ACCIDENT

Aircraft Type and Registration:	DH82A Tiger Moth, G-AOIL
No & Type of Engines:	1 De Havilland Gipsy Major I piston engine
Year of Manufacture:	1940
Date & Time (UTC):	15 May 2011 at 1408 hrs
Location:	Near Witchampton, Dorset
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Serious) Passengers - 1 (Fatal)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	44 years
Commander's Flying Experience:	210 hours (of which 41 were on type) Last 90 days - 3 hours Last 28 days - 2 hours
Information Source:	AAIB Field Investigation

Synopsis

The pilot and a passenger were on a local pleasure flight. The aircraft was seen by observers on the ground to pull up into a loop and during the manoeuvre it entered a spin from which it did not recover. The pilot was not formally trained in aerobatics and had limited experience of spin recovery. The manoeuvre started at 1,500 feet agl and there was insufficient height for the pilot to recover from the subsequent spin. The passenger was seriously injured and died later the same day in hospital. The pilot, who was also seriously injured, survived.

History of the flight

The pilot arranged to take two friends up separately for flights from Compton Abbas Airfield. He arrived at the airfield about an hour before he was due to meet them in order to prepare the aircraft. When he arrived he found that the aircraft had already been flown on a number of flights earlier in the day. No problems had been reported with the aircraft; it had been refuelled, to just below the full tank level, and parked on the apron area.

The pilot met up with his two friends and between them it was arranged that the lighter of the two should go on the first flight. This was because the aircraft was full of fuel and the pilot did not want the weight limit for the aircraft to be exceeded.

First flight

The pilot discussed plans for the first flight with his passenger, which included the possibility of the pilot flying a couple of loops.

The passenger was seated in the front cockpit. The pilot ensured that he was strapped in correctly and gave him a safety briefing. The engine was started after a couple of swings of the propeller, after which the pilot removed the chocks and strapped himself in to the rear seat. He carried out a check of the interphone which was satisfactory.

The aircraft took off at 1302 hrs, climbed to around 2,000 ft amsl, and headed towards Blandford Forum to look at a house the passenger was proposing to buy. The aircraft descended to about 900 ft agl as it passed close by the house and then climbed and flew further to the south, close to an area where a mutual friend of theirs lived. The pilot carried out a clearing turn and a loop at 1,200 ft agl. (Figure 1 depicts a plot of the track with altitude and height profile of the flight.) The aircraft then flew back towards Compton Abbas. One further loop was carried out en-route at 1,600 feet agl. The aircraft landed back at Compton Abbas at 1330 hrs.

Accident flight

When the aircraft returned the passengers changed over. The second passenger was wearing an 'Irvin' type flying jacket. He was considerably larger than the first passenger and the pilot spent some time helping him to adjust and secure his harness. The passenger took with him a camera which he wore around his neck on a strap. During the taxi out before takeoff he took several photographs, holding the camera up in front of him and pointing it backwards. There were no photographs taken with the camera during the flight.

The aircraft took off at 1356 hrs and after leaving the circuit flew in a generally southerly direction at an altitude of between 1,600 ft and 2,200 ft. At 1404 hrs, when the aircraft was 3 nm north-west of Tarrant Rushton Visual Reference Point (VRP), the pilot turned onto a south-easterly track and contacted Bournemouth Radar. He requested permission to transit into the Bournemouth Control Zone to Broadstone and to make two circuits there at 2,000 ft. The Bournemouth radar controller instructed the pilot to remain clear of controlled airspace and advised that it was very busy. The controller said he would call him back if it was possible to accept him, but subsequently, after determining that the aircraft was not fitted with a transponder, the controller advised that the aircraft could not be accepted.

The pilot continued on a south-easterly track for approximately two minutes, then turned to the left through 180º and flew in a north-westerly direction. Observers on the ground described seeing the aircraft climb up and reach the top of a loop, before they saw it enter a spin. The spin continued through a number of turns until the aircraft struck the ground.

The accident manoeuvre was performed in the same location that the pilot had completed a loop on the previous flight, near to the house of a friend. This friend was out walking his dog and saw the accident. He ran over to the site, a distance of about 500 m, and gave first aid assistance to the two people on board. Both were seriously injured and trapped in the wreckage but he was able to keep them breathing until an air ambulance arrived. They were treated at the scene before being flown to local hospitals. The passenger died later that evening as a result of his injuries.

Meterological information

The weather situation was dominated by high pressure lying to the southwest of the UK, maintaining a north-westerly flow over the accident area. The visibility was good to excellent with no weather reported in the area. The conditions for the flight were good with broken cloud at around 3,000 feet. The surface wind at Compton Abbas, at the time of the accident, was reported as from the north-west at 15 kt to 20 kt and the surface temperature was 16°C.

The Bournemouth Airport METAR recorded at 1420 hrs was:

> *'surface wind from 300° at 10 kt, visibility 10 km or greater, few cloud at 3,700 ft, temperature 16°C , dewpoint 5°C and pressure 1027 hPa.'*

An analysis of recorded meteorological data was carried out by the Met Office to obtain an estimate of the wind and temperature profile in the area of the accident, the results were:

1000FT: 310/15-20KT +09°C and
2000FT: 310/20-25KT +06°C

Pilot information

The pilot had attended a military Flying Grading evaluation course at Middle Wallop in 1992, while serving in the armed forces. He completed 13 hours dual flying in a Chipmunk but did not progress onto the flying training course. The syllabus for the Flying Grading included some experience of aerobatic manoeuvres.

In December 2008 the pilot started flying training with the intention of obtaining a PPL and then progressing onto a CPL. He completed his PPL in April 2009 and continued flying in order to accumulate sufficient hours to start the CPL training. During his PPL training, before his first solo flight had taken place, his instructor spent a one hour session with him in a Cessna 172 demonstrating and teaching spin and spin recovery techniques. A total of four spins were carried out.

In May 2009 the pilot purchased a share in G-AOIL. He was checked out by another member of the owners' group, who was a qualified flight instructor, and received a total of 9 hours of dual conversion training and an hour of observed solo flight. During the check-out the instructor reported that he had demonstrated some aerobatic manoeuvres. When the pilot had completed the check-out he was advised that further training, including in aerobatics, would be available at any time if he wished. The owners' group had a verbal agreement that no solo aerobatics were to be undertaken until a pilot had been cleared to do so.

The pilot carried a GPSMAP 695 during the flights fitted to a kneeboard strapped to his left leg.

Pilot's recollections

The pilot was seriously injured in the impact and suffered some memory loss, with an incomplete recollection of events around the time of the accident. He was however able to provide some information to the investigation in the months following the accident.

He reported that he would occasionally perform loops in G-AOIL but he did not consider that a loop constituted an aerobatic manoeuvre. He said that he would normally carry them out starting at an altitude of 2,500 ft. He also stated that he was familiar with HASELL[1] checks, including the requirement to

Footnote

[1] Height, Airframe, Security, Engine, Location, Lookout.

recover by 3,000 ft agl, and would always carry out the checks before executing a loop.

When the pilot was asked what the spin recovery technique should be, he commented that he had only previously spun in a Cessna 172 and stated that you should centralise the rudder, to stop the spin, and then apply back pressure gently, due to the high speed.

The pilot remembered clearly the radio telephony exchange with Bournemouth Radar and thought that immediately afterwards he had turned to the north to avoid entering the control zone. He did not recall entering a loop but reported later that he had encountered a problem with a restriction of the left rudder pedal during the left turn to the north. He recalled the aircraft being in a spin to the left and stated that although he had pushed hard on the right rudder pedal, it would not move and he could not recover from the spin.

Aircraft information

The Tiger Moth is a two-seat bi-plane fitted with dual controls. There are two cockpits, and the aircraft is usually flown from the rear cockpit. G-AOIL was built in 1940 and at the time of the accident it had accumulated 3,380 hours since an extensive overhaul in 1999, and the engine had accumulated 117 hours having been zero-lifed in 2009. On 15 April 2011 both the airframe and the engine had undergone a 50 hr / 6 month inspection and servicing.

The primary flying controls consist of a rudder, elevators and ailerons on the lower mainplanes only. This Tiger Moth had anti-spin strakes and autoslots fitted, although these are not mandatory. The autoslots are on the upper mainplanes which, when unlocked, deploy automatically at high angles of attack, for example during landing. Autoslots must be locked for aerobatics.

Key information for the support and continued airworthiness for Tiger Moths, such as modifications and inspections, is published by De Havilland Support in a series of Technical News Sheets (TNS). Whilst there are modifications that date from 1933, the TNS system has been actively updated in recent years.

'Z' type harnesses were fitted to the aircraft. These were commonly fitted at the time of this aircraft's restoration, and each occupant's harness consisted of two lap and two shoulder straps. The shoulder straps were fixed to the aircraft by a cable running across the fuselage, and the lap straps were attached to the fuselage structure. TNS 37 issue 2, issued in 2000, is a CAA mandatory TNS which specifies the fitting of higher strength transverse cables for the attachment of shoulder straps.

The original 'Sutton-type' harness was designed to '*keep the wearer firmly in his seat*' when subject to certain loads and the specification dated from circa 1940. The harness was not part of an integrated crashworthy aircraft design in which energy absorption and survivable space were considered to the extent that they are for more modern aircraft.

The fuel tank is installed above the front cockpit and has a capacity of 19 gallons.

Weight and balance

The contents of the baggage stowage were weighed and an estimate was made for the fuel state. The aircraft was the subject of a weight and balance report in 1999 and, using the weights of the occupants, it was estimated that the aircraft's weight, at the time of the accident, was 815 kg with a centre of gravity position of 15.2 inches.

The Airworthiness Certificate loading limitations for G-AOIL specifies that the maximum total weight is 828 kg and that when aerobatic manoeuvres are performed the aircraft shall not operate at a total weight in excess of 802 kg. It also specifies that the centre of gravity position for aerobatics shall be within the range of 7.0 inches to 15.3 inches aft of datum.

Spinning tests carried out originally by the manufacturer showed that centre of gravity position did not have a significant effect on the spin characteristics.

Spinning characteristics

This Tiger Moth aircraft was cleared for a number of aerobatic manoeuvres, including loops and spins, when operated within the required weight and centre of gravity range and when fitted with anti-spin strakes.

Spin characteristics vary between different aircraft types. For the Tiger Moth, each aircraft will be rigged slightly differently and this will affect the individual spin characteristics. In 1941, as a result of concern about a number of aircraft being lost in spinning accidents, the Royal Aircraft Establishment undertook a study of Tiger Moth spin characteristics. The study resulted in a recommendation that anti-spin strakes be fitted.

Engineering investigation

Examination of the wreckage at the accident site

The aircraft wreckage was in a grass field and was largely intact. The field was bounded by a thick 3 m high hedge, and 3 m from the hedge and inside the field was a 1 m high single-wire electric fence. The tail of the aircraft was resting on the wire with the nose of the fuselage pointing in a direction perpendicularly away from the wire towards the centre of the field. Importantly, there were no signs of the aircraft having touched the 3 m hedge, despite the close proximity.

There was significant damage to the leading edge of both lower mainplanes. The furthest piece of wreckage from the fuselage was a piece of propeller 11 m from the nose of the fuselage. The nose of the aircraft had struck the ground causing significant damage to the engine and the forward fuselage. The fuel tank was damaged and leaking, but still contained approximately 15 litres of fuel.

There was damage to both the lower forward portion of the engine cowling and the spinner that matched two significant indentations in the ground near the wreckage of the fuselage. The rear fuselage, which was intact, was aligned at approximately 25° to the ground marks made by the spinner and cowling which gave strong evidence that there was rotation about a vertical axis with the aircraft rotating to the right when the aircraft struck the ground. This direction of rotation was further corroborated by ground marks made by the tail skid dragging to the left (ie in the direction of aircraft nose to the right).

It was concluded that the aircraft had struck the ground at low speed, approximately 30° to 40° nose-down, with the right wing low and with the aircraft rotating to the right; consistent with the aircraft spinning to the right.

Three large pieces from one blade of the wooden propeller had broken off. There were chordwise marks on these pieces and a slash mark in the ground (50 cm long x 3 cm deep) in close proximity to an indentation in the ground that was probably made by the spinner. It was concluded that the engine had been turning, probably under low power, when the aircraft struck the ground.

A preliminary check on the continuity and integrity of the controls to the ailerons, rudder, elevator and autoslots was made at the wreckage site; nothing significant was found.

The attachment cables for both the front and rear occupants' shoulder straps had failed in overload so shoulder restraint had been compromised for both occupants.

Assessment of possible control restriction

A Tiger Moth aircraft, fitted with similar harnesses and seats, was used to assess the possibility that there might have been a restriction on the controls. Whilst the fuselage is constructed from tubular sections, the Tiger Moth has a comprehensive set of foot plates, plywood cover plates and a leather shroud around the base of each control stick minimising the risk of a control restriction to the sticks or rudder pedals from a loose article or a foot.

The passenger's camera was badly damaged in the accident. A camera of similar dimensions was obtained and its neck strap adjusted to be similar to that carried by the passenger. An assessment of the control movement was made with an occupant in the front seat wearing a similar flying jacket and of similar height and build to the accident passenger. This assessment included a full and free check on the control sticks. It was concluded that the clasp for the four-point harness had some potential to restrict full back stick for the elevator. It was considered unlikely that the camera could have restricted the full movement for the elevator.

Detailed examination of the wreckage

Engine

The engine was removed from the wreckage and inspected. Apart from the damage caused by the impact, nothing abnormal was found and the engine appeared to have been serviceable prior to the impact.

Aircraft structure

The fabric covering material was removed from much of the aircraft and the structure was inspected. The airframe appeared to have been in a serviceable condition prior to the accident, and there was no evidence of an in-flight malfunction or failure.

The fitting of the higher strength attachment cables for the shoulder straps to G-AOIL was documented in the log book and dated August 2002. The attachment cables were inspected and, apart from the overload failure to the front and the rear cables, they appeared to have been in good condition prior to the accident and they both had valid part numbers.

Flying controls

A detailed check on the continuity and integrity of the controls to the ailerons, rudder, elevator and autoslots was made from each point of control input to each control surface, including checks for any restrictions; nothing significant was found. The autoslots appeared to have been stowed and locked at the time of the accident.

The cockpit area was badly disrupted as a result of the aircraft striking the ground. This included significant damage to the rudder controls and control sticks, with a multitude of scratches and witness marks on the structure, some of which would have occurred in normal usage. Witness marks from any restriction would have been difficult to detect, even without the significant damage from the ground impact. Thus it was not possible to determine if there was any damage or witness mark that might have arisen from a control restriction in the cockpit.

Pathological information

The aircraft was in a nose-down attitude when it struck the ground and the front cockpit was subjected to greater impact forces than the rear. An expert in aviation pathology carried out a post-mortem examination on the passenger. It was found that he had died of multiple injuries sustained in the accident as a result of the impact forces. Although the shoulder strap attachment wire of his harness failed and he had sustained a head injury, it was considered that this probably did not affect the outcome.

Recorded information

The RTF transmissions between the pilot and Bournemouth ATC were recorded.

Radar data from the radar head at Bournemouth Airport was recorded for the accident flight. All the radar returns were primary so no height information was available. The quality of positional information of these the returns was also low because they had to be extracted from screen shots of the recorded data as would have been displayed to the radar controller.[2]

A Garmin GPSMAP 695 was recovered from the accident site and subsequently downloaded at the AAIB. It contained the track logs for a number of flights of which the last two were for the day of the accident. The second of these was the accident flight. Each flight log contained time, position and altitude, as well as the track angle and average groundspeed between each point. The GPS was set up to record points using a Garmin proprietary algorithm based on the distance and/or track angle change from the previous point. The time between points was therefore variable, ranging from between 1 and 16 seconds for the first flight and between 2 and 13 seconds for the accident flight.

First flight

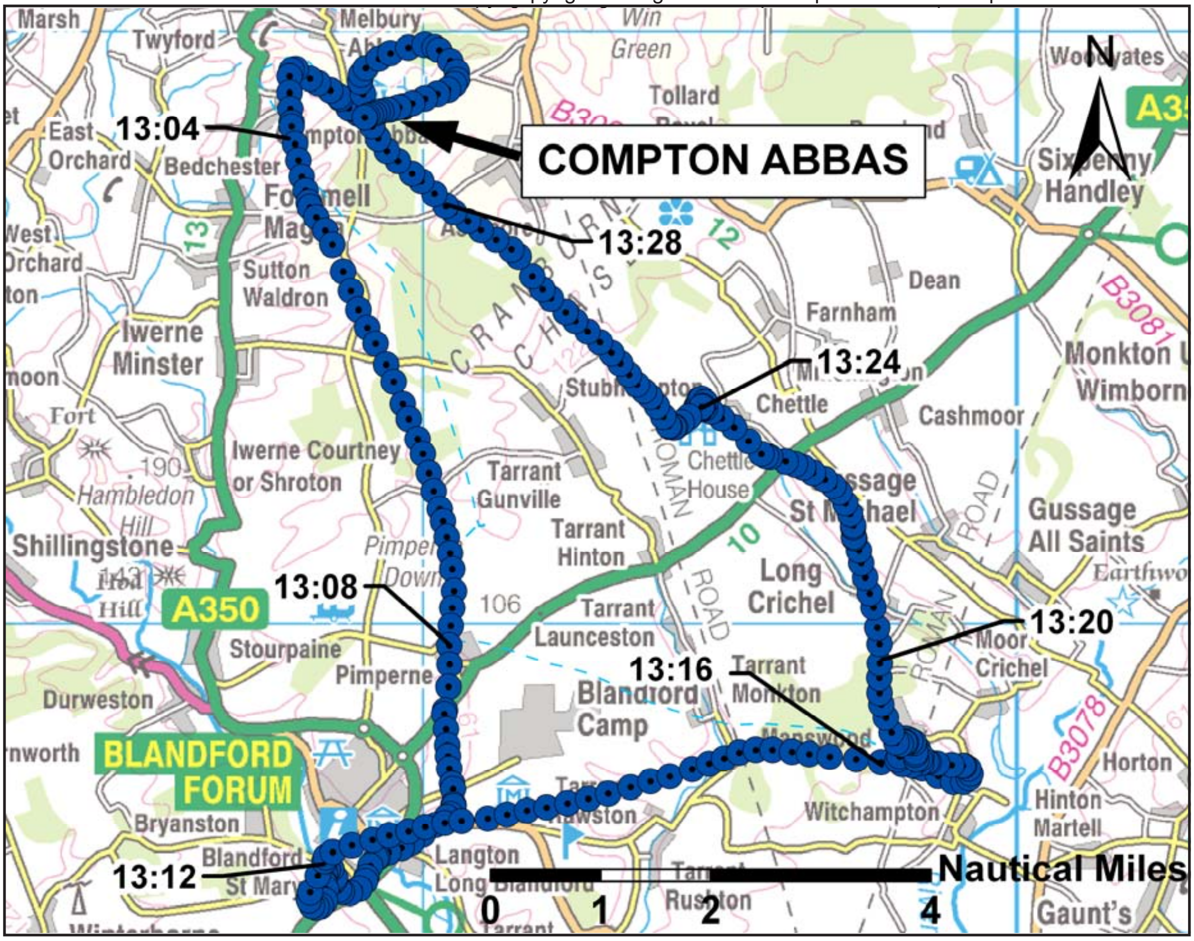
The first recorded flight was a local flight from Compton Abbas with a duration of 31 minutes. (Figure 1 depicts the ground track and altitude trace). Indicated on the altitude trace are significant points in the flight in terms of minimum altitude, descent rates and manoeuvres, as well as the height of the ground below the aircraft. Of note was the minimum altitude of 850 ft agl close to the town of Blandford Forum, some tight level turns, and a loop at about 1,200 ft agl followed by a descending turn to the right at 2,330 ft/min, from 1,000 ft agl down to a height of 410 ft agl, near Witchampton. This loop was performed on a north-westerly heading, into the prevailing wind, and was started within 20 m of the position of the subsequent accident site. Further on, near Chettle House, there was a second loop at about 1,600 ft agl, followed by an immediate right descending turn of 300 ft at 2,350 ft/min. The maximum recorded altitude during the flight was 2,150 ft amsl.

Accident flight

Figure 2 shows the ground track and altitude trace for the accident flight. The track again heads south south-westerly with the aircraft climbing to, and levelling off at, 2,000 ft amsl for two minutes. It then climbs to 2,170 ft amsl (the maximum recorded altitude for the flight), before descending and climbing a little as it turned onto a southerly track, followed by a left turn towards Bournemouth Airport. The aircraft then descended to 1,610 ft amsl, during which time the pilot was in contact with Bournemouth Radar. Over the next 100 seconds the aircraft made a series of short

Footnote

[2] Bournemouth Radar is only recorded by the Air Traffic Service (ATS) Unit at Bournemouth Airport, and is not part of the UK's national coverage that is recorded by the National Air Traffic Service (NATS). The latest version of CAP 670 SUR 10 , effective January 2012, requires all ATS units to provide recorded radar data in a useable format.



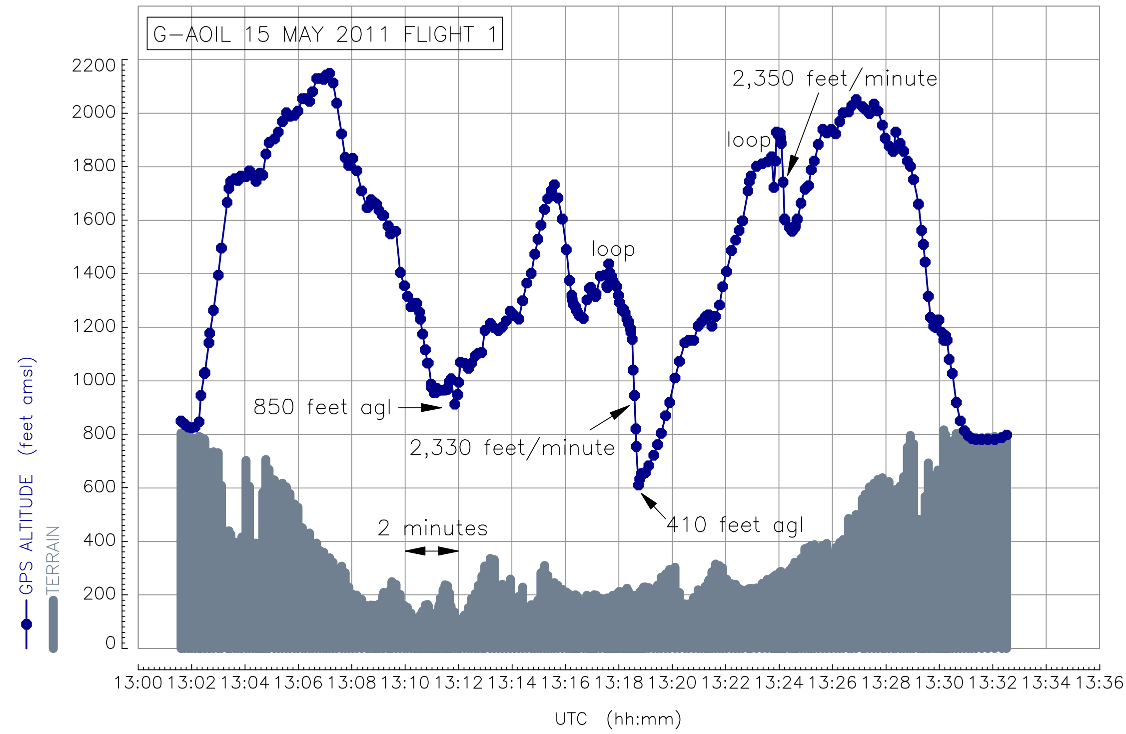
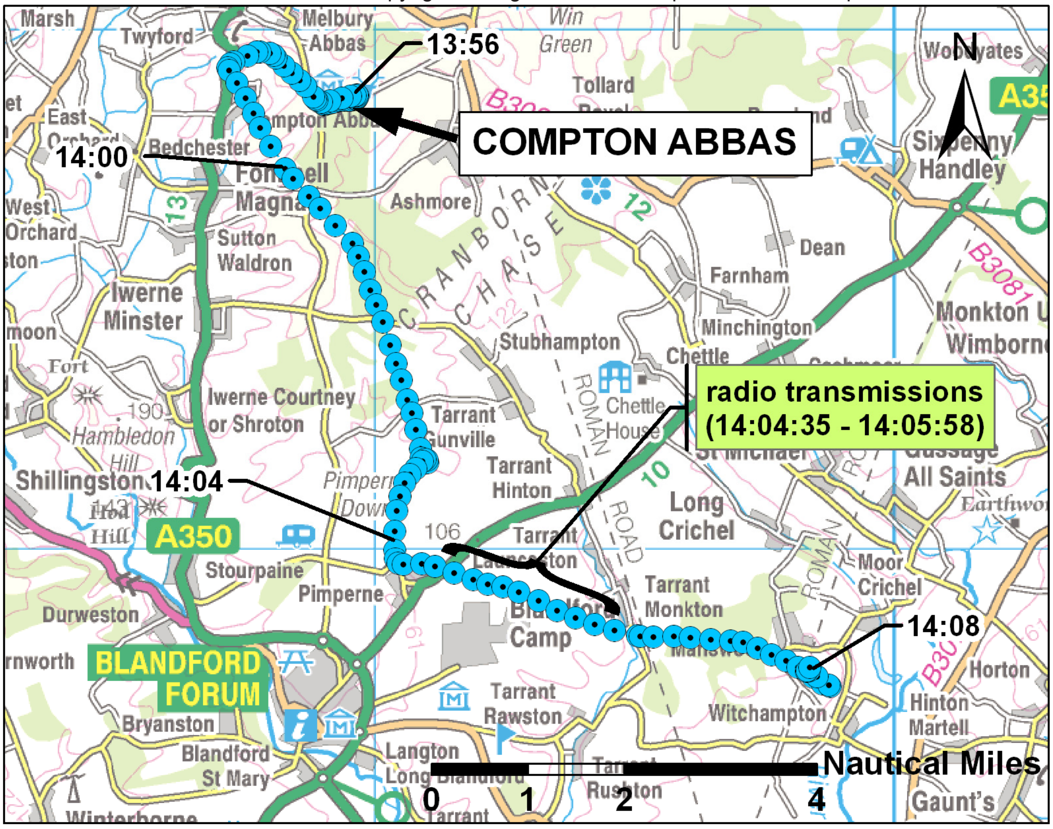


Figure 1

GPS track and altitude data for first flight of G-AOIL on 15 May 2011



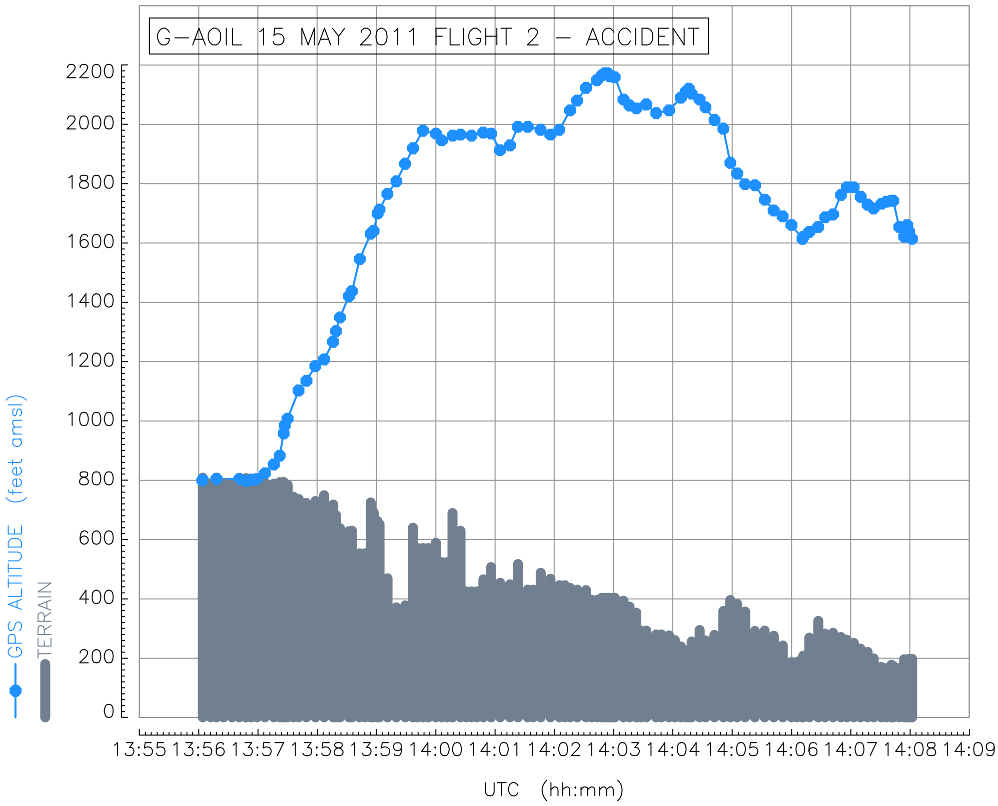


Figure 2

GPS track and altitude data for accident flight of G-AOIL on 15 May 2011 climbs and descents before turning left through 180º in the vicinity of Witchampton. This portion of the flight is illustrated in Figure 3 and shows the aircraft, after the turn, descending 120 ft over a distance of about 0.25 nm. The forward movement then stops and the aircraft climbs 40 ft to a point left of track 3 seconds later before descending 45 ft in the opposite direction to a point about 1,400 ft agl over 5 seconds. This was the last recorded point on the GPS. The absence of any further recording was probably due to the recording algorithm calculating that the horizontal position of the aircraft relative to the ground (ie ignoring height) had not changed sufficiently; lack of satellite reception is unlikely but could not be ruled out.

Other information

Witnesses

The passenger for the first flight was able to give a good description of his flight. He said that the pilot had carried out several loops, steep turns and steep turning descents. When asked what height the loops were performed at he thought it was around 1,200 ft[3].

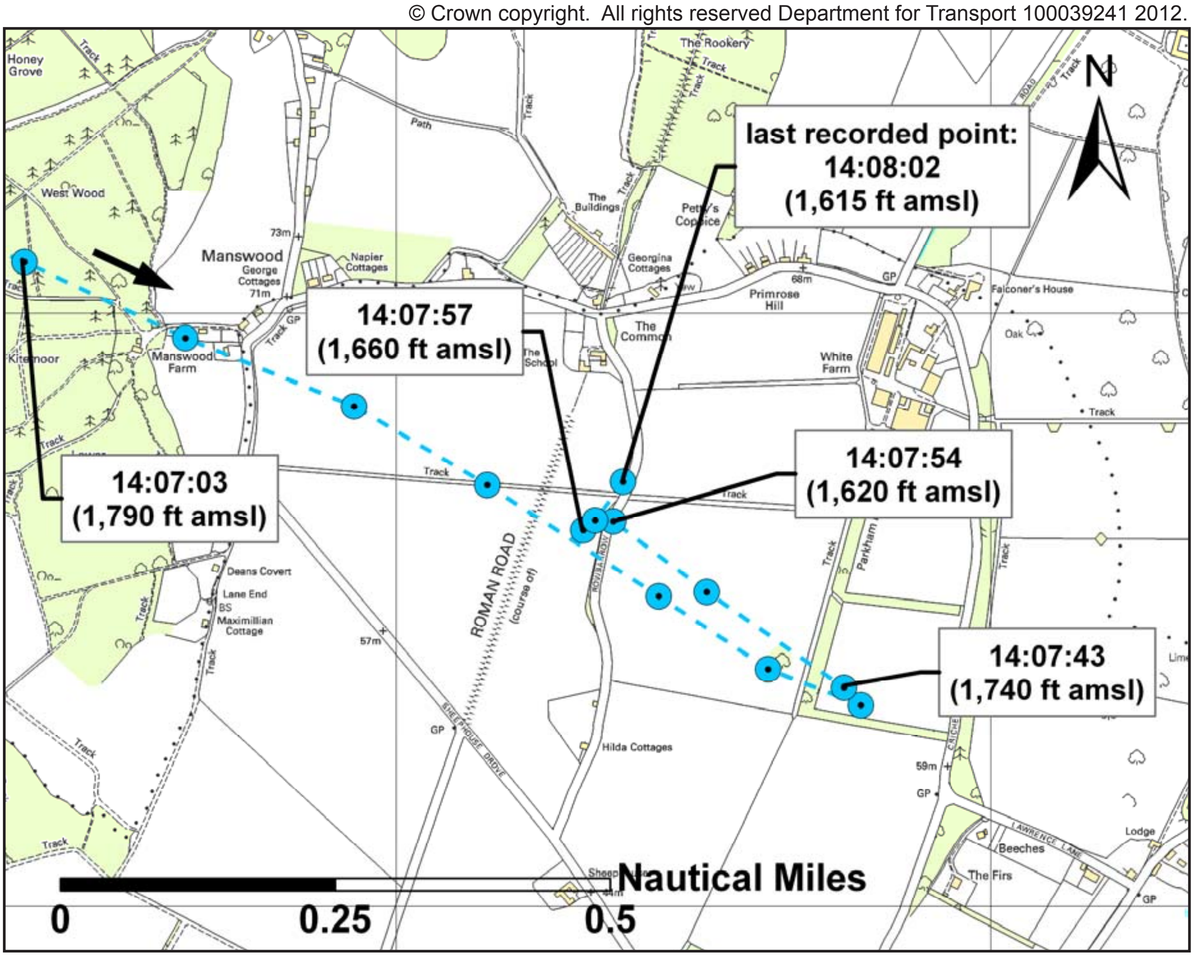


Figure 3

GPS track for the last one minute of the accident flight

Footnote

[3] After the accident the front cockpit altimeter was found to have been set at aerodrome QFE, the airfield elevation was 811 ft amsl.

There were a number of witnesses to the activity of the aircraft in the period just before the accident, the closest of whom was some 350 m distant.

Two witnesses, one of whom was a retired professional pilot, saw the aircraft at some distance away carry out a steep turn and then shortly afterwards commence a loop. They did not see the conclusion of the manoeuvre but one was sufficiently concerned by the low level of the manoeuvre to express this to the other.

One witness was in his garden and saw the aircraft doing aerobatics before watching it spiral down. The engine went quiet and he expected to see the aircraft "swoop up again", but it disappeared from view behind some trees and he heard the sound of the crash.

Another witness, also in his garden and closest to the accident site, watched the aircraft reach the top of a loop. He then saw it start to spin and described the spin as flattish at first and then steeper. His estimate was 30 to 40º nose-down initially and later, up to 80º. The noise of the engine stopped and he could hear the aircraft making a "whishing" sound. He realised it was too low to recover. When he heard the impact he ran to telephone the emergency services.

Several other witnesses saw the aircraft in a spin. One witness, who was the friend of the pilot and the passenger, ran to assist at the scene. The witnesses were consistent in saying that the engine noise ceased during the spin.

Aerobatics

There are several publications produced by the UK Civil Aviation Authority (CAA) which provide information and guidance for general aviation pilots about aerobatics and spinning.

The (CAA) Publication *'Safety Sense Leaflet 19 General Aviation Aerobatics'* includes the following statement:

> *'Aerobatics, whether in a glider or a powered aircraft, provide an opportunity for pilots to learn and participate in a new facet of sporting aviation. It is, however, vital to keep safety in mind, since a reckless or careless attitude can result in serious injury or death. Almost every year accidents occur where the height available proves insufficient to recover from an intentional or, more usually, a badly executed aerobatic manoeuvre.'*

The leaflet goes on to detail the HASELL[4] check:

> *'The standard HASELL check needs to be carried out with particular vigilance:*
>
> - *Height – depends on experience of pilot, but novices should commence at no less than 5000 ft above ground level and all manoeuvres should be completed by 3000 ft agl.*
> - *Airframe – flaps up, brakes off, (in some aircraft brake application restricts rudder movement), wheels up, etc to suit your particular aircraft.*
> - *Security – all harnesses fastened, canopy/ doors secure and no loose articles.*
> - *Engine – all engine instruments reading normally, mixture rich, carb heat check, adequate fuel selected and electric fuel pump on if applicable.*

Footnote

[4] A standard mnemonic introduced during PPL training to prompt a series of safety checks prior to carrying out many types of manoeuvres, such as stalls, spins, spiral dives or aerobatics.

> - *Location – clear of congested areas and outside or below any controlled airspace (unless appropriate permission from the controlling ATC unit has been given). An area offering good forced landing options in the event of engine problems is wise. Note a good landmark to assist orientation. However, avoid likely navigation "choke points", and remember gliders use the rising air under cumulus clouds.*
> - *Look-out – clearing turns in both directions and check above and particularly below for aircraft which might enter your operating space.'*

The CAA Publication '*Handling Sense Leaflet 3, Safety in Spin Training*' advises the following Standard Spin Recovery technique:

> *'Throttle: Closed*
>
> *Aileron: Neutral*
>
> *Rudder: Check the direction of yaw and use FULL anti-yaw rudder. A pause is often recommended between moving the rudder and elevator, and this is important to ensure rudder effectiveness.*
>
> *Elevator: Move the control column centrally forward. As the aeroplane starts to recover the attitude will steepen and the rate of rotation will increase; keep moving the column towards full deflection until the spin stops.*
>
> *Centralise: Centralise all controls as soon as the spin stops or the aeroplane will flick in the opposite direction!*
>
> *Climb: Roll towards the nearest horizon and pitch into a climb attitude applying power carefully.'*

Analysis

Evidence suggests that the aircraft was serviceable before the flight and no pre-existing defect which contributed to the accident was found in the investigation.

The physical evidence at the wreckage site, for example the difference in the alignment of the ground marks to the fuselage, and the tail skid drag mark, made it possible to conclude that the aircraft was in a spin to the right when it struck the ground.

The pilot stated that he had a rudder control restriction. The inspection of the wreckage, and in particular the flying controls, revealed nothing conclusive to suggest that there was a control restriction. However, given the level of damage sustained by the aircraft, the possibility of a control restriction could not be eliminated.

The pilot completed a loop on the first flight in the same location as the subsequent accident, from a similar heading and at approximately the same height. The GPS and eyewitness evidence indicates that the pilot had commenced a vertical manoeuvre consistent with the start of a loop, prior to the spin. There could be a number of reasons why the loop was not completed successfully. One possibility is that the pilot was unable to pull the stick fully back during the manoeuvre due to interference between the passenger's harness and the front cockpit control stick.

The pilot did not recollect attempting a loop during the accident flight. His recollection was that following the exchange with the Bournemouth radar controller he had immediately turned left, away from the Control Zone, and had experienced a rudder control restriction during the turn. However, the GPS data shows that the aircraft did not turn to the left until approximately two minutes after his last radio transmission.

The pilot had not undertaken aerobatic training and had limited experience of spinning and spin recovery. He had been shown spins in a Cessna 172 aircraft at an early stage of his PPL training. However, its spin characteristics are unusual in that it will normally recover from a spin if the pro-spin controls are released and no further action is taken. When asked what the recovery actions from a spin should be, the pilot reported that opposite rudder would be required to stop the spin and then when rotation had stopped back stick would be required to recover from the dive. He omitted the crucial inputs of closing the throttle, neutralising the ailerons, and applying forward stick to unstall the wings. Thus, as he did not have sufficient knowledge or training on the Tiger Moth's correct spin recovery technique, it is probable that he would not have been able to recover from an unintentional spin, especially given the limited height available.

When an aircraft enters an unintentional spin it can sometimes be difficult for a pilot to determine the spin direction correctly. In this case the pilot believed he had entered a spin to the left, whereas the evidence shows the aircraft was spinning to the right.

The pilot had carried out loops earlier in the day at significantly less than the recommended height from which recovery could be effected should something happen during the manoeuvre. The standard HASELL check, published in CAA Publication '*Safety Sense Leaflet 19 General Aviation Aerobatics*', recommends that all manoeuvres should be completed by 3,000 ft agl. The pilot did not provide a reason why he chose to commence the loops at a height lower than that recommended.

The AAIB has investigated several accidents where pilots have carried out aerobatics with either insufficient training and/or at lower than recommended heights. It is not well understood why a pilot might disregard the recommended safe margins for carrying out aerobatics, although there are a number of possible reasons. Some of these may be: overconfidence, airspace ceiling restrictions in the area in which they are flying, the length of time it takes to climb up to a safe altitude or a wish to be seen from the ground.

The reason for the loss of control during the loop could not be determined but regardless of the reason, the manoeuvre was carried out at too low a height for the pilot to be able to recover from the subsequent spin.