

Robinson R44, G-POWE

AAIB Bulletin No: 10/98 **Ref: EW/C98/4/2 Category: 2.3**

Aircraft Type and Registration: Robinson R44, G-POWE

No & Type of Engines: 1 Lycoming O-540-F1B5 piston engine

Year of Manufacture: 1996

Date & Time (UTC): 19 April 1998 at 2045 hrs

Location: Near Gumley, Leicestershire

Type of Flight: Private

Persons on Board: Crew - 1 - Passengers - 3

Injuries: Crew - 1 (Fatal) - Passengers - 3 (Fatal)

Nature of Damage: Helicopter destroyed

Commander's Licence: Private Pilot's Licence with Night Rating

Commander's Age: 36 years

Commander's Flying Experience: 362 hours (of which 61 hours were on type)
Last 90 days - 53 hours
Last 28 days - 16 hours

Information Source: AAIB Field Investigation

History of flight

The pilot involved in the accident was a regular user of the two company helicopters based at Leicester (Stoughton) Aerodrome; in addition to G-POWE, there was also a Robinson R22 model. On each of the three days prior to the accident, the pilot had flown in G-POWE; two of these flights were at night. The pilot made no mention of any unserviceabilities to the resident company instructor and no rectification was carried out between 16 and 19 April. No-one else flew the aircraft during this period and records show that the last fuel uplifted for the helicopter was 92 litres (24.3 US gallons) on 18 April. During the morning of 19 April another pilot, who intended to fly G-POWE, carried out a pre-flight inspection. The helicopter appeared fully serviceable and the pilot noted the fuel contents as about 3/4 full (approximately 30 to 35 gallons); in the event this pilot did not fly G-POWE as another helicopter became available.

At about lunch time on 19 April, the accident pilot met with the company flying instructor who was based at Leicester and was told that he could have the use of G-POWE for the rest of the day; however, the instructor emphasised that the helicopter was to be returned to Leicester at the end of the day. Subsequently, G-POWE was seen to lift off from Leicester at about 1340 hrs; two friends of the pilot recognised his voice on the air to ground radio frequency. The pilot flew to a local inn near Market Harborough. During the rest of the afternoon the helicopter remained on the ground at the inn apart from some short local flights flown by the pilot. He also went to his home in Market Harborough for a short time during the afternoon; during the time the helicopter was unaccompanied on the ground it was under the attention of an employee of the inn. At about 1730 hrs, the pilot returned and flew G-POWE back to Leicester Aerodrome where he was seen in the flying club lounge. Then, sometime after 1800 hrs, G-POWE was seen to lift off from Leicester and various acquaintances of the pilot heard him call on the air to ground frequency and declare that he was transiting the Leicester area en-route to Desford. At Desford, he landed at a private site where the helicopter was shut down and the pilot met his three passengers. After a short time, he took off with his three passengers and flew to a hotel located between Leicester and Market Harborough. Witnesses stated that the helicopter arrived at the hotel at approximately 1830 hrs and, after all four occupants had a meal, G-POWE lifted off at about 2030 hrs. Throughout the intervening period, the helicopter was parked in a grass area about fifty yards from the hotel. As the occupants returned to the helicopter, observers noted that it was raining.

Around this time, a witness who was about 3 km to the north of the crash site, heard and saw what he thought was a helicopter passing from right to left as he looked to the south. He recalled that the weather was overcast and that it was drizzling. The lights of the helicopter went out of sight behind some nearby trees but, shortly afterwards the witness heard "spluttering or stalling" sounds and he could hear the sound of the rotor blades; about 20 seconds later, he heard a crash. Initially he began to walk towards the area of the supposed crash site but found that the intensity of the rain was increasing and decided to go to a nearby friend's house where he called the police. The police control room recorded the time of the call as 2054 hrs.

Search and rescue

Following the initial report of a possible helicopter crash, the Police Search Manager initiated an initial search plan. This involved deploying approximately 12 police vehicles on a sweep of the roads around the suspected crash area. Initially, the weather was below limits for the police helicopter to fly but, after approximately two hours, it improved sufficiently for an airborne search to be started; this search, which lasted about 45 minutes, was hampered by the continuing poor weather conditions and did not locate the crash site. Throughout this period, continuing enquiries were made to establish the possible identity of the helicopter and its occupants. A seismographic survey was also conducted but this gave no indication of any significant ground impact.

Throughout the night, the search continued using the resources of the Derbyshire Mountain Rescue Team supplemented by personnel and dogs from Leicestershire Fire and Rescue Departments. Military assistance had also been requested and an airborne search, involving both an RAF Search

and Rescue helicopter and the police helicopter, was planned for when the weather improved. However, before this occurred, a local landowner discovered the crash site.

Weather information

No confirmation was available that the pilot had specifically checked the forecast weather for the route he intended to fly. However, weather information was available through many passive sources; this included TV, radio and a forecast displayed at the Leicester Flying Club. Additionally, he had often flown over the area by day and night and could be expected to be very familiar with the terrain and lighting.

The weather forecast displayed at the Leicester Flying Club showed a frontal system approaching from the west; the front was forecast to be in the Leicester area by 2100 hrs. Weather associated with the front would be rain and low cloud.

An aftercast was provided by The Meteorological Office at Bracknell. The synoptic situation at 1300 hrs on 19 April 1998 showed a southerly flow ahead of a frontal system approaching the area steadily from the west. The weather was good with a visibility of 10 km and cloud scattered base 2,500 feet amsl and broken base 4,500 to 5,000 feet amsl; the surface wind was 150°/7 kt and the temperature was 10°C with a dew point of 5°C; the QNH was 1005 mb. Soon after 1300 hrs, outbreaks of rain would probably have reached the area from the west. At 2100 hrs, the frontal system was lying from Manchester to Birmingham and moving steadily eastwards. There was occasional rain and drizzle with a visibility around 3,000 metres. Cloud was scattered with a base 500 feet amsl and overcast with a base 1,000 feet amsl. The surface wind was 130°/5 kt, temperature was 8°C and a dew point of 7°C; QNH was then 1003 mb. The deteriorating conditions were moving eastwards across the area.

When these temperature and dew point figures are plotted on a carburettor icing probability chart for flight in air free of cloud, fog or precipitation, they give a prediction of carburettor icing at any power. The risk and rate of ice build-up would be greater when flying in cloud, fog or precipitation.

Two pilots were flying in the Leicester area at about 1845 hrs. They subsequently recalled that, at the time, the cloud was scattered with a base around 1,000 feet to 1,200 feet agl; the visibility was 5 km and it was raining slightly.

The East Midlands Police Air Support Unit (ASU) is based approximately 9 km south of the accident site and the unit helicopter had landed there at about 2005 hrs. The pilot subsequently stated that the weather conditions when he landed were close to the unit's flying limits of 600 feet

agl cloud base and a visibility of 8 km. Thereafter, the duty crew were asked to scramble following the initial call of a possible crash but, with the cloud base recorder indicating a cloud base below the legal minimum, the crew were unable to do so. However, at about 2105 hrs, the recorder showed an apparent reading sufficient to allow the crew to get airborne. When they did so, the pilot found that the cloud base was about 300 feet agl and returned to his base. Later that night, at 0005 hrs, the crew again got airborne to carry out a search. Nothing was found but the pilot noted the weather as poor in places with patches of low cloud; the pilot used a QNH of 1007 mb for his first flight and 1006 mb for his later flight. He also recalled that there were very limited visual clues due to the lack of lights in the rural areas.

The accident site

The accident site was in a small steep sided valley approximately 900 metres to the south west of the village of Gumley. The area consisted of rolling hills and ridges covered with animal grazing land interspersed with areas of woodland. Generally the elevation of the land in the area was 550 feet amsl whereas the accident site was approximately 400 feet amsl. The accident site was in a grassy area used for race horse training. The initial impact by the helicopter was on the bottom section of a steep southerly facing grassy slope. At the time of this initial impact the helicopter was flying in a southerly direction. After the initial impact the wreckage continued down the grassy slope, entered a wooded area, crossed a stream and then ascended up a north facing slope into the wood before coming to rest. After coming to rest there was a severe post impact fire which consumed a large part of the wreckage.

Examination of the accident site showed that at the point of initial impact the helicopter was pitched nose down by approximately 22°, banked to the left by about 35°, with a ground speed of 80 to 100 kt and descending at about 2,000 feet per minute. There was no evidence that the helicopter was yawed or that the fuselage was rotating. All the major components were present at the site indicating that nothing of significance had broken away from the helicopter prior to the first impact. The main rotor blades struck the ground on three occasions during the impact sequence. The first strike was a glancing blow, the second was substantial and the third, which was also substantial, stopped the rotor system. This evidence, together with the lack of heavy impact damage to the main rotor blades, indicated that they were rotating at a reasonable speed but that there was low energy in the system. The tail rotor blades struck the ground at a later stage of the impact sequence. The ground impact marks made by the tail rotor blades and the lack of major damage to them indicated that they were being driven, under low power, by the main rotor. The severity of the post impact fire and areas of fuel affected vegetation indicated that there was a reasonable quantity of fuel in the helicopter's fuel tanks at the time of the accident.

It was subsequently reported that a branch had fallen from a tree into a road at a position which was thought to be close to the track followed by the helicopter. On examination the branch was found to be dead and there were no witness marks to suggest that it had been hit by the helicopter; it was concluded that the branch had fallen naturally.

Subsequent detailed wreckage examination

A detailed examination of the helicopter's cockpit instrumentation, flying control, fuel, engine and power transmission systems was carried out. Microscopic examination of the instrument panel illumination, warning and indication light bulbs showed that, at impact, the illumination lighting was on, which was consistent with a flight at night and was an indication that the electrical system was functioning. The low rotor warning light was found to be on indicating that the main rotor speed was below 97% of its normal operating speed. The alternator warning light was not illuminated at impact indicating that the engine had not stopped operating. The low engine oil pressure and engine speed governor warning lights were broken and could not be examined. All other system indicator lights were OFF at impact. The combined engine and main rotor speed gauge was severely damaged by the impact and microscopic examination of the indicator needles and gauge face revealed witness marks which gave impact readings of approximately 68% engine speed, which is about engine idling speed and a main rotor speed of between 70 and 85% of its normal operating speed. The altimeter sub-scale was set at a pressure setting of 1008 mb. Examination of the other cockpit instrumentation could not establish their impact indications. Because the severe post impact fire had consumed a large area of the helicopter's structure, a complete examination of the flying control and fuel systems could not be carried out. Those items of these systems that could be examined did not show any indications of a pre-impact disconnect or restriction. It was found that the dual cockpit flying control system was fitted.

The engine was taken to a manufacturer's approved overhaul organisation and a strip examination carried out. This examination revealed that the engine was in very good condition and that at impact it was running at a low speed consistent with idling. The engine governor actuator system was recovered intact and its position was found to be neutral, indicating that either the system was not engaged or that the engine speed was below the governed speed range of 80%. The engine carburettor intake hot air system was found to be in operation and at impact the carburettor valve was in the full hot air position.

The main rotor and tail rotor power transmission systems were found to be intact and with no pre-impact disconnections. The tail rotor transmission drive system showed good evidence of the tail rotor having stopped abruptly whilst being driven at low power by the main rotor, which was consistent with the ground impact marks made by the tail rotor blades and the low power damage to them.

Relevant operational information

The post mortem examinations of the pilot and his passengers revealed no medical conditions which may have contributed to the accident.

Calculations indicate that G-POWE was within the normal weight and balance limitations at the time of the accident.

The pilot had undergone his training for his Private Pilot's Licence from November 1996 to February 1997 in the Robinson R22 helicopter. He completed his conversion to the R44 model in April 1997 and maintained a high level of currency in both models up to the time of the accident. In January 1998, he completed the required night and instrument training necessary for a night rating for which he qualified on 20 January 1998. This night rating entitled the pilot to fly at night but, outside controlled airspace, he was to fly in accordance with the Instrument Flight Rules (IFR). The relevant Rules of the Air require that an aircraft shall not fly at a height of less than 1,000 feet above the highest obstacle within a distance of 5 nautical miles of the aircraft unless it is necessary for the aircraft to do so in order to take off or land, or the aircraft is flying at an altitude not exceeding 3,000 feet amsl and remains clear of cloud and in sight of the surface. However, the pilot is also required to maintain at least 500 feet clear of any person, vessel, vehicle or structure unless the aircraft is landing or taking off.

The Robinson Model R44 Pilot's Operating Handbook includes a limitation that "Orientation during night flying must be maintained by visual reference to ground objects illuminated solely by lights or adequate celestial illumination". Additionally, within the Handbook are safety notices which are issued by the Robinson Helicopter Company as a result of various accidents and incidents which have occurred. Safety notices which may be pertinent are as follows:

Safety Notice SN-18: "Flying a helicopter in obscured visibility due to fog, snow, low ceiling, or even a dark night can be fatal. Helicopters have less inherent stability and much faster roll and pitch rates than airplanes. Loss of the pilot's outside visual references, even for a moment, can result in disorientation, wrong control inputs, and an uncontrolled crash. This type of situation is likely to occur when a pilot attempts to fly through a partially obscured area and realises too late that he is losing visibility. He loses control of the helicopter when he attempts a turn to regain visibility but is unable to complete the turn without visual reference. You must take corrective action before visibility is lost! Remember, unlike the aeroplane, the unique capability of the helicopter allows you to land and use alternative transportation during bad weather, provided you have the good judgement and necessary willpower to make the correct decision."

Safety Notice SN-26: "Many fatal accidents have occurred at night when the pilot attempted to fly in marginal conditions after dark. The fatal accident rate during night flight is many times higher than during daylight hours. When it is dark, the pilot cannot see wires or the bottom of clouds, nor low hanging scud or fog. Even when he does see it, he is unable to judge its altitude because there is no horizon for reference. He doesn't realise it is there until he has actually flown into it and suddenly loses his outside references and his ability to control the attitude of the helicopter. As helicopters are not inherently stable and have very high roll rates, the aircraft will quickly go out of control, resulting in a high velocity crash which is usually fatal. Be sure you never fly at night unless you have clear weather with unlimited or very high ceilings and plenty of celestial or ground lights for reference."

The Air Navigation Order (ANO) Article 38 requires that "The commander of an aircraft registered in the United Kingdom shall reasonably satisfy himself before the aircraft takes off that the flight can safely be made, taking into account the latest information as to the route and aerodrome to be used, the weather reports and forecasts available and any alternative course of action which can be adopted in case the flight cannot be completed as planned."

The helicopter crashed approximately 2.9 nm to the east of the hotel where the occupants had a meal. Desford, where the passengers lived is slightly north of west of the hotel and Leicester, where G-POWE was based, was to the north of the hotel.

During the week following the accident, one of the investigators flew in the ASU helicopter at night to get an idea of the terrain and the lighting conditions in the area. It was noted that there were significant obstacles around the hotel and that the general lighting was very sparse in the adjacent area. The pilot of the ASU helicopter assessed the approach and take off at the hotel as difficult at night and the most suitable departure would be to the east.

Discussion of accident

Examination of the wreckage revealed that the engine was running, but at idle power and the rotor RPM was between 70 and 85%. In the absence of any technical malfunction, three aspects were considered as possible factors in the accident and these are discussed below.

Misting of the canopy

It was raining when the occupants walked from the hotel to the helicopter. Wet clothes in a confined area can cause misting of the canopy, particularly when the relative humidity is very high. If misting had occurred the resulting restricted visibility could have been a considerable distraction for the pilot.

Carburettor icing

Weather conditions at the time were conducive to carburettor icing and it was confirmed from the wreckage that carburettor heating was applied at the time of impact. There is no way of knowing when this had been applied and whether there had been any power reduction because of carburettor

icing prior to the application of the heat. Furthermore, the selection of carburettor heat might have been a distraction to the pilot at a critical time. The possibility of carburettor icing could not be dismissed.

Disorientation

From witness statements, the pilot was thought to be intending to fly from the hotel direct to Desford to disembark his passengers and then fly to Leicester. Alternatively, he may have planned to fly direct to Leicester to return the helicopter and then possibly take his passengers back to Desford by car. The accident site was 2.9 nm east of the hotel, in a direction away from both Leicester and Desford.

Having taken off from the hotel in an easterly direction (the most suitable) the pilot would then have been expected to turn north or north west towards Leicester. A turn to the left would not only have been in the expected direction but would also have taken him towards the generally lower ground between the hotel and Leicester. Additionally, Leicester was less than 5 miles away and its ground illumination would have provided good visual references for flight. That he did not turn left suggests either that he was intending to fly to another destination or that he was unable/reluctant to turn left because of some other reason. There is no available evidence of an alternative destination but this cannot be dismissed.

The pilot was qualified and current on the helicopter. Furthermore, at the time he initially took-off at 1340 hrs, the weather was suitable for the planned series of flights. The weather was deteriorating throughout the day but was still within his normal flying limitations up to the time he landed at the hotel where he and his three passengers had a meal; it was still daylight when he landed there. However, the weather continued to deteriorate while the four individuals were eating and it was dark when they returned to the helicopter. Unless the pilot had checked the forecast weather in detail, he may not have been aware of the extent of the deterioration. Information from the crew of a police helicopter based about 5 nm away confirmed that the cloud base was close to 600 feet agl at 2005 hrs and was below 300 feet agl at 2050 hrs. Therefore, when the pilot of G-POWE lifted off at approximately 2030 hrs, the cloud base would have been between 600 feet and 300 feet agl. Additionally, it was raining and the hotel was located in an area with very limited ambient lighting. At the time the pilot took-off from the hotel, the weather was unsuitable for his proposed flight. Either the pilot was not aware of the forecast or he was confident of his ability to cope with the existing weather.

The pilot had completed five hours instrument flying in achieving his night rating but this is very basic experience and the R44 has limited instrument flying instrumentation; the instrument training during the night rating qualification is purely to acquaint the pilot with the basic skills necessary to recover from cloud which he has entered accidentally. The actual flight to the east took him initially over some rising ground. Thereafter the aircraft was seen to be flying over an area of lower ground, beyond which was a ridge. Over this ridge the gap between cloud and terrain would have

been minimal and, given the rural nature of the area and the existing weather, there would have been a lack of external visual references. Even if the aircraft had not actually entered cloud, the prevailing conditions would have been conducive to disorientation. It was as the aircraft crossed the ridge that it adopted a southerly heading and then descended rapidly to impact in a nose down/left bank attitude.