights in two-seat autogyros and began a course of instruction in April 2009 on the MT-03 autogyro. The pilot completed about 10 hours of training on the MT-03; then in July 2009 he started training on single seat Montgomerie-Bensen autogyros.

The pilot had a valid medical declaration issued by his General Practitioner and appeared in good health during the weekend of the accident.

Pathological information

An autopsy determined that the pilot had died from severe multiple injuries as a result of non-survivable impact forces. He had a long medical history of episodes of irregular heart beat, caused by an electrical abnormality. If he had suffered an episode in flight it would have had the potential to cause distraction or incapacitation but it would not have created any anatomical changes which would be evident during an autopsy. Thus, there was no way of determining whether or not this occurred.

Meteorological information

The weather conditions on the morning of the accident were not suitable for autogyro flying training; there had been low cloud, rain and gusty wind conditions. However, at about 1400 hrs the weather cleared and for a while conditions were good, being described as clear and calm with light westerly winds. As the afternoon progressed, the wind strength increased.

An aftercast from the Met Office indicated that a partly unstable north to north-westerly flow covered the Little Rissington area at 1530 hrs on 11 October 2009. At 1500 hrs the automated weather report for Little Rissington recorded a surface wind from 290º at 5 kt, temperature 15ºC, dewpoint 14ºC, visibility 35 km, scattered cloud at 5,000 ft and a QNH pressure of 1013 hPa. By 1600 hrs the wind had increased to 10 kt and the cloud had lowered to a height of 1,400 ft. A satellite image at 1530 hrs showed a cluster of convective cloud immediately to the north of the airfield and it was considered that these conditions could have given rise to turbulence in the circuit.

Examination of the wreckage

The aircraft was found lying in long grass at the edge of a field approximately 250 m from the north-eastern boundary of the aerodrome. The main portion of the wreckage was coincident with the point of impact but pieces of the propeller blades were found along a line, on a bearing of 095°(M), up to 102 m from the main wreckage. Fuel was present throughout the aircraft's fuel system but, due to the disruption, only a small quantity remained. Any residual fuel was recovered and from visual inspection it appeared to be mixed with lubricating oil, as expected. There was a strong smell of fuel reported at the site immediately after the accident.

Examination of the ground markings and the aircraft confirmed that it had struck the surface, inverted, in a near vertical descent. The main rotor had been revolving but it was not possible to assess the rotational speed. Both main rotor blades had impact marks on their trailing edge, 69 cm from the centre of the rotor mast, and all three blades of the propeller showed evidence of strike marks and splintering. The fixed horizontal element of the empennage, variously called a stone-guard or a stabiliser, was not fitted to the aircraft and was later found in the boot of the pilot's car.

The wreckage was removed from the site and taken to the AAIB facilities for detailed examination.

Detailed examination

The aircraft was examined and no evidence of pre-impact failure of the structure or flying controls was found. The engine had suffered some disruption and was removed from the airframe and partially disassembled for inspection. This examination did not identify any evidence of pre-impact failure. The throttle mechanism was checked and was found to operate freely and smoothly throughout its range. The calibration of the ASI was assessed using a test set and the instrument was found to be indicating accurately.

Aircraft information

This Montgomerie-Bensen B8MR was a single-seat open-framed autogyro powered by a Rotax 582 two-stroke twin-piston engine driving a three-bladed fixed pitch pusher propeller of wooden construction.

The primary structure consisted of a keel beam with a rotor mast attached. The pilot's seat, which incorporated the fuel tank, was fitted forward of the mast. A small binnacle containing the flight and engine instruments was mounted in front of the pilot. The engine was mounted behind the mast. An empennage, consisting of a vertical fin and rudder and a fixed horizontal element, was attached to the rear of the keel. This particular aircraft was fitted with an optional extended rotor mast to allow a larger propeller to be fitted.

Lift is provided by a two-bladed aluminium rotor driven by autorotative forces generated by airflow passing up through the rotor blades; it can be pre-spun

before takeoff by a flexible shaft powered by the engine.

Flight control is by means of a control stick, connected through a rod and bellcrank system to mechanisms mounted at the top of the rotor mast that alter the pitch and roll angle of the rotor disc, and by pedals operating the rudder. Unlike a helicopter, the collective pitch of the rotor blades cannot be changed. A hand-operated throttle lever, mounted to the left of the pilot's seat, controls engine power.

This type of autogyro has a thrust line above the centre of gravity and, when power is applied, the aircraft has a tendency to pitch nose-down. In normal flight this is countered by the lift or rotor thrust developed by the main rotor blades. In certain circumstances, such as a sudden application of power, too much forward control stick input, pilot induced oscillation (PIO), turbulence or excess airspeed, this high thrust line can give rise to a Power Push Over (PPO). A PPO occurs when the rotor is unloaded, causing the rotor speed to decay and the autogyro to pitch forward under the influence of the propeller thrust. This will rapidly become irreversible, and lead to the aircraft 'tumbling', unless immediate corrections are made by the pilot. The training for recovery from any unusual attitude is to close the throttle, centre the control stick and allow the aircraft to settle into autorotation before attempting any control inputs. If the pilot were to make a large aft cyclic input in an attempt to correct the attitude, the blades may strike the propeller or tail surfaces.

The CAA issued a Mandatory Permit Directive (MPD No: 2005-008) on 24 August 2005 which placed limitations on all single-seat gyroplanes. The MPD states:

> *'CAA flight testing of some Bensen derivative gyroplanes has found that poor handling characteristics exist if such machines have a thrustline / CG offset that exceeds +/- 2 inches. The CAA considers that inexperienced gyroplane pilots are at risk due to these handling characteristics and that this combination constitutes an unsafe condition.'*

A number of limitations were imposed by this MPD and the Light Aircraft Association (LAA) incorporated all of these limitations into the Operating Limitations of the Permit to Fly for this type of aircraft, thereby ensuring compliance with this MPD. The thrustline / CG offset for G-BIPY had not been measured, so remains an unknown quantity in the accident.

The MPD also specified wind limitations, which were included in Operating Limitations of the Permit to Fly. Flight was prohibited when the surface wind, including gusts, exceeded 15 kt (17 mph) or when the surface wind gust spread exceeded 10 kt (12 mph).

The pilot purchased the aircraft in September 2009 with a view to using it to complete his autogyro flying training. Previously, it had been subject to an extensive overhaul in June 2009, prior to the renewal of its Permit to Fly. A new[1] engine was then installed in September 2009, at the pilot's request.

On the morning of the accident flight the pilot installed a modification to add an 'O' ring to the jet needle in each carburettor. This was an approved modification and was completed under the supervision of a LAA Inspector.

Footnote

[1] Although the engine was unused it was originally supplied by the UK distributor in August 1989. It was intended for use in another aircraft that was not completed and had been in storage until installation on this aircraft.

Witnesses also reported seeing the pilot removing the aircraft's stone-guard/stabiliser that morning, although there was no record of this.

Accident history

The safety record of autogyros was discussed following an accident to Bensen B8MR(modified), registration G-BIGU, in AAIB Bulletin 9/2004 and in the re-issued Bulletin 6/2007. This identified that all but one of the pilots involved in fatal accidents had less than 50 hours on autogyros and a large proportion of them held fixed wing or helicopter licences. It was also noted that longitudinal instability was cited as a primary cause in half of the fatal accidents over a three year period in the USA.

In the 19 years from 1990 to 2009 there have been 15 fatal autogyro accidents in the United Kingdom, the majority of which have been in single seat aircraft. The CAA *Aviation Safety Review – 2008*, Civil Aviation Publication (CAP) 780, provides a comparison of fatal accidents rates between autogyros, microlights and gliders. The rate for autogyros peaked in 2002 and has declined slowly since then, however; the rate per flying hour for autogyros is approximately ten times that for gliders and microlight aircraft. This relatively high rate, together with several AAIB Safety Recommendations, led to a number of actions being included in the CAA Safety Plan 2006. These actions included research into the aerodynamic characteristics of autogyros and changes to pilot and instructor licensing and training. The CAA Safety Plan identified several risk factors that may have relevance to this accident:

'Lack of experience and of recency were both factors identified in the analysis of gyroplane accidents'

'Extensive fixed wing flying experience has also been cited as a contributory factor in some gyroplane accidents'

Analysis

Engineering conclusions

The aircraft appeared to be in good condition and work conducted during the recent overhaul was to the required standard. The Certificate of Validity of the Permit to Fly was in date and no evidence of pre-impact failure was found within the structure, engine or control linkages.

It appears that the pilot had removed the stone guard/stabiliser during the morning prior to the accident flight, without recording the work or first clearing it with the Light Aircraft Association (LAA). However, based on written flight test reports and anecdotal evidence, its removal would not have had a measurable effect on the aircraft's handling characteristics. The pilot had previously flown his instructor's aircraft which also did not have a stone guard/stabiliser fitted.

Damage to the main rotor and the extended trail of propeller fragments indicated that the propeller contacted the main rotor sometime before the aircraft struck the ground. The nature of the damage to the propeller also showed that the engine was delivering power when this happened. The co-location of the main wreckage with the point of impact was symptomatic of a near-vertical final descent with little or no forward speed.

Operational

The aircraft first deviated from its expected flightpath when the descent was not initiated on the base leg of the second circuit. It was not possible to ascertain why this occurred but some explanations were considered. The pilot may have been distracted or partly incapacitated,

he may have had difficulty controlling the aircraft in turbulence or he may have mis-identified his position in the circuit pattern and, when he realised, made a sudden control input.

The pilot had a pre-existing medical condition that could have led to his being distracted or temporarily incapacitated. Autogyros can only fly for a short time 'hands off' or without a pilot input so, in such a situation, a loss of control would develop rapidly.

The weather conditions when the pilot started flying in the afternoon were calm and good. There were some indications from the aftercast that the wind speed increased with time and that there may have been some associated turbulence in the circuit around the time of the accident. Turbulence increases the likelihood of a displacement to the intended flightpath which is undesirable, particularly for an inexperienced student pilot.

The instructor made a radio call in an attempt to contact the pilot and it appeared that this led to a response from the pilot, since the aircraft started to turn and descend shortly afterwards. However, this could have been coincidental.

This autogyro has very light and sensitive controls, so, if the pilot made a sudden or instinctive input in the wrong direction or too strongly, it could have led to a loss of control. He had significant experience on larger types of aircraft which used different control systems, therefore, it is possible that he reacted to an event with an instinctive but inappropriate control input.

The loss of control, as observed by the witnesses, suggests that a problem developed with longitudinal stability. The aircraft was reported as pitching steeply nose-down and "tumbling", which is a characteristic seen as a result of a PPO.

In summary, there are several different circumstances which may have contributed to this accident but it was not possible to draw a firm conclusion from the available evidence. There was a loss of control of the autogyro but the reason for it could not be determined.