Bell 206B Jet Ranger, G-OBTW

AAIB Bulletin No: 2/98 Ref: EW/C97/3/4Category: 2.3

Aircraft Type and Registration:	Bell 206B Jet Ranger, G-OBTW
No & Type of Engines:	1 Allison Model 250-C20 turboshaft engine
Year of Manufacture:	1972
Date & Time (UTC):	16 March 1997 at 0805 hrs
Location:	Gravesend near Albury, Hertfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 - Passengers - None
Injuries:	Crew - 1 fatal - Passengers - N/A
Nature of Damage:	Helicopter destroyed
Commander's Licence:	Private Pilot's Licence (Helicopters)
Commander's Age:	58 years
Commander's Flying Experience:	126 hours (of which all were on type)
	Last 90 days - 32 hours
	Last 28 days - 8 hours
Information Source:	AAIB Field Investigation

History of flight

On the morning of the accident the pilot obtained the weatherforecast from the Meteorological Office using the MetFax facility. This gave a general low level situation of 18 km visibility,6/8 stratocumulus between2,500 to 4,000 feet with occasional 8 km visibility in haze and6/8 stratus cloud between1,000 and 2,000 feet mainly in the south and east of the country. In addition, for sea and coastal areas there was forecast tobe areas of isolated 3,000 metres visibility in mist or drizzlewith between 5/8 and 8/8stratus or stratocumulus between 300 feet and 4,000 feet and similarareas of fog or drizzle with 7/8of stratus between the surface and 2,000 feet. The pilot's intendedroute was from Albury, due north to his home near Spalding inLincolnshire.

After carrying out his external pre-flight checks, the pilot startedthe engine and radioed Stansted ATC to advise them of his intendedflight at 1,000 feet on a track of 360_. In reply he was givena

radar transponder code and advised that he would receive a FlightInformation Service (FIS). After a second radio call to Stanstedconfirming that he was about to lift-off, there was no furtherradio contact between the pilot and ATC despite several attemptsby Stansted ATC to contact him. It is not known whether he listenedto the Stansted Aerodrome Terminal Information Service (ATIS)broadcast which is a continuous broadcast of recorded non-controlinformation. The broadcast was reportinga wind of 260_/13 kt, visibility 3,000 metres with scattered cloudat 200 feet and overcast at 300 feet, temperature and dewpointof 10_ and 9_C respectively and a QNH (an altimeter setting toread airfield height) of 1026 mb. The departure point of theflight was at Piggott's Farm, Albury which is six miles to thewest of Stansted Airfield.

The helicopter's flight was observed and recorded by Debden radarand the Stansted Watchman radar. The track plots observed bythese two radars were coincident. Height information was notavailable since the helicopter was not, and was not required tobe, fitted with a height encoding altimeter (Mode C). Thetrack, as recorded by the radars, is shown in Figure 1 togetherwith the position of the witnesses closest to the accident site.

After lift-off, the helicopter flew in a northerly direction forless than a mile before turning slowly to the left just southof the village of Cockhampstead. This turn continued until thehelicopter was once again tracking north. After crossing AlburyHall it began to turn once again to the left until it was trackingeast. The flight continued in this direction for two miles, crossingthe villages of Gravesend and Patmore Heath. At this point itturned north for one mile before turning east for another mileuntil it reached the River Ash where it then flew south beforeturning left to the north-west. Shortly after crossing the RiverAsh once again the helicopter was seen to turn very sharply tothe left at which point the engine was heard to stop and the helicopterdescended vertically until it hit the ground some twenty yardswest of the road from Little Hadham to Furneaux Pelham.

A considerable number of witnesses either heard or saw the helicopterduring its short flight. The weather in the area was describedas consisting of low cloud with areas of mist, dense in places,particularly on the hills and close to woodland areas. Therewas general agreement that the sound of the helicopter was constantlyvarying in pitch. Some witnesses were convinced that the helicopterwas flying in the cloud although during the final moments of theflight it was seen to be in the clear.

Technical investigation

The aircraft had crashed alongside an unclassified road aboutone third of a mile north of the village of Gravesend. Damageto the aircraft and ground marks showed that it had descendedupright but banked to the right. Its descent had been verticalwith no detectable forward or sideways velocity. The machinehad bounced after the first impact and had yawed slightly to theleft before settling. This showed that it may have been yawingat a low rate as it descended. The rate of descent had been highand the whole fuselage structure was crushed by the impact withthe ground. Kerosene fuel had splashed on to the ground fromthe ruptured fuel tank but it did not catch light and no firedeveloped in the wreckage. The main rotor and tail rotor werevirtually stopped at impact and there was no torsional damagein the transmission shafts between the engine and the rotors toshow that power was being produced by the engine at impact.

The pilot's twist grip control on the collective lever, was foundto be on the 'flight' side of the Flight Idle Stop. The guardedfuel valve switch was at 'ON' and the valve itself was found tobe open. Engine anti-icing was selected to 'OFF'. (Its use isnot required above +4.5_C; Stansted reported +10_C.)

There were numerous failures in the mechanical linkages of theflying control system but these all exhibited the characteristicsof overload and distortion consistent with impact. None of thefailures were characteristic of any pre-existing failure condition. The hydraulic servo-actuators from the flying control systemwere tested on a rig and they operated correctly. The hydraulicpump and reservoir had suffered impact damage but the pump's internalcondition was good.

The possibility was considered that the aircraft had suffereda loss of electrical power because there was no evidence withinthe wreckage of electrical power being available at impact andthe battery switch was found to be in the 'OFF' position. However,this switch position, as with most of the switch positions, couldnot be considered to be reliable as the switch was unprotectedand could easily have been moved in the crash. Electrical failurewould stop the two fuel boost pumps which are in the bottom ofthe fuel tank though this should not normally cause an enginestoppage as the pump within the engine itself ought to be ableto continue to suck fuel from the tank. The radar informationshowed that the aircraft's transponder was operating until theaircraft was directly over the accident site and this is an indicationthat the aircraft's electrical system was working up to that point.

The main gearbox was not initially free to rotate but when itwas dismantled its internal components were found to be intactand the seizure had been caused by light impact damage. The free-wheelunit and tail rotor gearbox operated normally and the failuresfound in the shafting were in overload and were clearly causedby the ground impact.

Loss of engine power

Fuel from the owner's supply, taken through the delivery nozzle,was analysed and it conformed to specification. A second samplefrom the supply tank sump contained some contamination but thisis not considered significant as it is the purpose of the sumpto collect any debris which enters or is generated within thetank and all the fuel that was recovered from the aircraft andthe engine was clean. In particular, the main filter on the aircraftwas clean and fully charged with fuel and the pipe which fed thefuel spray nozzle in the engine combustion chamber also containedclean fuel.

The engine was removed and examined at the facility of the manufacturer'sagent in the UK. After an initial examination involving minimaldisturbance the engine was mounted on a test bed and run. Ontest, the operation of the engine and its control system was completelysatisfactory . The engine was then stripped and examined. Nosignificant defects were found except for some slight rubbingdamage between rotational and static components which was interpretedas having occurred at impact with the engine rotating at a verylow speed. This would be consistent with the engine not producingpower but 'running down' from normal speeds towards stop at impact.

The radar information showed the aircraft's flightpath to be veryerratic with a particularly sharp change of direction just beforethe crash. If the aircraft was subjected to erratic unbalancedflight then it would be possible for the fuel to slosh from sideto side in the tank possibly allowing the fuel pump inlets tobe uncovered and air to be entrained into the fuel pipework. This is most likely with a low fuel level. However, the deformationthe tank had suffered when it burst on impact showed that it hadcontained a substantial amount of fuel and taking account of theflight times recorded since the helicopter was last refuelled,it was calculated that there would have been about one third oftotal fuel remaining at the time of the crash. Furthermore, whenthe aircraft hit the ground the fuel pipe to the burner nozzlewas charged with fuel and there was no direct evidence, therefore,that there had been air in the system.

A loss in the stability of the airflow through the engine (surging)can typically be caused by deterioration within the engine itselfor by ingestion of material through the intake and is most likelyto occur when large power changes are being demanded. On test,the engine was not found to be susceptible to surge, it was ingood condition and showed no evidence that it had ingested anything.

Thus, as no water or other contamination was found there was noevidence for any possible cause of flame extinction and it wasnot discovered why the engine had lost power before impact.

Conclusions

The pilot had learned to fly in June 1996 after buying his ownhelicopter (GOBTW). He flew exclusively in this helicopterand had completed his training on 16 February 1997. His privatepilot's licence had been issued by the CAA on the 4 March 1997and the accident flight was his tenth after the completion ofhis training. He did not hold an Instrument Rating or IMC Ratingand the helicopter was not cleared for flight in IMC. Post mortemexamination did not reveal any condition which might have contributedto the cause of the accident.

The weather conditions at the time of the accident were not suitablefor VFR flight. Considering the meandering nature of the trackflown in conjunction with the witness statements, to the pilotappears to have been prevented from following his desired routeby the necessity to avoid low cloud and to search for clearerpatches. Conditions were such that keeping the surface in sightwas difficult and, with limited flying experience, particularlyin bad weather, the pilot would have been prone to the onset ofboth geographical and spatial disorientation. The meanderingnature of the helicopter's track, which was not in the pilot'splanned direction as drawn on his chart, suggests some geographicaldisorientation arising from the necessity to maintain VFR flight.

Throughout its short flight the helicopter was constantly manoeuvring,as opposed to being in straight and level flight. This wouldexplain the fluctuating noises reported by witnesses who wouldhave heard the predominant noise from the helicopter's main rotorblades constantly altering as the helicopter banked, climbed,and descended at an unusually low height. Vigorous manoeuvring,which possibly occurred shortly before the crash, could have precipitatedengine failure due to a temporary uncovering of the fuel pumpinlets and/or disruption of the engine's airflow. For whateverreason, the engine and main rotor were practically stationaryat the time of impact. Two possibilities remain; either the accidentwas the result of pilot disorientation whilst attempting to flyin conditions which were not conducive to VFR or, and possiblyconnected with such unstable flight, an engine failure occurredat a critical moment when the pilot was unable to take the appropriateemergency action following loss of power.