

## ACCIDENT

<b>Aircraft Type and Registration:</b>	Piper PA-28-140 Cherokee, G-BHXK	
<b>No &amp; Type of Engines:</b>	1 Lycoming O-320-E2A piston engine	
<b>Year of Manufacture:</b>	1965 (Serial no: 28-21106)	
<b>Date &amp; Time (UTC):</b>	4 April 2015 at 1030 hrs	
<b>Location:</b>	Near Loch Etive, Oban, Argyll and Bute	
<b>Type of Flight:</b>	Private	
<b>Persons on Board:</b>	Crew - 1	Passengers - 1
<b>Injuries:</b>	Crew - 1 (Fatal)	Passengers - 1 (Fatal)
<b>Nature of Damage:</b>	Aircraft destroyed	
<b>Commander's Licence:</b>	Private Pilot's Licence	
<b>Commander's Age:</b>	28 years	
<b>Commander's Flying Experience:</b>	150 hours <sup>1</sup> (of which 100 were on type) Last 90 days - 62 hours Last 28 days - 19 hours	
<b>Information Source:</b>	AAIB Field Investigation	

## Synopsis

The aircraft was on a private flight from Dundee Airport to Tiree Airport. While established in the cruise at an altitude of 6,500 ft it entered a gentle right turn, the rate of which gradually increased with an associated high rate of descent and increase in airspeed. The aircraft struck the western slope of a mountain, Beinn nan Lus, in a steep nose-down attitude. Both persons on board were fatally injured.

No specific cause for the accident could be identified but having at some point entered IMC, the extreme aircraft attitudes suggest that the pilot was experiencing some form of spatial disorientation and the recorded data and impact parameters suggest that the accident followed a loss of control, possibly in cloud.

## History of the flight

The pilot had arranged to fly to Tiree with his wife for a family visit, departing on Saturday, 4 April, the day of the accident, and returning on Monday evening. They were recorded on CCTV arriving at the airport with luggage and some boxes, which they loaded into the aircraft. The pilot spoke briefly to the duty instructor at the flying club, where he kept his aircraft, but did not use their flight planning facilities as he had his own flight planning application on his iPad. This provided the capability to enter the route from Dundee to Tiree

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### Footnote

<sup>1</sup> The pilot's first log book was not available to the investigation and the total hours stated are derived from a number of sources.

and access the relevant information such as weather and NOTAMs. It was later established from the software provider that the pilot had accessed the web site on 3 April 2015, the day before the accident, and again on the morning of the accident flight. It was not possible to establish the times or activity carried out during those sessions.

The weather that morning is covered in detail in the Meteorology section of this report, but the pilots of several other aircraft who had considered flying west from Dundee, elected not to do so due to the presence of a warm front over the west coast of Scotland. The pilot's wife had contacted a relative in Tiree the evening before the flight and on the morning of the flight texted the relative asking what the weather conditions were like. When she was told it was misty she responded that the pilot had checked the weather and had said that it was due to clear at 1100 hrs, although it was not stated whether this was local time or UTC. The relative sent a picture of the conditions to the pilot's wife.

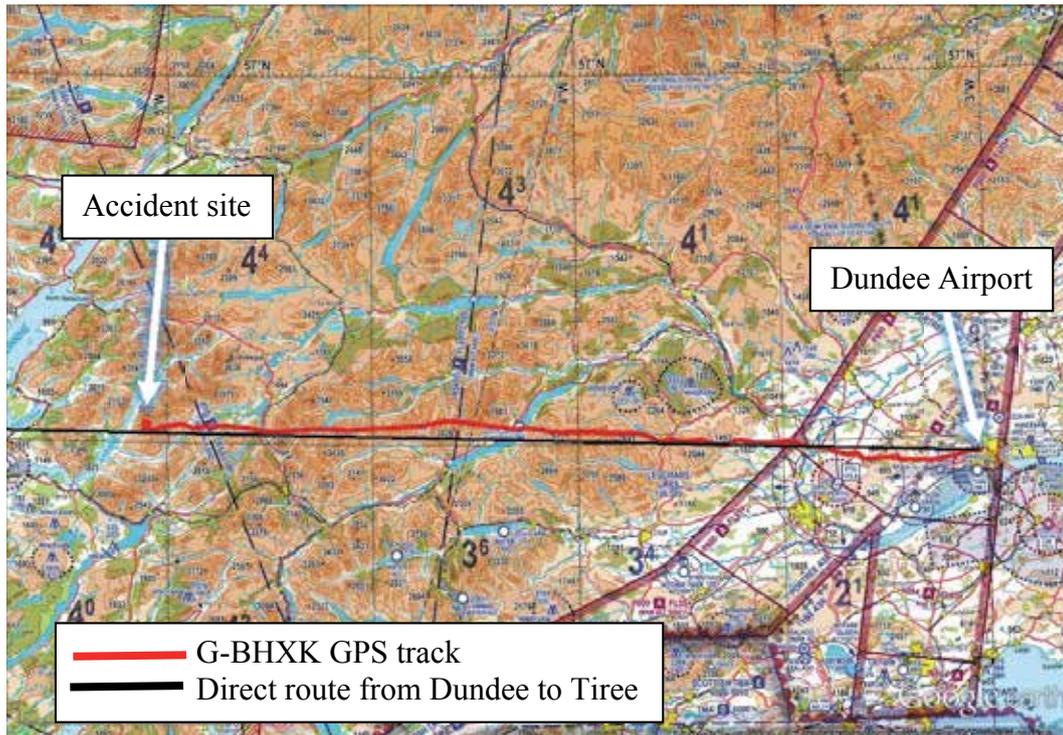
Having loaded the aircraft, the pilot taxied the aircraft to the refuelling point, where one of the flying club instructors filled both wing tanks to full. Having signed for the fuel, the pilot started the aircraft and requested taxi for a flight to Tiree, with two persons on board and five hours endurance. This was approved and the aircraft taxied in accordance with ATC instructions to Holding Point Alpha before being cleared to line up on Runway 27. The aircraft was cleared for take-off and departed Dundee at 0938 hrs. It climbed to 6,500 ft and the pilot contacted Scottish Information at 0948 hrs. The aircraft was allocated a transponder code 7401, Mode C and received a basic service. The pilot also made a brief courtesy call to the AFISO at Perth on his other radio, to make him aware of the aircraft's position, height and routing.

The aircraft was fitted with a Garmin 295 GPS navigation system, which the pilot normally used to enter his route and he also carried a 1:500,000 aviation chart covering the route to be flown.

The aircraft continued on its westerly track (Figure 1), maintaining the same altitude on the regional QNH of 1023 HPa.

At 1027 hrs G-BHXX was approximately 15 nm east of Oban Airport, when a commercial aircraft inbound for Tiree contacted Scottish Information who transmitted the 0950 hrs Tiree METAR; "THE TIREE 950 IS AN AUTOMATIC METAR, SURFACE WIND THREE ZERO ZERO ONE TWO KNOTS, VISIBILITY THREE THOUSAND EIGHT HUNDRED METRES IN MIST, OVERCAST AT TWO HUNDRED FEET, THE SYSTEM UNABLE TO DETECT TOWERING CUMULUS OR CB, TEMPERATURE PLUS NINER, DEW POINT PLUS EIGHT AND THE TIREE QNH 1025 ". The pilot of the commercial aircraft responded, "WE'LL NOT BE GOING THERE THEN, QNH 1025, AND THAT'S 950, AS I SAY WE'LL GIVE YOU A CALL BACK IN TEN MINUTES OR SO JUST TO SEE IF YOU'VE GOT THE LATEST". This was monitored and also acknowledged by the pilot of G-BHXX who transmitted "THANKS VERY MUCH, GOLF XRAY KILO".

At 10:28:28 hrs, as the pilot of G-BHXX acknowledged the weather report, the aircraft commenced a gentle turn to the right, maintaining its altitude. After some 40 seconds, the rate of turn increased and the aircraft entered a tightening turn to the right, with a significant rate of descent. If not already in cloud, at some point during the descent the aircraft would have entered IMC which would have persisted all the way to the ground.



**Figure 1**

1:500,000 chart showing MSA, G-BHXX track (red) and direct route to Tiree from Dundee (black)

Later analysis of the recorded data showed that, with the extreme attitude and rapid change of direction, the accuracy of the radar-derived and GPS-derived track and height information became unreliable. It is possible that a final 360° tight turn was completed before the aircraft impacted the ground at high speed on a westerly heading.

The SAR helicopter which was deployed from Prestwick to search for G-BHXX was unable to reach the accident site due to the low cloud base in the area. Following its search, the helicopter climbed to 4,000 ft for the return flight to Prestwick. The commander of the helicopter noted that they were VMC 'on top' of the layer of stratus cloud at that altitude but that there were cumulus clouds appearing to break through the top of the stratus layer.

### **Pilot qualifications and experience**

The pilot had started flying training on 11 April 2012 and his PPL was issued on 10 June 2014. He held a Class 2, Joint Aviation Authorities Medical Certificate with no limitations, issued on 18 May 2012 and valid to 18 May 2017. He commenced his IMC rating training on 3 November 2014 and successfully passed the flight test on 31 January 2015. He completed his Night Rating test on 27 March 2015. At the time of the accident, the pilot had not submitted the forms to the CAA to have the IMC and Night Ratings endorsed on his licence.

Whilst on holiday abroad in December 2014, the pilot's Flying Log Book was stolen and he started a new log book with the first entry on 3 November 2014. The investigation was

unable to establish accurately his total flying hours but these would have been in excess of the 130 hours recorded in his training records, known previous flights and his new log book.

It was reported that, during his IMC training and his test, the pilot had demonstrated an above average standard and had been keen to experience actual IMC rather than flying under a 'hood' or 'foggles'. His instructor could not recall the pilot ever having experienced any spatial disorientation episodes during the course. The course included recovery from unusual attitudes and again, the pilot had demonstrated a good level of ability. The same instructor had accompanied the pilot on a cross-country flight in IMC during which the pilot had been operating a radio or navigation system and the aircraft had entered a gentle right turn. The instructor made the pilot aware of his deviation from heading, which he promptly corrected.

The pilot had previously demonstrated a responsible approach to poor weather when, on a flight to Tiree, the weather had deteriorated after his arrival. Instead of attempting to fly back, his wife travelled on a commercial flight to Dundee to attend her work and the pilot waited for an improvement in the weather before departing.

### **Aircraft history**

The aircraft was built in 1965 and accumulated in excess of 8,700 flight hours at the time of the accident. The aircraft's registration records indicated that it was first registered in the United Kingdom in 1980, since when it had five changes of ownership, with the final owner (the pilot) acquiring it in July 2014. The engine installed in the airframe was constructed in 1990 and had achieved approximately 1,300 hours since its last overhaul. The engine was removed in July 2012, at around 1,180 operating hours, due to worn camshaft lobes and, following repair, was re-installed in October of the same year. During the repair, a modification was embodied that increased the engine power from 140 to 160 hp.

The aircraft documentation included engine and airframe log books, which indicated that the most recent maintenance was an Annual Inspection, carried out on 2 December 2014. In addition there was an Airworthiness Review Certificate that was valid until 7 July 2015. The log book entries contained no records of flights after 4 November 2014 (the last flight before the Annual Inspection). Inquiries suggested that flights were routinely recorded in a separate log, before being periodically transferred to the aircraft log books. The pilot's flying log book indicated that he had flown G-BHXX on at least 12 days between 4 November 2014 and 25 February 2015, sometimes with two or three flights per day, which totalled more than 21 hours.

### **Accident site details**

The aircraft crashed on the down-slope on the western flank of Beinn nan Lus at an elevation of approximately 500 m amsl. The distribution of the wreckage indicated that the impact track was approximately 265°M. The terrain was rugged, with the ground consisting of grass-covered boggy earth, with outcrops of rock. The slope in the area of the impact was approximately 20° and was aligned with the impact track. The flight path angle, assessed from items such as the wing tip structural components that had penetrated the ground, was around 20-25° relative to the local slope, so the dive angle

of the aircraft was probably around 45°. A small number of airframe fragments had been ejected up to around 20 m rearwards from the impact point, with a large quantity of debris being projected some 60 m down the track.

The impact was severe, with the bulk of the airframe being brought to a halt in the soft earth over a distance of 1-2 m. This had resulted in the disintegration of the airframe, with chordwise crumpling of the wing structure releasing the upper skins of each wing. There was similar longitudinal crushing of the fuselage, resulting in the door separating into two pieces and being found a few metres beyond the fuselage. The empennage had sustained the least damage and had landed on top of the main wreckage.

Forward of the wing leading edges, the aircraft had fragmented in the impact, with debris from the cockpit, including instruments and flying control components, forming the bulk of the wreckage items downhill from the impact point. The engine had penetrated the earth to a depth of around 0.8 m before striking a large rock. This had resulted in extensive damage to the underside of the crankcase and the removal of the carburettor and air box, together with other accessories, including the magnetos, from the rear of the accessory gearbox. The remaining bulk of the engine had emerged from the crater it had made and rolled some 35 m down the hillside. The propeller had become detached at impact and was found close to the engine; the blades had sustained chordwise scuffing, with significant damage to one leading edge, indicating that the engine was developing power at impact.

The disruption of the wreckage was consistent with a high-speed impact, likely to have been considerably higher than the maximum cruise speed of around 125 kt. The disposition of the wreckage, with the ground marks and probable dive angle, indicated that the aircraft struck the ground in an upright attitude, with a small amount of roll to the left. The wing tip fairings had remained in the holes in the ground they had made at impact and the distance between them was 30 ft, the wingspan of this aircraft type. It was thus concluded that there had been no significant airframe overload distortion prior to impact, such as might have resulted from a violent flight control input.

Following the on-site examination the wreckage was collected together and air-lifted by helicopter to the base of the mountain, from where it was taken to the AAIB's facility at Farnborough.

## **Detailed examination of the wreckage**

### *General*

The wreckage was subjected to detailed examination of the structure, flying controls, engine and as many of the instruments as could be identified. The investigation was hampered by the severe damage to the aircraft that had occurred during the impact. All the structural failures were identified as being the result of the ground impact, with no evidence of a pre-impact structural failure. Despite the damage to the wing skins, the fuel filler caps had remained in place.

The pieces of the door were examined and the damage to the latch mechanism indicated that the door was closed at the time of the impact.

### *Flying controls*

The primary flight controls on this aircraft type are conventional and simple, with a cable system used between the cockpit controls and the surfaces. The cables had remained attached to the surfaces but had sustained overload failures in the areas of maximum disruption, close to where they had been attached to the rudder pedals and control yokes. It was concluded that there had been no pre-impact disconnect.

The elevator trim system consisted of a trim tab operated by a handle in the cockpit roof. The handle was connected via a cable loop to a screwjack mounted below the rudder; the jack was in turn connected to the tab. The nature of the impact would have relieved the tension in the cable circuit, thus tending to preserve the pre-impact setting. This was found to be in the approximate neutral position.

The flap operating lever, together with the ratchet/detent plate at its base, had been heavily damaged in the impact. A roller that engaged with a detent at each flap position was missing and there was no compelling evidence as to which setting had been engaged prior to the impact. However, the flap positions relative to the (heavily distorted) wing trailing edges suggested they had been retracted at impact.

### *Engine*

Due to the engine damage it was not possible to determine the position of the carburettor heat control or to test the magnetos.

Through a hole in the crankcase underside it was apparent that the forward end of the crankshaft had been bent through an angle of around 15°, causing it to fracture the crankcase around the front journal bearing. The spark plugs and cylinders were removed and examined. The plugs were normal in appearance, as were the combustion deposits on the piston crowns and cylinder heads. The cylinder bores were free from scores or any other evidence of pre-impact distress. Removal of the accessory gearbox cover revealed that the gear wheels were still in mesh. The crankcase was split to gain access to the internal components and it was found that the bearings and inserts, the camshaft lobes and cam followers were all in good condition, with no evidence of pre-impact mechanical distress or lubrication failure.

### *Cockpit*

The extreme damage to the instrument panel and instruments meant that there was little meaningful or reliable information to be obtained from them. The altimeter subscale was found to be set to approximately 1023 HPa, which was the Regional QNH.

The face of the airspeed indicator had become separated from its mechanism: a straight scratch on the surface was roughly aligned with the 180 kt area of the scale, although there was no evidence that confirmed the mark had been made by the indicating needle at impact. The attitude indicator had been severely crushed and it was not possible to establish an impact attitude indication. The instrument contained a gyroscope, powered by suction generated by a vacuum pump mounted on the engine accessory gearbox. Disassembly

of the pump revealed that some of the spring-loaded carbon vanes were fractured but the lack of small fragments indicated they had not been rotating in this condition, so the vane damage is likely to have occurred at impact.

Indication of the vacuum pressure (suction) generated by the pump is provided by the suction gauge; the front face of this instrument, together with its aneroid capsule, were recovered and the indicating needle was found between 4 and 5 psi. This represented a typical in-flight value, although there was no supporting evidence that it was a pre-impact indication.

Most of the fuel pressure gauge was recovered, with the indicator needle approximately in the centre of the green 'operating range'. This was a 'moving coil' type of instrument, the delicate mechanism of which does not lend itself to the preservation of evidence. However, the needle had been firmly pressed onto the scale by an object striking the front of the instrument and, as with the suction gauge, the indication was a typical in-flight value.

The fuel selector on this aircraft type is a rotary knob operating a three-way valve and is located on the left wall of the cockpit. It is used to select fuel from either the left or right wing tanks. Thus the three available selections are LEFT, RIGHT and OFF. In this case the impact had destroyed the selector knob, and had broken off the right tank feed line fitting from the valve body. Examination of the component indicated that the left tank was selected at the time of the impact.

In summary, the examination of the wreckage did not provide any evidence of an aircraft defect before the impact with the ground.

### **Meteorology**

On the day of the accident, the surface analysis charts valid at 0600 and 1200 showed a high pressure system centred to the west of Ireland. A warm front orientated north-south was moving eastwards, affecting western Scotland, and at the time of the accident was passing over the area of the accident site. The weather on the east coast of Scotland was good, following the passage of an earlier occluded front. The METARs for Dundee (EGPN) covering the time of departure were:

METAR EGPN 040920Z 26007KT 9999 FEW049 08/05 Q1023=

METAR EGPN 040950Z 24007KT 9999 FEW049 09/06 Q1023=

These indicated a light westerly wind with visibility in excess of 10 km and 1 to 2 oktas at 4,900 ft.

There were no TAFs available for Tiree and Oban at or before the time of the accident. The Islay (EGPI) TAFs were probably the closest representative forecasts for the destination airfield and these were:

TAF EGPI 040501Z 0406/0415 28008KT 6000 BKN010 TEMPO 0406/0412 3000 BR BKN005 PROB30 TEMPO 0406/0410 0600 FG BKN001 PROB40 TEMPO0412/0415 4000 BR BKN008=

TAF EGPI 040800Z 0409/0418 28007KT 6000 FEW010 BKN015 TEMPO 0409/0410 0600 FG BKN000 TEMPO 0410/0412 3000 DZ BR BKN005 PROB40 TEMPO 0412/0418 4000 BR BKN008=

These TAFs, which would have been available to the pilot, indicated a visibility of 6,000 m with a significant cloud base of 1,500 ft, with temporary reductions to 600 m in fog and cloud to the surface until 1000 hrs, with temporary reductions of visibility 3,000 m in drizzle and mist and cloud at 500 ft at the time of the accident.

Tiree was recording auto METARs throughout the period, which were available prior to departure and, when airborne, through Scottish Information. The winds were north-westerly at about 10 to 12 kt. The visibility was variable and at the time of departure from Dundee the visibility at Tiree was 2,300 m in mist. The cloud base throughout the period of the flight was 5 to 7 oktas at 200 ft, with some observations recording a second broken layer above this at 1,800 ft. The airport elevation is 18 ft.

Oban, the closest airfield to the accident site, had light east to south-easterly winds. The visibility fluctuated between 1,500 and 6,000 m in slight or moderate drizzle. Cloud bases varied throughout the period. At the closest observation of the accident (1020 hrs) the cloud bases were 1 or 2 oktas at 1,000 ft and 8 oktas at 1,200 ft. The 1050 observation showed a deterioration in visibility, with mist developing.

The cloud forecast to the east of the warm front was broken or overcast stratus or stratocumulus, with tops at 4,000 to 7,000 ft, and areas of broken or overcast stratus with tops of 1,000 ft. To the west of the warm front the cloud forecast was scattered or broken (locally 'few' to the lee of mountains) cumulus or stratocumulus, with tops at 4,000 to 6,000 ft, with occasional ('isolated' from 1100 hrs) broken stratus with tops at 1,500 ft.

The freezing level recorded by an aircraft equipped with the Aircraft Meteorological Data Relay (ADMAR) system departing at 1020 hrs from Glasgow Airport was 6,000 ft. At this height, around the cruising altitude of G-BHXX, there would have been a risk of moderate icing in cloud.

### **Weight and Centre of Gravity**

The maximum permissible weight for the aircraft was 2,150 lbs with the Centre of Gravity (CG) datum defined as 78.4 inches ahead of the wing leading edge. The forward CG limit for 1,950 lbs is 86.5 inches aft of the datum and for 2,150 lbs is 90.1 inches aft of the datum. The aft CG limit is 94.0 inches at all weights.

The weight and balance for the aircraft at the time of the accident was estimated from available data as 2,013 lbs with a CG position of 88.25 inches aft of the datum. The aircraft therefore appears to have been operated within its permitted weight and CG envelope throughout the flight.

## Pathology

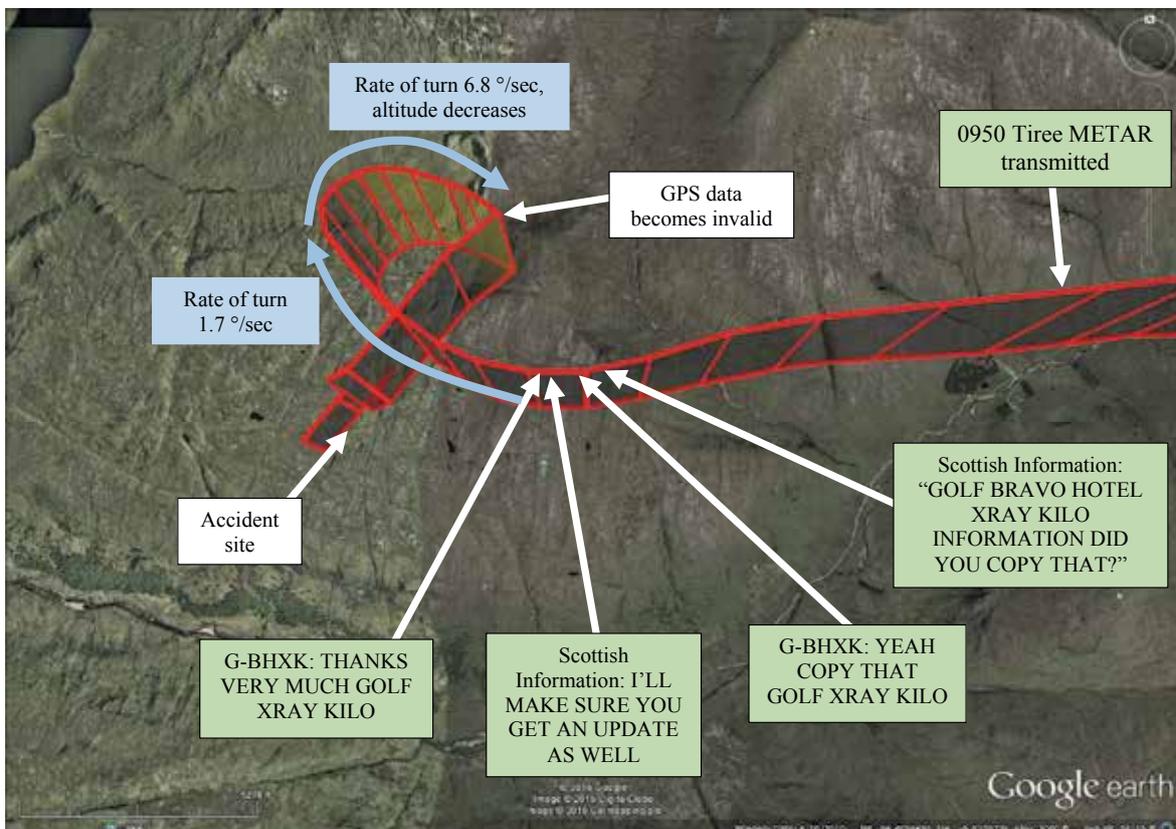
A post-mortem examination established that both persons on board the aircraft died as a result of multiple injuries sustained in a non-survivable accident. There was no evidence of any pre-existing medical condition and toxicological investigation revealed nothing that could have contributed to the accident. The test for carbon monoxide could not be performed.

## Recorded data

The aircraft's flight path was captured on a number of radar heads, recordings of which were provided by NATS. In addition, a Garmin 295 GPS was recovered from the aircraft wreckage which, despite superficial damage, was successfully downloaded at the AAIB. A track log recording of latitude, longitude, GPS altitude and time was recovered for the accident flight. The pilot's iPad was recovered from the wreckage but had sustained too much damage to be downloaded to access flight planning information.

The GPS recording commenced in Dundee at 0931:04 hrs with the takeoff roll commencing at 0938:14 hrs. The aircraft then climbed to 6,500 ft tracking in a westerly direction.

At 1027:39 hrs, when G-BHXX was approximately halfway between Dundee and Tiree, Scottish Information broadcast the 0950 automated METAR from Tiree after a request by another aircraft. At 1028:25, G-BHXX was asked if this information was copied, to which



**Figure 2**

Final stage of the G-BHXX GPS track

G-BHXX replied at 1028:28 hrs “YEAH COPY THAT GOLF XRAY KILO”. At the same time that this transmission was made, the aircraft heading began to slowly increase at an approximately constant rate over the next 38 seconds, from 252°T to 317°T, (1.7°/second). During this time, the recorded altitude remained constant at 6,500 ft but the derived groundspeed reduced from 98 kt to 71 kt.

Just after the heading began to increase, at 1028:31 hrs, Scottish Information advised “I’LL MAKE SURE YOU GET AN UPDATE AS WELL” to which G-BHXX replied “THANKS VERY MUCH GOLF XRAY KILO” at 1028:33 hrs.

At 1029:08 hrs, the rate of turn and groundspeed began to increase and the altitude decreased, with the final valid GPS position recorded 21 seconds later. At this point, the aircraft’s heading was 123°T, representing an average rate of turn over the 21 seconds of 6.8 °/second. After 1029:08 hrs, the recorded GPS position and altitude became erratic and unreliable. In previous accidents investigated by the AAIB, when an aircraft enters a tight turn it can lead to obscuration of the GPS antenna by the aircraft structure. This can have an effect on the positional accuracy and, considering the increased rate of turn encountered by G-BHXX, this is likely to have been the case.

The Mode C altitude continued to be recorded by the radar, with the final recording of 3,900 ft at 1029:39 hrs. This gave an average vertical speed during the descent of 5,200 ft/min. With the accident site elevation of approximately 1,250 ft, there may have been an additional turn which was not recorded.

## **Analysis**

### *Engineering*

The examination of the accident site and the wreckage indicated that the aircraft had struck the ground at high speed, in an erect attitude and with a flight path angle of around 45° to the horizontal. The steepness of this flight path suggests that the aircraft was not fully under control at the time, although the lack of significant bank angle could also suggest that the pilot was in the process of recovering from the dive.

There was no evidence of pre-impact structural failure or detachment, or of any flying control disconnect.

Examination of the engine indicated that it had been developing power at impact and that the internal components had been in good condition. Further, evidence from some of the cockpit instruments suggested that the engine had been operating normally. The attitude indicator was too badly damaged to provide evidence as to its indication at the time of the impact; however, the vacuum pump, an essential component in this system, appears to have been operating normally.

### *Prevailing weather conditions for the flight*

The aircraft departed Dundee Airport in fine aviation conditions with a light westerly wind, 1 to 2 oktas of high cloud at 4,900 ft and visibility in excess of 10 km. As the flight progressed

westwards towards Tiree, it would have encountered a deterioration in the weather as it flew towards the warm front which was moving eastwards across the region. From the surface observations, broken and overcast stratus was widely reported from 200 ft at Tiree to 1,400 ft at Oban, and was becoming lower at the time of the accident. Given Oban airfield's elevation of 18 ft and the height of Beinn nan Lus mountain, the accident site, about 12 nm east north east of Oban, would have been in the cloud.

The cloud tops were forecast as 4,000 to 6,000 ft to the west of the front and 4,000 to 7,000 ft to the east. The freezing level was forecast at 6,000 to 8,000 ft but the ADMAR report at Glasgow Airport accurately recorded it at 6,000 ft. There would have been a risk of moderate icing in cloud above this height.

The flight planning application on the pilot's iPad had accessed information on the morning of the accident. It would have provided weather information and, although no TAF was available for Tiree, the TAF for Islay would have been an indication of the forecast for Tiree. The automated METARs for Tiree were available and would have shown the weather was not suitable for a VFR 'surface contact' flight, but a VMC 'on top' transit flight might be achievable, subject to conditions en route and weather at the destination permitting a VMC arrival. The pilot also had a laptop computer and mobile phone with which he may have accessed the Met Office web site but all this equipment was damaged in the accident and the data was not retrieved.

### *The flight*

The pilot had filled the aircraft fuel tanks which, as he had declared to Dundee ATC, gave him five hours endurance. This would have been sufficient to overfly Tiree and, if there was no improvement in the weather, return to Dundee. It is not known whether this was the pilot's intention.

From the forecast tops of the clouds, it is probable that the initial part of the flight was in VMC above the cloud. As the flight progressed to the west and the height of the cloud tops increased it is possible that the aircraft entered IMC. Flying above the cloud would have placed a greater reliance on the Garmin 295 GPS navigation system than on the pilot's 1:500,000 chart and navigation aids such as VOR and DME were available to him, enabling calculation of Minimum Safe Altitudes (MSA).

It is significant that when the Tiree 0950 METAR was passed to the commercial flight at 10:27:38 hrs, and acknowledged by the pilot of G-BHXX at 10:28:28, the aircraft commenced a controlled, and initially level, right turn. It is likely that the pilot realised that it was not going to be possible to continue the flight and decided to return to Dundee or another airfield, although he did not state this to ATC at the time.

Whilst the pilot had successfully completed his IMC rating course and passed the flight test, he had not submitted the documentation to have the rating endorsed on his licence. He was therefore legally limited to flights in Visual Meteorological Conditions (VMC). During the IMC training his instructor could not recall the pilot having suffered any spatial disorientation

and the only instance of a significant deviation from an intended heading was when the pilot was operating a radio navigation system and not fully monitoring his flight instruments.

#### *Loss of control*

The recorded data indicates that the apparently level and controlled turn developed into a spiral dive, consistent with some form of spatial disorientation. In the absence of any evident technical or physiological reason for the descending manoeuvre, it is likely that the aircraft, prior to or during the right turn, had entered cloud or that the pilot had experienced some loss of, or false, visual horizon. The gentle initial right turn is likely to have been the commencement of a deliberate turn back to the east or from the pilot carrying out some cockpit activity, such as adjusting the navigation equipment while not monitoring the flight instruments, as had occurred with his instructor. This in turn may have led to him becoming disorientated.

At the moment of impact, the aircraft was in an extreme nose-down attitude but with the roll attitude almost wings level. This suggests that the pilot had recovered from the turn and was in the process of recovering from the unusual pitch attitude but there was insufficient height available to recover fully.

The aircraft was flying close to the freezing level of 6,000 ft. The aircraft was equipped with pitot heating but no airframe de-icing equipment. Due to the damage to the aircraft, it was not possible to locate the pitot heat selector switch although it was reported that the pilot normally flew with the pitot heat selected ON. Had the aircraft been flying in cloud, the Met Office aftercast indicated that moderate icing was likely at the cruising altitude. Blockage of the pitot system or ice accretion on the airframe could also have been the initiating event for a turn back, to exit the icing conditions, and a deterioration in the aircraft's handling characteristics.

#### **Conclusion**

The pilot was properly licensed to conduct the flight in VMC and the aircraft appears to have been serviceable. No specific cause for the accident could be identified but the descent in IMC with extreme aircraft attitudes suggests that the pilot was experiencing some form of spatial disorientation; the recorded data and impact parameters suggest that the accident occurred following a loss of control, possibly in cloud. Whether this was due to an attempted turn back manoeuvre or simply loss of control in IMC is not known. In addition, the meteorological conditions were conducive to airframe icing, which had the potential to degrade the aerodynamic characteristics of the aircraft and thus may have been a factor in this accident.