ACCIDENT

Aircraft Type and Registration:	Zenair CH 601HD Zodiac, G-BVPL
No & Type of Engines:	1 Continental Motors Corp O-200-A piston engine
Year of Manufacture:	1996
Date & Time (UTC):	30 December 2007 at 1548 hrs
Location:	Near Selkirk, Scottish Borders
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Destroyed
Commander's Licence:	Private Pilot's Licence (A)
Commander's Age:	65 years
Commander's Flying Experience:	310 hours (of which 130 hours were on type) Last 90 days - 11 hours Last 28 days - 1.5 hours
Information Source:	AAIB Field Investigation

Synopsis

After a local flight lasting approximately 50 minutes from Midlem Airstrip, control of the aircraft was lost and it crashed approximately ½ nm from the airstrip. It impacted the ground in an area of gorse bushes at relatively high speed and in a nose-down attitude. The weather in the area at the time was both unlikely to have been suitable for VFR flying and highly conducive for carburettor icing. No technical or medical causal factors were identified during the investigation.

History of the flight

The pilot had told his family that he intended to carry out a local flight, possibly as far south as the Otterburn danger area as it would be closed during the holiday period. He checked the weather and NOTAMS in the morning using the internet, before leaving home for Midlem airstrip, where he had based his aircraft for the previous two years. During the morning, the airfield owner noticed the pilot's car was by his hanger and went to speak with him; the pilot was just finishing refuelling his aircraft and they had a short conversation.

Around noon, G-BVPL departed Midlem. A microlight pilot at Huntleywood private strip, some 10 nm to the northeast of Midlem, heard the noise of an aircraft engine which he judged as being made by a Continental engine. He saw an aircraft of similar size to G-BVPL, apparently cruising normally, twice in a ten minute period at around 1240 hrs. At 1545 hrs, some 2½ hours after the accident, two dog walkers

discovered the wreckage of G-BVPL in a thick area of gorse, approximately ½ nm from Midlem airstrip. They could see the pilot in the wreckage and called to him, but received no reply. One of them then ran to the nearest house and contacted the emergency services and the airfield owner, who was quickly on the scene. Despite the strong smell of fuel and the risk of fire, they managed to force their way through the gorse to the aircraft, but it appeared to them that the pilot had been fatally injured.

Pilot's history

The pilot had held a PPL since 1997, but had flown relatively infrequently for several years after gaining his licence. However, he began flying on a regular basis since purchasing G-BVPL in 2005, completing some 130 hours in the two years prior to the accident. A considerable number of the 130 hours had been spent operating G-BVPL from Midlem.

A post-mortem examination revealed no evidence of a medical nature which could have been causal in the accident, and that this was a non-survivable accident.

Airfield information

Midlem is a grass airstrip, 600 ft amsl, located at the western end of the Tweed valley, in southern Scotland. To the north, within 500 m of the runway, the ground rises sharply to a ridge some 200 ft aal. The main runway is orientated 24/06 and is 2,000 ft in length. There is a secondary strip 23/05, also 2,000 ft in length, for use in strong crosswinds.

Weather

The pilot is reported to have checked the weather in the morning using the Met Office website. During his brief discussion with the airfield owner, the local weather was mentioned and there is no reason to believe the pilot had not made himself aware of the weather forecast for the Midlem area.

Aftercast

An aftercast was obtained from the Met Office and compared with the forecast conditions and reports from other pilots operating in the area.

The general weather situation at 1200 hrs was an occluded front running north-south and moving east across the Scottish Borders. By 1600 hrs, the front would have been a short distance to the southwest of the accident site. During the time between takeoff and the wreckage being discovered, the accident site would have experienced variations in the weather conditions between dry periods to slight drizzle. The high ground in the vicinity was likely to have been covered in patches of cloud (hill fog). The visibility was probably in the region of 20-30 km in the east and around 2,000 m closer to the occlusion. In hill fog, the visibility may have been 200 m. Cloud cover was considered to have been, at best, patches of stratus with a base of 1,100 ft amsl, with broken or overcast stratocumulus base 2,500 ft amsl. It is possible that, on occasions, cloud cover could be scattered or broken stratus at 900 ft amsl. The poorer conditions were reported as being likely towards the end of the period (1600 hrs) and the estimated winds were light and variable. Using the airfield at Midlem as a reference, at 1,000 ft agl the temperature was estimated at +2.6ºC and the dewpoint -1.1ºC, giving a relative humidity of 77%. This relative humidity would have risen to 86% at 1,500 ft and 97% at 2,000 ft.

Pilot report

The airfield owner, himself a pilot, stated that in his estimation the weather started to close in around 1200 hrs to 1230 hrs, such that he could no longer see the hills

(some 20 km to the south) by 1400 hrs. At that time, the cloudbase was very low and it had started to drizzle.

Flight plan and communications

The pilot of G-BVPL did not file a flight plan, and was not required to do so. According to the airfield owner, the pilot's normal practice was to maintain a listening watch on the Scottish Information frequency; no ATC agency reported any communications with G-BVPL on the day of the accident. The airspace surrounding Midlem is uncontrolled and radar coverage in this area is poor at low levels. As G-BVPL returned to the area of Midlem airstrip it is likely that the pilot would have changed frequency to the local Safetycom[1]. This frequency is unmonitored and any distress call would have relied on another pilot being in the local area on the same frequency.

Accident site examination

The aircraft had come to rest nose-down in a gorse thicket on the summit of a small hillock. There were no witness marks on the land surrounding the thicket to indicate that the aircraft had touched down prior to the thicket. The gorse bushes surrounding the aircraft were undamaged. After clearing the gorse to allow access, examination revealed that the right wing had been subject to a relatively uniform load which had crushed the leading edge, Figure 1; its inboard trailing edge section and aileron had been buckled under a compressive load. The left wing exhibited two areas of damage to the leading edge, one just outboard of the left main landing gear, caused by impact with a large gorse bush, the other the left wingtip, which had been subject to a significant impact. The rear section of the left wing, outboard of the landing gear, had been

Figure 1

Photograph illustrating impact damage to the wings and forward fuselage

Footnote

[1] Safetycom is a radio frequency that pilots may use to announce their intentions in the absence of any ATC/ATIS/AG unit.

pulled away from the inboard section of the wing and the rear fuselage and tail had been bent upwards and to the right. The main landing gear was undamaged and no evidence was found to indicate that they had made contact with either the gorse or the surrounding field prior to the impact. The engine had been pushed upwards and rearwards, causing severe damage to the bulkhead and the forward area of the cockpit.

There was a strong smell of fuel at the accident site and there was clear evidence of fuel contamination of the soil. The propeller was found to be relatively undamaged, with one blade broken from the hub; there was no evidence of propeller/engine rotation at impact. The subscale setting of the barometric altimeter was 1008 hPa, and the ASI was showing 55 kt.

Detailed wreckage examination

Inspection of the aircraft's flight controls showed no evidence of pre-impact damage or restriction. Examination of the cockpit revealed that, although the magneto switch was selected to BOTH, the fuel tank selector valve was in the OFF position. The aircraft was fitted with two throttle controls, one on each side of the instrument panel. The control on the left side of the aircraft was found in the fully forward position with its friction lock fully applied.

Examination of the engine showed that it had not suffered from any major mechanical failure and that the carburettor butterfly valve had been in the fully open position at impact. At the accident site, the carburettor air heat control was found in the COLD position. However, examination of the remains of the carburettor air intake showed that it was probable that the heat valve had been in the HOT position at the time of impact, despite the position of the cockpit control. Carburettor heat is selected to HOT by pulling the control knob away from the instrument panel and the control is not fitted with a locking device. The disparity was considered to have been the result of the significant disruption of the forward fuselage. The aircraft had been fitted with a carburettor intake temperature gauge which, when tested, was found to function correctly. The engine's magnetos were removed but damage prevented functional tests being carried out. Strip examination revealed no evidence of any pre-impact mechanical/electrical failure within either unit.

The fuel selector valve fitted to the aircraft was a four-position unit which allowed the selection of fuel from the left, right and main fuel tanks or to OFF. The valve was found to move freely between the three fuel tank positions but, in order to select OFF, it is necessary to lift a knob whilst turning the selector. No evidence was seen of any pre-impact fault with this valve, or of any evidence that it had been forcibly moved to the OFF position in the impact. A general examination of the fuel system revealed no evidence of any pre-accident defects.

Disassembly of the artificial horizon revealed the presence of witness marks on the unit's gyroscope consistent with it having been spinning at the time of the impact. The remaining flight instrumentation also appeared to have been serviceable.

Recorded information

A GPS receiver, a Garmin GPSmap295, was recovered from the aircraft. The unit was damaged, preventing normal download; however, the recorded GPS track was recovered with the assistance of the BEA[2]. The aircraft's ground speeds were derived from the position and timestamp data recorded. All times quoted are UTC.

Footnote

[2] Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA), the French equivalent of the AAIB.

The aircraft departed from Midlem airstrip at 1222 hrs and carried out the flight as shown in Figure 2. As it returned to the airstrip, the recording showed a slow descent starting at 2,200 ft amsl, 28 km from the runway, which averaged around 100 ft/min. Approximately 2.5 km from the airstrip, on a track not in-line with the runway, the descent rate started to increase and the ground speed, which had been steady at approximately 90 kt, started to reduce. Between 44 and 49 seconds later, a left turn was initiated during which the ground speed reduced to 48 kt. This was followed, during the last five seconds, by an increase in ground speed.

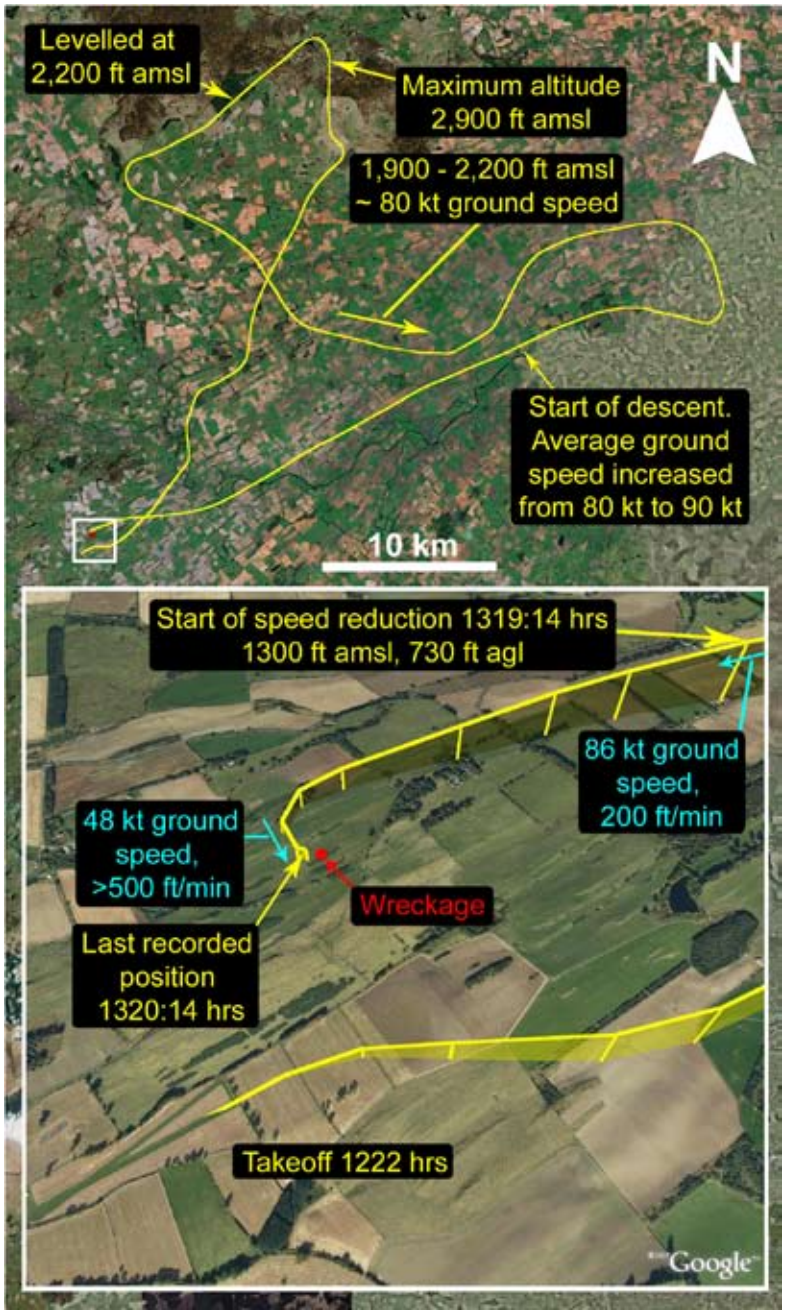

Figure 2

Google Earth ™ mapping service / Large image -
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The recorded track ended just short of the wreckage site. The derived altitude rate indicated a steady descent rate of approximately 500 ft/min. However, whilst the lateral manoeuvre described by the last few points of the track were consistent with reaching the wreckage point before the next GPS track sample could be recorded, the derived altitude rate is inconsistent with this, requiring a doubling of the descent rate after the track finished and before impact. GPS vertical accuracy is not as good as its lateral accuracy under normal conditions. During the final turn, the GPS would have been losing and reacquiring use of satellites, as the right wing effectively blocked the signal path of satellites near to the horizon. These factors make the final trend in derived altitude rate unreliable. It is likely that the average descent rate was nearer to 1,000 ft/min during the final turn and that the GPS track terminated within approximately one second of the impact.

Analysis

Engineering aspects

The damage to the aircraft was consistent with it being in a nose-down attitude, and travelling at a relatively high speed, when it struck the ground. It appeared to have made contact initially with the gorse with its left wing tip, which resulted in it rotating about the left wing and causing the nose and the right wing leading edge to strike the ground heavily. The witness marks found on the artificial horizon gyroscope confirmed that it had been spinning and that the instrument was probably operating correctly when the aircraft struck the ground. The setting of 1008 hPa on the altimeter subscale would, given the atmospheric pressure in the region at the time of the accident, have been appropriate for operation from Midlem airstrip.

No evidence was found to suggest that the engine had suffered from a mechanical failure prior to impact and the position of the carburettor butterfly valve at impact suggests that the pilot had selected maximum power. As there was no evidence of pre-impact damage to either magneto, a complete failure of the engine's ignition system is considered unlikely but, as the units could not be tested, it cannot be entirely discounted.

Given the lack of rotational damage to the engine and the fuel selector being found in the OFF position it is almost certain that the engine was not producing any significant power at the time of impact. The design of the fuel selector valve, which prevents the inadvertent movement to OFF, and the lack of any evidence that it had been forcibly moved to that position in the accident, strongly suggests that the pilot deliberately turned off the fuel prior to the accident. The strong smell of fuel and fuel contamination of the soil around the wreckage indicated that the aircraft had not run out of fuel.

Whilst the carburettor temperature gauge fitted to the aircraft would have given the pilot an indication of the possibility of carburettor icing, the weather conditions prevalent at the time of the accident were conducive to the formation of carburettor icing over a very wide range of power settings, including cruise power[3]. The position of the carburettor hot air valve confirmed that carburettor heat had been selected at some point prior to the impact. Any periodic application of carburettor heat for short periods of time (typically less than 10 to 15 seconds) during cruise power checks, may not have been sufficient to completely remove any accumulated ice, given the temperature and relative humidity conditions in which the aircraft was operating. Any build-up of carburettor icing would probably have resulted in the engine losing power and running roughly; the application of carburettor heat in

Footnote

[3] Ref: CAA Safety Sense Leaflet 14, *Piston Engine Icing*.

this situation would result in an increase in the rough running and further power loss, until all of the ice had dissipated. However, with the engine at low power, the effectiveness of carburettor heat would have quickly diminished as the engine exhaust manifold cooled. In the event of a significant build-up of ice, it is possible that the engine may have stopped before any ice could be cleared.

In summary, no evidence was found to suggest that the aircraft had suffered any pre-accident technical defects. There was no evidence of any engine power at impact, but the aircraft had not run out of fuel. It was concluded that the fuel selector valve had been moved to OFF by the pilot prior to the impact, possibly as part of a 'crash' drill.

Operational aspects

The weather at the time of departure was almost certainly suitable for a short local flight. However, with the worse weather approaching from the west there was a reasonable risk of G-BVPL becoming 'weathered-out' from Midlem. There were a number of other suitable airstrips further east and, indeed, it appears the pilot overflew Huntlywood twice during his flight.

The pilot was operating without a flight plan, although one was not required, and was not in communication with any ATC unit. He had left no definite plan of his route at his point of departure, and no note of either planned duration or fuel on board. Although this accident was non-survivable, had the pilot not received fatal injuries overdue action may not have been commenced within time to effect a rescue, as no indication of the time of return or the nature of the flight was available to potential rescuers. The ability to operate freely in the open FIR brings with it an increased risk to pilots/passengers should an accident occur. It is up to individual pilots operating in remote areas to determine how much risk they wish to bear and choose the risk mitigation strategy best suited to themselves.

The GPS recorded flight path appears to show a descending turn as the final flight manoeuvre. This may have simply been, for example, the pilot's attempt to turn back into what little wind there was in order to carry out a forced landing. However, had significant reduction in the available power occurred, this would have removed an option for the pilot to fly to a landing area with better weather and escape from conditions that may have been unsuitable for visual flight.

Other reasons considered for the descending turn were that the pilot could have been making an avoiding manoeuvre due to a real or perceived threat, or that loss of control occurred due to poor visibility or entry into full IMC.

Conclusions

In the absence of any pre-impact technical defect being identified from the examination of the wreckage, it was concluded that the pilot may have lost control of the aircraft after entering IMC or an area of poor visibility. It was also considered possible that the engine lost power due to the effects of carburettor icing, resulting in an attempted forced landing, and which would have precluded a diversion to an airfield with more suitable weather conditions.