Cessna 152, G-BHPX

AAIB Bulletin No: 7/2001 Ref: EW/C2000/12/6 Category: 1.3

Aircraft Type and Registration:	Cessna 152, G-BHPX
No & Type of Engines:	1 Lycoming O-235-L2C piston engine
Year of Manufacture:	1979
Date & Time (UTC):	13 December 2000 [time unknown]
Location:	En route Inverness to Benbecula, Scotland
Type of Flight:	Private
Persons on Board:	Crew - 1 - Passengers - 1
Injuries	Crew - 1 (fatal) - Passenger; 1(fatal)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	39 years
Commander's Flying Experience:	268 hours Microlight, 192 hours Fixed Wing
	Last 90 days - 8 hours
	Last 28 days - Nil
Information Source:	AAIB Field Investigation

Background

The pilot and a business colleague planned to fly from Inverness, Morayshire to Benbecula in the Outer Hebrides for a business meeting. The pilot's own aircraft was out of service undergoing modification work, and he decided to hire an aircraft for the trip from his local flying club. The preferred date for the flight was the 11 December 2000 but a suitable aircraft was not available, and the flight was therefore delayed until the 13 December 2000.

On the 12 December 2000 the pilot confirmed the availability of a Cessna 152 for the following day with the flying club and, because he wished to make an early departure, he asked that it should be filled with fuel the night before. He telephoned Benbecula ATC to seek landing permission for the following day and advised that his estimated time of arrival (ETA) would be 1030 hrs and estimated time of departure (ETD) would be 1300 hrs. The pilot asked the ATC controller about the weather forecast and, on being informed that quite poor conditions were expected the pilot said he would call again before departure from Inverness to check the weather.

The pilot retired to bed at about 2300 hrs on the 12 December 2000 and appeared to have a good night's rest before leaving home at about 0715 hrs. He drove to his place of work and picked up his

business colleague and set off for Inverness airport at 0800 hrs. At 0841 hrs he telephoned Inverness ATC to 'book out' and gave his time en-route as 1 hour 45 minutes, endurance as 4 hours and advised that his route would take him from Inverness to Garve and 'through that way'. There is no record of a call to Benbecula to check the weather.

The weather

The weather for the departure from Inverness was fine with a strong surface wind of 240°/19kt gusting to 33 kt and scattered clouds at 4,000 feet.

A commercial helicopter pilot who flew along the Achnasheen valley just before the accident aircraft's departure from Inverness estimated the cloudbase over the eastern end of the valley near Garve to be approximately 3,000 feet reducing to about 2,000 feet toward the west coast. He also reported showers becoming more frequent as the morning progressed.

History of the flight

The aircraft took off at 0856 hrs and departed to the west of the airfield. With two well built occupants, a full load of fuel, a liferaft and documents for the planned meeting on board, the aircraft was at, or very close to, its maximum take-off weight. At 0913 hrs the pilot reported "abeam Dingwall at 3,500 feet" whereupon ATC advised him to change frequency to Scottish Flight Information Service. Eyewitnesses reported seeing an aircraft meeting the Cessna's description flying over the pilot's place of work in Muir of Ord and later circling above a cloud layer about three miles to the south of Garve.

At approximately 1130 hrs a representative of the company due to host the pilot in Benbecula telephoned the pilot's place of work to advise them that the aircraft had not arrived and to confirm that the intention to visit remained. He was advised that the pilot and his colleague were out of the office all day and were planning to fly to Benbecula. The representative tried to contact the pilot and his passenger by mobile phone without success. At 1430 hrs the aircraft had still not arrived and the company representative in Benbecula again called the pilot's place of work. A director of the pilot's company called back at about 1440 hrs and the company representative in Benbecula advised the director of his concerns.

By 1500 hrs the Rescue Co-ordination Centre at RAF Kinloss had been informed and overdue action commenced. A request for information on local radio resulted in a large number of reported sightings or "hearings", but no further evidence of the aircraft's progress could be gained. There were no further radio calls from the aircraft to ATC units and examination of radar recordings showed no trace of the aircraft. In the days following a large scale land and air search was conducted over the Scottish Highlands but without success and after four days the search was scaled down.

On 23 February 2001 a hill walker discovered an aircraft wheel and a liferaft in a gully on the southern side of the Liathach Mountains near Torridon, Wester Ross. A subsequent search by the Torridon Mountain Rescue Team (MRT) found the wreckage of G-BHPX, together with the bodies of its occupants, at approximately 2,700 feet above mean sea level roughly one kilometre to the east south east of the Mullach an Rathain peak in the Liathach Mountains.

Injuries to persons

The pilot had no significant previous medical history and was apparently fit. Both he and his passenger died from severe multiple injuries. The autopsy revealed no evidence of any medical condition, alcohol or any toxic substances which might have caused or contributed to the accident.

The injuries sustained during the accident suggested that the safety harnesses had probably detached from their mountings at impact. The accident was not considered to be survivable.

Examination of the aircraft

When first discovered, the aircraft wreckage and surrounding area were largely covered by snow, and a detailed examination of the wreckage was impossible. The accident site was visited on 27 March 2001.

The main wreckage was lying on a 22°slope (average), although there were steeper sections above and below. The line of the valley followed an approximate east-west direction, and the aircraft had crashed onto the south-facing slope (i.e. north side of the valley). The ground was rocky, strewn with boulders and interspersed with areas of coarse grass and moss. The wreckage was in a compact area although some items, including sections of aileron and the liferaft, had fallen several hundred feet below the impact site. The only parts of the airframe that were not accounted for were the main wheels, although one of these had been sighted in a gully by the MRT on an earlier visit to the site. Some earlier minor disturbance of the wreckage occurred when the MRT recovered the bodies of the aircraft occupants, and subsequently secured it to the mountainside with ropes. However, the wreckage lay substantially in its impact position.

It was apparent that the aircraft had impacted the hillside on a track of approximately 020° magnetic and come to an immediate halt. Parts of the alternator and carburettor, located respectively on the front and underside of the engine, were found partially buried in the rocks close to where the engine had come to rest. The absence of a significant groundslide had resulted in the impact energy being dissipated in a very short distance, which accounted for the extreme disruption of the airframe, particularly the cabin area. The degree of destruction was consistent with a high, rather than low, impact speed.

Pieces of the anti-collision beacon, mounted on top of the fin, were found on the ground beyond the impact area. This indicated that the tail of the aircraft had whipped over the top of the cabin area, striking the ground ahead of the nose, before rebounding and coming to rest at the rear of the aircraft. Structural failures had occurred at the junction of the fuselage with the cabin and with the empenage, although the structure had remained bound together by the primary flying control cables, none of which had broken. The fact that the tail initially passed over the top of the cabin suggested that the aircraft had a slight nose down attitude at impact.

The local topography, relative to the impact heading, had resulted in the nose and right wing striking the ground almost simultaneously. This had precipitated an inertial failure of the left wing at approximately mid span, allowing the outboard section to swing forward and contact the ground close to the cabin area. The disposition of the nose and right wing tip impact points indicated a small amount of right bank at impact.

The propeller had become detached during the impact, with one blade separating from the hub. The severity of the damage, particularly to the leading edge of the separated blade, indicated that the engine had been developing power at impact.

Despite the disruption that had occurred to the cabin, the engine controls appeared relatively undamaged. The mixture and carburettor heat control knobs were pushed fully forward, i.e. full rich and cold air selected. The throttle control was retarded such that 45 mm of the shaft was exposed. Subsequent comparison with two intact aircraft showed that the total throttle control movement from idle to fully open was around 75 mm. Rigging differences between aircraft would prevent a precise correlation between throttle position and engine rpm, even supposing the as-found position

on the accident aircraft could be regarded as entirely reliable. However, it was concluded that the throttle position probably equated to a cruise setting.

The carburettor air box was recovered from the wreckage and the internal flap that directs airflow from either the air filter (cold air) or the warm air duct was found in a mid position. However, it was clear from the pattern of distortion that the flap had been driven, in the impact, from the cold position.

Elsewhere in the cockpit wreckage it was established that the battery/master switch was ON, magnetos were on BOTH, pitot heater was OFF, altimeter subscale setting was 982 mb (the Inverness QNH 981 mb on departure, the Portree Regional Pressure Setting 973 mb) and the fuel was selected ON. The flap lever was set to zero and this was confirmed by examination of the electric motor operated screwjack in the right wing, which was found in the flaps retracted position.

Little useful information was obtained from the instruments. However, it was noted that the indication on the attitude indicator was in broad agreement with that derived from the distribution of the wreckage.

The attitude and direction indicator instruments both contained gyroscopes operated by suction from a vacuum pump mounted on the engine accessory gearbox. Disassembly of the pump confirmed that there had been no pre-impact failure of the internal components.

The elevator trim screwjack extension was measured and following comparison with an intact aircraft, was found to be at a slightly nose down setting. However, it was possible that some movement could have occurred in the impact.

The engine hours meter within the tachometer was found with a reading of 6,142.4 hours. Although the flying club did not keep day to day records of engine hours, a reading of 6,131.5 hrs was taken on 30 November 2000. A total of 8.9 hours had been flown since 30 November 2000 and on 4 December 2000 about 0.3 hours of ground running was carried out during the aircraft's 50-hour check. Although these hours may not be totally accurate, they indicate that the maximum duration of the accident flight was approximately 1.5 to 1.7 hours.

The MRT found the pilot's GPS when the main wreckage was discovered in February. The unit was sent to the AAIB for downloading of stored data, but unfortunately it had been severely damaged and data extraction was not possible.

In summary, it was concluded that the aircraft had been structurally intact prior to impact and had struck the ground in an erect attitude, banked slightly to the right and possibly on a descending flightpath. The engine was delivering power at the time of impact and was likely to have been at a typical cruise setting. There had been no pre-impact failure of the flying controls and no evidence was found of any defect that could have contributed to the accident.

Meteorological information

The weather forecast for the Scottish Region valid for between 0500 hrs and 1300 hrs on 13 December 2000 showed a low pressure system (964 mb) centred near Shetland moving slowly north east and a strong, unstable, west north-westerly airflow over most of the region. There was a strong wind warning for the region with frequent gusts to 35 kt and occasional gusts to 50 kt in the vicinity of showers. For the Highland region in the area of the Cessna's planned route the forecast was for generally good visibility reducing in occasional heavy showers to 4,000 metres and in isolated heavy showers to 2,500 metres. In the Hebrides more general rain and rain showers were expected with the visibility at around 10 km. The cloudbase was expected to be generally 2,000 feet

reducing to 1,200 feet in heavy showers. There were warnings of cloud on hills, moderate icing and turbulence in cloud, moderate turbulence below 6,000 feet, severe icing, severe turbulence and hail in cumulonimbus cloud and thunderstorms. There are no definitive reports of the amounts of snow lying on the mountains in mid-December, but the Met Office opinion is that there would have been little lying below 3,000 feet amsl. Radar images of rainfall in the Torridon area at 1000 hrs and 1030 hrs both show significant rainfall to the north of the Torridon valley with rainfall, possibly slight to moderate, in the general area of the Liathach mountains.

The aircraft's route

The pilot did not file a flight plan and knowledge of his route is limited to the 'booking out' telephone call in which he described flying to Garve and "through that way". The evening before the flight, the pilot had discussed the route with a friend who was a commercial pilot and who had considerable experience of operating in the area. The route they discussed involved flying from Garve along the Achnasheen valley to Plockton on the shores of Loch Carron and then flying either north or south around the Isle of Skye coast before crossing the sea to Benbecula. A route using the Torridon valley was not discussed, but the pilot was familiar with the area from holidays spent nearby.

The pilot carried a GPS which had a map mode, but witnesses who had flown with him on previous flights reported that he tended to use the GPS as back up only and always carried a topographical map. They also expected that he would not have programmed a detailed route with multiple waypoints but would have simply entered the position of his destination into the GPS computer.

The pilot was not qualified to fly in cloud and it was expected that he would attempt to fly in VMC conditions at around 3,500 feet following the route. A month before the accident flight the pilot had flown the same route in a Cessna 172 and on the return leg, flying in the valleys below the level of the mountain tops, he had encountered a moderate shower and turbulence. After landing he had expressed some concern at the experience and witnesses expected that if he encountered bad weather en-route he would be more likely to turn around than to descend to follow the route in the valleys.

Emergency equipment

G-BHPX was a flying club training aircraft and was not fitted with emergency equipment other than a fire extinguisher and first aid kit. During discussions with his commercial pilot friend on the evening preceding the flight, the pilot was offered the use of immersions suits, an emergency locator transmitter and flares but he declined the offer stating that he had a liferaft and lifejackets. A liferaft was discovered just south of the main wreckage site.

Emergency Locator Transmitters

Emergency Locator Transmitters (ELTs) can be used to assist search and rescue (SAR) operations. There are many different types of ELT but amongst those for aviation use are personal locator beacons (PLBs) and emergency position indicating rescue beacons (EPIRBs).

PLBs normally transmit on 121.5 or 243 MHz. They are usually carried by individuals who can switch them ON and OFF as required, but some can be switched on automatically in a crash. The transmitted carrier wave can be received by SAR aircraft which use their direction finding equipment to locate the transmission. COSPAS and SARSAT satellites can also receive PLB transmissions. An EPIRB is usually fitted to the aircraft itself and is designed to start transmission automatically once a crash occurs. Most EPIRBs transmit primarily on 406.25 (or 406.28) MHz,

which can be received, fixed and acted upon much more rapidly by the satellite system. EPIRBs also transmit on 121.5 MHz or 243 MHz for SAR aircraft homing.

The COSPAS/SARSAT system gives world-wide coverage as part of an international search and rescue organisation. The satellites are designed to locate the position of transmissions on frequencies 121.5, 243 and 406.25 MHz using doppler analysis. SARSAT system accuracy is generally no better than 20 nm on 121.5 and 243 MHz, however, the accuracy increases to about 5 nm on 406.25 MHz. A further advantage of 406.25 MHz is that the carrier wave also contains specific information related to that particular transmitter which can be utilised by the SAR organisations to expedite the recovery of the aircraft and personnel.

In 2009 the SARSAT system will no longer use 121.5 and 243 MHz for fixing, although ground and air based SAR systems in the UK are expected to continue use of these frequencies for the foreseeable future.

The overwhelming majority of ELT activations in the UK are false and, partly in an attempt to address this problem, the CAA requires that ELTs comply with EUROCAE Standard ED62, and ELTs transmitting on 406MHz and fitted to UK registered aircraft must be registered with the UK Mission Control Centre. Similarly PLBs should comply with ED62 and the fitting of EPIRBs to aircraft must be approved by the CAA.

Overdue procedure

The action to be taken by ATC in the event of an aircraft becoming overdue is detailed in the Manual of Air Traffic Services Part 1 and is related primarily, although not solely, to aircraft that have filed a flight plan. In most circumstances an aerodrome is required to take preliminary overdue action 30 minutes after ETA. There was no requirement under current regulations for the pilot to file a flight plan for the planned flight, but the UK Aeronautical Information Publication (AIP) Part 2 (En route) states "it is advisable to file a VFR flight plan if the flight involves flying over the sea, more than 10 nm from the UK coastline or over sparsely populated areas where Search and Rescue operations would be difficult". A flight plan may be filed by telephone, fax or RTF.

Rule 20 of the Rules of the Air Regulations 1996 requires that, if a flight plan is not submitted, the pilot must inform the person in charge of the aerodrome, or the ATC unit or the aerodrome flight information unit at the aerodrome of departure of his intended flight. The telephone call to Inverness ATC made by the pilot at 0841 hrs is considered to be sufficient compliance with this requirement and is termed 'booking out'. However, unlike the normal flight plan procedure there is no requirement for Inverness ATC to transmit the 'booking out' to any other ATC unit. Thus, for the incident flight, Inverness ATC were not required to inform Benbecula ATC of the flight details and, apart from the request to use the airfield by the pilot the day before, Benbecula ATC were not aware of the flight.

Analysis

The pilot was qualified for the flight and had a current medical certificate; the aircraft was serviceable with no known defects. At take-off the aircraft was at, or very close to, its maximum operating weight but, apart from reduced manoeuvre margins compared to an aircraft at normal training weights, this is not thought to have been a factor in the accident.

There was no evidence that the pilot had checked the weather before departure on the 13 December 2000. However, although he did not telephone Benbecula on the 13 December 2000, as he had stated he would do during his telephone call the previous day, he was certainly aware of the poor

forecast and had discussed possible routes with his friend the night before. It was most likely that he checked the weather by some means and was therefore aware of the forecast conditions.

The actual weather conditions reported by aircraft in the area indicate that the pilot would probably have had difficulty flying his planned route at 3,500 feet but, without radar data, data recovered from the pilot's GPS or reliable eyewitnesses beyond Garve, the route flown is not known. However, given that the engine-hour monitor indicates a maximum flight length of around 1.7 hours and that eyewitnesses report seeing and hearing an aircraft meeting G-BHPX's description just south of Garve at between 0930 hrs and 1000 hrs, it seems unlikely that the aircraft would have deviated far from the planned route.

The aircraft's track at impact of 020° magnetic could indicate that the aircraft had flown to Plockton on Loch Carron and had been diverting to the north to seek an alternative route to Benbecula or to return to Inverness. Given the high ground between Plockton and Glen Torridon and the forecast cloudbase obscuring the mountain tops, it seems more likely that the aircraft had been flown into Glen Torridon via one of the valleys that connect Glen Torridon with the Achnasheen-Strathcarron valley. Thus Glen Torridon was being used as an alternative east-west route. The pilot was expected to be using his GPS in map mode, and he would therefore have been aware of his general position. However, the GPS map provides no pictorial representation of high ground and the pilot would have had to refer to his hand-held chart to relate GPS position to the topography. In a high workload situation this task would have been difficult to accomplish.

Examination of the wreckage showed no evidence of any defect that could have contributed to the accident. The altimeter sub-scale was set to 982mb whereas it would be normal to set the altimeter to the Portree Regional Pressure Setting of 973mb. Examination of the Inverness, Benbecula and Stornoway QNH settings at around the time of the accident shows that the 982mb setting would have given a reasonably realistic altitude of around 2,700 feet. The Portree setting would have shown the aircraft to be approximately 270 feet lower but with the highest terrain in the area being 3,460 feet above mean sea level it is unlikely that the pilot was flying in with an incorrect altimeter setting believing himself to above the terrain.

Ground witness marks and the artificial horizon indicated that the aircraft was in a slight right bank with cruise power set. The impact was apparently in level or slightly descending flight. It is likely that the aircraft was under control and unlikely that any action had been taken by the pilot to avoid hitting the mountain. Thus it is improbable that the occupants had seen the high ground before impact.

The possibility that strong winds on the day might have created up-draughts or down-draughts that were beyond the performance capability of the aircraft to counter was considered. Whilst this possibility exists, the indications derived from the wreckage, suggesting controlled flight at impact, makes this possibility remote. It is more likely that the pilot experienced conditions of reduced visibility, either in cloud or in a shower, before impact. The slight descent and low bank angle might indicate an attempt to descend clear of cloud, but it is equally possible that the aircraft had inadvertently entered a shower and the pilot was trying to route to the north to clear the shower. The radar returns indicating rainfall in the area at around the estimated time of the accident support this hypothesis. Although the exact amount of snow that was on the mountain on the day of the accident is not known, it is possible that the pilot failed to see the mountain due to 'white out' conditions in a snow shower.

The search and rescue effort began at 1500 hrs just over 4 hours after the aircraft's ETA at Benbecula and not long before sunset. If the pilot had filed a VFR flight plan in accordance with the advice in the UK AIP, overdue action would have started 30 minutes after the scheduled ETA

and it is possible that the wreckage might have been found earlier. The lack of an ELT further hampered the search and rescue effort. Whilst this accident was not survivable, the search and rescue effort for G-BHPX contrasts sharply with a similar accident to a Cessna 172 that crashed in the Cairngorms on 25 January 2001. The Cessna 172 was fitted with an EPIRB transmitting on 121.5 MHz and 243.0 MHz and, although the survivors were unaware of the EPIRB's existence, the emergency signal was received by SARSAT and alerted rescue aircraft were able to locate the wreckage by homing on the EPIRB signal. The survivors were rescued within three and a half hours of crashing. [Note: details of that accident will be published in a future AAIB Bulletin].

Safety recommendation

Compared to the total number of private light aircraft flights made annually within the UK, relatively few are made over remote terrain or beyond 10 miles from the coast. Only a small percentage of these flights result in accidents or even forced landings. Nonetheless carriage of an ELT in the event of an accident occurring in a remote area has the potential to safe life, reduce search and rescue costs and reduce anguish for relatives of missing occupants. Given the average population density of the UK and the relatively small number of flights over remote areas it would not justify the cost and effort of fitting EPIRBs to all existing UK light aircraft. However, this accident and the later similar accident to a C172 in the Cairngorms, highlight the desirability of aircraft flying over such areas to carry a PLB or be fitted with an EPIRB. The following recommendation is therefore made:

Recommendation 2001-51

The CAA should advise pilots flying in the private category whose intended route takes them over sparsely populated areas or in areas where search and rescue might be difficult that their aircraft should either be fitted with an approved EPIRB or they should carry an approved PLB that can be automatically activated on impact or manually activated by survivors.