

# Hughes 369E, G-OABG

## AAIB Bulletin No: 6/97 Ref: EW/C96/10/5 Category: 2.3

<b>Aircraft Type and Registration:</b>	Hughes 369E, G-OABG
<b>No &amp; Type of Engines:</b>	1 Allison 250-C20B turboshaft engine
<b>Year of Manufacture:</b>	1984
<b>Date &amp; Time (UTC):</b>	19 October 1996 at 1834 hrs
<b>Location:</b>	Near Cauldon Lowe, Staffordshire
<b>Type of Flight:</b>	Private
<b>Persons on Board:</b>	Crew - 1 - Passengers - None
<b>Injuries:</b>	Crew - 1 (fatal) - Passengers - N/A
<b>Nature of Damage:</b>	Helicopter destroyed
<b>Commander's Licence:</b>	Private Pilot's Licence with Night Rating
<b>Commander's Age:</b>	59 years
<b>Commander's Flying Experience:</b>	770 hours approximately (of which 585 were on type) Last 90 days - more than 20 hours Last 28 days - Not known.
<b>Information Source:</b>	AAIB Field Investigation

### The accident flight

The pilot landed at Haydock Park racecourse at 1755 hrs to disembark two passengers before departing on the 11th sector of the day to return to home landing site at Holloway, Near Matlock, Derbyshire. It was dark (sunset was at 1710 hrs) and had just started to rain.

After becoming airborne, at 1802 hrs, the pilot contacted Manchester Approach Radar Control stating that he had just lifted off from Haydock Park, that he was returning to Derby and would like to route via Stoke on a heading of 155°. The Manchester Controller cleared him to fly under Special Visual Flight Rules (SVFR) on that heading, and to fly "NOT ABOVE 1,500 FEET". At 1812 hrs the pilot informed Manchester ATC that he was "CHANGING ON TO 120 NOW FOR THE TRENT BEACON". At 1815 hrs he informed Manchester ATC that he was changing to the East Midlands frequency. The controller advised the pilot that East Midlands had details of his flight and were expecting him.

At 1826 hrs, after several attempts, the pilot managed to raise the East Midlands Approach controller on 119.650 MHz. The pilot asked the controller for a QDM (bearing to East Midlands) and was given 120°. The pilot then asked if the controller could give him some idea of his range. The controller replied "NO I CAN'T CAN YOU SQUAWK 7361 IDENT". The pilot complied with this request and then asked if he could be seen on radar. The controller did not have radar contact and asked at what height the pilot was flying. The pilot replied that he was at 1,000 feet. The controller transmitted "I'M GETTING A TRACE BUT NO... YOU'RE OBVIOUSLY FAIRLY LOW I ASSUME". The pilot immediately replied ".... I'M IN TROUBLE... GIVE ME A QDM PLEASE". The controller quickly responded with "ONE TWO ZERO DEGREES... CAN YOU CLIMB TO TWO THOUSAND FEET?". The pilot responded "BRAVO GOLF CLIMB TO TWO THOUSAND I'M ER... OH YES HERE WE ARE I'M OUT OF THE CLOUD AGAIN". The pilot was then asked if he would like to continue steering 120° so that he could head towards East Midlands and the controller would advise him when he could see his transponder squawk on radar.

At 1829 hrs the controller indicated that the helicopter was now showing on radar and that it was 28 miles north west of East Midlands. The pilot asked "CAN YOU STEER ME IN... I'M COMPLETELY BLIND AND I'VE GOT A PROBLEM". The controller replied "WELL THERE IS HIGH GROUND OUT THERE... CAN YOU CLIMB AT ALL?". The pilot said "I SHALL HAVE TO... I'M COMPLETELY BLIND SO YOU TELL ME WHERE TO GO". "WELL I WOULD CLIMB STRAIGHTAWAY TO THREE THOUSAND FEET AT LEAST IF YOU CAN (on the pressure setting of) ONE ZERO ONE EIGHT... AND WHERE DO YOU WANT TO LAND?" replied the controller. The pilot indicated that he wished to land at East Midlands airport. The controller then gave the pilot headings to fly to East Midlands and at 1830:30 hrs he transmitted "JUST CHECK YOUR HEADING IT SHOULD BE ONE THREE ZERO I GET THE IMPRESSION THAT YOU'RE TRAVELLING NORTH EAST AT THE MOMENT... THAT'S IT FLY STEADY AT THREE THOUSAND FEET ON HEADING ONE THREE ZERO AND WE'LL BRING YOU IN TO EAST MIDLANDS". The controller then passed the current East Midlands weather as visibility 7 km in rain, scattered cloud at 600 feet, broken cloud at 1,200 feet, Runway 27 in use with a surface wind of 120°/05 kt.

At 1832 hrs the pilot asked if the controller was receiving his transponder transmission. The controller replied "... YES I'VE GOT YOU IN RADAR CONTACT ON SECONDARY RADAR BUT I GET THE IMPRESSION THAT YOU'RE GOING ROUND IN CIRCLES CAN YOU FLY A STEADY HEADING?". The pilot responded "I'M TURNING BACK TO ONE TWO ZERO NOW". The controller then asked the pilot to confirm that he was still level at 3,000 feet. The pilot replied "NO I'M DOWN TO TWO AND A HALF TRYING TO CLIMB AGAIN AND I'M STILL LOSING MY TRACK". Seconds later (at 1833:30 hrs) the pilot transmitted "BRAVO GOLF I'M IN TROUBLE" followed by "BRAVO GOLF IN TROUBLE". This was the last transmission recorded from pilot. The controller electronically tagged the last observed radar position of the helicopter at 1833:35 hrs. Returns from Clee Hill radar are received at East Midlands ATC every 8.2 seconds. He attempted to re-establish radio contact with G-OABG and initiated emergency search and rescue action.

A telephone call, from a resident close to the crash site near Cauldon Lowe, Staffordshire, alerting the police, was logged at 1836 hrs and the first policeman arrived at the site at 1903 hrs. The police helicopter was also alerted but had to abort its mission due to adverse weather conditions (at 1913 hrs the police log recorded the visibility in the area as 50 metres). The first fire vehicle arrived at 1904 hrs and the ambulance arrived shortly after. The helicopter had crashed onto open pasture close to the A52 road, caught fire, exploded and was completely destroyed. The pilot was fatally injured in the impact.

### **Previous sectors on the day of the accident**

On the morning of the accident the pilot flew from his house near Matlock, Derbyshire, where he had parked his helicopter overnight, to Southwell racecourse, near Newark. There he collected a passenger before flying, via a private landing site to the north of Newark, to Haydock Park, 10 miles west of Manchester, to collect a further two passengers, a married couple. The couple were expecting the helicopter to arrive at 1030 hrs but the pilot was 'running late' and did not arrive until 1130 hrs. After landing the pilot left the helicopter with its rotors running to brief the passengers and assist them in strapping in. From Haydock Park the pilot, with one passenger seated alongside him in the front, right hand seat and the couple seated in the rear, flew to Wellesbourne Mountford where, at 1217 hrs, with rotors running, the helicopter was refuelled to full tanks with 263 litres of fuel. One of the passengers described the flight as "turbulent even though it was a fairly clear, sunny and bright afternoon". As the helicopter approached the London area from the west the pilot and the front seat passenger studied an aeronautical chart of the area and a road atlas was passed to one of the rear seat passengers in order that he could also assist in the navigation. The flight continued and eventually landed at Kempton Park racecourse at 1308 hrs.

At approximately 1530 hrs, as the race meeting concluded, the helicopter took off for its return series of flights. There was light rain as the helicopter departed but generally the conditions in flight were clear. Very soon the weather conditions deteriorated. One of the passengers stated that the pilot spoke of "bad weather...and if things got any worse he would have to take the helicopter down". The front seat passenger, who was familiar with helicopter operations, assisted the pilot with the visual navigation but as the weather got worse she said "I can't see" and on several occasions she told the pilot to climb because he was "too low". The radio altimeter warning horn, which had been set to sound at 500 feet agl, was also heard by the passengers several times during the flight.

The weather conditions improved as the helicopter landed at Costock, 6 miles south of Nottingham, to refuel before proceeding on to Southwell racecourse near Newark. From there the pilot made a brief excursion to a private landing site before disembarking one of the passengers at Southwell. He then flew with the husband and wife back to Haydock Park. For this flight the husband occupied the front right seat with his wife seated in the rear.

The passengers described the weather conditions as clear but the pilot told them that he was concerned about their flight over the Pennines and referred to the 'turbulent ride' he had encountered earlier in the day. Whilst en route the front passenger became aware that the pilot had a moving map (Global Positioning System (GPS) 'Routefinder') displaying the helicopter's progress. The pilot explained to the passenger that the reason for the navigation confusion earlier in the day was due to a display malfunction, an occurrence that had happened three or four times before on previous flights.

As the flight progressed the pilot was cleared to transit close to Manchester Airport en route to Haydock Park. The passengers stated that visibility was good and that they could clearly see aircraft parked at the airport. As they approached Haydock the husband, seated in the front, identified the racecourse, which is to the east of the M6 motorway but the GPS map display indicated that it was to the west of the motorway. Eventually, after some manoeuvring, the pilot landed the helicopter at Haydock. By this time it was raining and, because of the deteriorating weather, the couple offered the pilot accommodation for the night. He declined their invitation and departed Haydock, a few minutes later, on his final sector.

### **Meteorological information**

An aftercast obtained from the Meteorological Office at Bracknell detailed the synoptic weather situation at 1800 hrs as a warm front located some 10 nm south west of the Weaver Hills approaching from the west. The weather was occasional rain and drizzle with a visibility ranging from 4,000 metres to 20 km but 200 metres or less in hill fog. The mean sea level pressure was 1007 mbs and the cloud was broken with a base of 800 to 1,000 feet covering hills, broken at 2,000 to 3,500 feet and overcast at 10,000 feet. The surface wind was 170°/10 kt at a temperature of °C with the 2,000 feet wind as 230°/17 kt at a temperature of °C.

### **Eye witnesses**

There were no witnesses who saw the helicopter crash. One witness, positioned to the north west of the crash site saw the helicopter hovering at a very low altitude over her house at approximately 1815 hrs. She described the helicopter as being low enough for her to "shout at the pilot". She could clearly see its two large skids and its red anti-collision light. The helicopter hovered for 10 to 20 seconds before moving off slowly, at the same low altitude, towards the village of Stanley. One witness, standing by the front door of his house at Cauldon Lowe near the crash site, heard but did not see the helicopter as it appeared to circle overhead. The weather was "extremely foggy" as it passed over his house and ran parallel with the main road before crashing in a "ball of flame". This witness immediately telephoned the emergency services and ran to the crash scene to see a second explosion and two areas of fire. He was joined by a neighbour and together they searched the area for survivors only to find that the pilot had been fatally injured.

### **Radar analysis**

Radar recordings from the Clee Hill radar site indicated the helicopter's track minutes before the accident. Height information was not available as the helicopter was not required to transmit on Mode 'C' and did not have this facility. The plotted track showed the helicopter manoeuvring erratically from a heading of 010° on to 090° then turning right onto 225°, left onto 135° then spiralling to the right before radar contact was lost. The last recorded radar position was timed at 1833:35 hrs.

### **Medical aspects and pathology**

The pilot held a Class III medical certificate and had last been examined by an Aviation Medical Examiner (AME) on 7 March 1996. The only condition on his medical certificate was that he had to wear spectacles that corrected for near vision. Post mortem examination revealed no pathological evidence of any medical or physical condition which may have caused or contributed to the accident.

### **Pilot's experience**

The pilot started training for a helicopter Private Pilot's Licence (PPL(H)) on Enstrom helicopters at Shoreham in May 1982. In June that year he was granted a PPL(H) and also purchased an Enstrom helicopter. On 13 January 1983 he started a night rating course, flying the Enstrom, which he completed four days later on the 17 January 1983. The next day, 18 January 1983, he flew this helicopter from Shoreham to his house in Derbyshire. He departed Shoreham at 1538 hrs (civil twilight ended at 1655 hrs) to arrive home at dusk. However, stronger headwinds than expected were encountered en route resulting in him still being airborne as night fell. Close to Market Harborough, he inadvertently entered a snow storm. Whilst trying to turn back and descend to vacate this weather he became distracted and allowed the airspeed to reduce to 30 kt. He lowered the nose of the helicopter while continuing the turn and crashed into a ploughed field. (This accident

was investigated by the Accidents Investigation Branch and the report was published in AIB Bulletin No 3/83).

On 30 June 1989 the helicopter (G-OABG), whilst cruising at 600 feet agl, started a moderate vibration together with severe 'grinding and groaning noises'. The pilot was the same one who was involved in the accident which is the subject of this report. He was able to bring the helicopter to hover in a large school playing field adjacent to his track. The tail rotor and half of the tail rotor gearbox then detached causing the helicopter to yaw sharply to the right and drop heavily to the ground. None of the four occupants was injured. Subsequent investigation by the AAIB (reported in Bulletin No 10/89) showed that the metal leading edge erosion strip from one of the tail rotor blades had detached due to inadequate bond strength at the adhesive to strip interface. Maintenance checks and regular inspections of this component had been performed diligently.

Examination of the pilot's log books showed that his last Certificate of Experience was signed on 12 September 1996. The last night flight recorded in his log book was the accident flight on 18 January 1983 described above.

The Air Navigation (No 2) Order 1995, Schedule 8 states that a pilot shall not fly as pilot in command of a helicopter at night unless:

- (i) his licence includes a night rating (helicopters and gyroplanes); and
- (ii) his licence includes an instrument rating (helicopters) or he has within the immediately preceding 13 months carried out as pilot in command not less than 5 flights, each consisting of a take off, a transition from hover to forward flight, a climb to at least 500 feet and a landing, at a time when the depression of the centre of the sun was not less than 12° below the horizon.

Examination of the pilot's licence showed that the conditions that had to be observed were that the holder of the licence was not permitted to fly helicopters:

- (a) Out of sight of the ground or water; and
- (b) By sole reference to instruments.

### **Helicopter maintenance**

An Annual Star inspection had been carried out on 18 September 1996 at 2511:41 flying hours and had included the satisfaction of a number of Airworthiness Directives and the replacement of some rotor system components. The inspection had culminated in an air test and the renewal of the Certificate of Airworthiness by the CAA for a further period of three years.

The aircraft log book had not been made up since the Annual Star inspection, but a partially burned notebook found in the wreckage recorded a further 28 sectors, but without the associated dates. The duration of six of these flights was illegible due to fire damage and it is not known at what date the record ceased. The 11 sectors flown on the day of the accident were not included in the notebook, however, the average duration of the legible sectors was applied to the 17 unrecorded sectors to give an additional total of 20:21 hours flown since the Annual Star inspection. This figure does not include any sectors which may have been flown between the end of the record in the notebook and the start of flying on 19 October 1996.

## Examination of the wreckage

The aircraft had crashed in open pasture with the front end of the skids buried almost vertically in the ground to a depth of 1 metre; other components were severely damaged. The area covered by the wreckage was very localised, measuring 12 metres in its maximum dimension. The disposition of wreckage indicated a high vertical speed in a nose down attitude (60°-80° below the horizontal) with no forward throw of components. The engine and the majority of the aluminium structure and controls were burnt out.

There had been rotor tip contact with the ground from two blades which fractured at their strap assemblies. Two other blades had hit the ground along their entire span, and the fifth blade had only slight damage. There was no indication of coning from the position of the blades on the ground. The strap assembly failures were primary evidence that there was significant torque (power) being transmitted to the rotor hub at the time the blades were stopped by impact. This evidence of engine operation was corroborated by shear damage to the splines on top of main rotor mast and the gas turbine compressor blades which showed evidence of tip damage, bending against the direction of rotation, and shearing at the roots.

A copy of the East Midlands ATC approach frequency recording was analysed to examine the background sounds present during the final transmissions from the aircraft. From the content of the sounds it was apparent that a frequency originating from the free turbine was present enabling the speed of the main rotor to be determined. The accuracy of this process was estimated to be within the tolerance of 1.5%. An examination of the final 8 discrete transmissions from the pilot was made and the main rotor speeds during each of them was derived.

During the first six transmissions, occurring between 1813:12 hrs and 1833:02 hrs, the derived main rotor speed was between 103% and 105%. The normal operating range is 102% to 104%, thus, allowing for measurement tolerances, the rotor speed was consistent with normal operations. During the penultimate transmission from the aircraft, starting at 1833:28 hrs and having a duration of 2.5 seconds, the measured rotor speed was 99.5% at the beginning decreasing to 96% before recovering slightly to 97.5%. The sound of a repeating tone was also present during this transmission. The frequency and repetition rate of this tone was compared with the recordings of known cockpit audio warnings in other Hughes 369 helicopters and identified as that of the low rotor speed and/or engine failure warning horn. The warning is set to activate if the main rotor speed drops below 98%, and most of the rotor speed measurements were below this value. The final 1.5 second transmission, commencing approximately 5 seconds after the end of the previous one, indicated that the rotor speed had increased from 99.5% to 101.5%. The aural warning was not present during this transmission indicating that the tone recorded previously had been due to low main rotor speed and not to engine failure.

This evidence suggests that the rotors were being powered normally at the time of impact. Given the degree of disruption and the severe fire that followed the impact, total examination of all the helicopter systems and components was not possible. The possibility of some malfunction, other than engine and drive-train failure, cannot therefore be ruled out entirely. However, the chances of such an event occurring in the short time frame between the pilot's final RT transmissions and the estimated time of impact are judged to be extremely remote.