Jodel D112, G-AXTX, 11 September 2000

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Aircraft Type and Registration:	Jodel D112, G-AXTX
No & Type of Engines:	1 Continental A65-8F piston engine
Year of Manufacture:	1961
Date & Time (UTC):	11 September 2000 at 1640 hrs
Location:	20 miles north of Swansea
Type of Flight:	Private
Persons on Board:	Crew - 1 - Passengers - Nil
Injuries:	Crew - Fatal - Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	41 years
Commander's Flying Experience:	295 hours (of which 153 hours were on type) Last 90 days - 30 hours Last 28 days - 9 hours
Information Source:	AAIB Field Investigation

History of the flight

The pilot had owned G-AXTX since November 1997 and the annual 'Permit To Fly' was valid until 14 September 2000. He had arranged to fly the aircraft to Shenstone Airstrip, near Lichfield, where he would meet with a Popular Flying Association (PFA) Inspector to enable the technical inspection for the renewal of the 'Permit To Fly' to be completed.

The pilot arrived at Swansea Airport at approximately 0845 hrs to prepare for the flight. On arrival, he sat with a pilot friend for a short time and chatted about his intended flight. The friend noticed that the pilot had a map upon which was drawn a direct route between Swansea and Shenstone. He offered to accompany the pilot on the flight but this offer was declined as the pilot considered that it would result in the landing weight at Shenstone being too high. The pilot also commented that he expected his flight would take approximately 90 minutes and that he would refuel at Halfpenny Green Airfield (now called Wolverhampton Business Airport) for his return flight.

Shortly after, the pilot was seen to bring his aircraft out of the hangar and refuelled it with 12 litres of fuel; he was airborne at 1027 hrs. On board, the pilot had a Garmin Global Positioning System

(GPS), a Magellen GPS and two 'ICOM' radios; all of this equipment was handheld. Post accident interrogation of the Garmin GPS showed that part of the flight to Shenstone had been logged. This confirmed a direct track to Shenstone with an average groundspeed of 90 kt. Based on a flight time of 90 minutes, the pilot would have landed at Shenstone about 1200 hrs. Following the 'Permit To Fly' inspection, the pilot dipped the fuel tank of G-AXTX and stated that he had 9 gallons (41 litres); he then took one further gallon from the PFA Inspector and added it to the aircraft's fuel tank. The departure from Shenstone was not recorded (thought to be just after 1400 hrs) but the aircraft landed at Wolverhampton at 1437 hrs. There, the pilot uplifted a further 26 litres of fuel and visited the 'Tower'. Personnel in the 'Tower' later confirmed that the pilot appeared to be relaxed and in good humour. At 1513 hrs, the pilot took off from Wolverhampton.

Later that afternoon, two walkers were camped on the Welsh mountains some 20 miles north of Swansea when they heard the sound of, but couldn't see, an aircraft circling to the south of their position. At the time, they described the weather as very changeable with the visibility varying from clear to approximately 80 metres. After circling about three times, the aircraft changed direction and flew directly overhead their position before changing direction again and taking up a westerly heading. The aircraft seemed to cross their position twice before the engine suddenly stopped; shortly afterwards, they heard the sound of "restart noises" and then silence. Shortly afterwards, they saw the aircraft for the first time as it came vertically down; they described it as "falling down with the propeller directed to the ground, no turning or spiralling of the plane". There was no fire or explosion as the aircraft impacted the ground about 100 metres from their position. They immediately reported the crash on their mobile telephone together with their GPS position and went towards the crash site. On arrival, they found the pilot, badly injured and unconscious, in the aircraft. They covered him and awaited the arrival of the emergency services. They later made the comment that there was a slight smell of fuel but that they would have expected more.

The police recorded the time of the first call at 1643 hrs and alerted the coastguard, the ambulance, the Mountain rescue team (MRT) and the Aeronautical Rescue Co-ordination Centre (ARCC). The ARCC recorded the initial alerting time at 1655 hrs and at 1701 hrs assigned a rescue helicopter from RAF Chivenor to the task. The helicopter was airborne at 1720 hrs and flew towards the area of the crash. The weather deteriorated as the crew approached the area and there was some discussion about whether to airlift the MRT to the area or to try and locate the crash site. However, by 1753 hrs, the helicopter had made visual contact with the crash scene and landed adjacent to it.

Weather information

Prior to his flight, the pilot had obtained a list of Terminal Aerodrome Forecasts (TAFs) from The Meteorological Office through the Internet. The TAF for Cardiff Airport, the nearest available airfield to Swansea was timed at 0330 hrs and indicated the following weather: From 0400 to 1300 hrs: surface wind 100°/08 kt, CAVOK; tempo 0400 to 0800 hrs 7,000 metres, few at 1,000 feet agl. At the time of his departure from Swansea, it was a warm clear day with a light surface wind.

The witnesses who saw the aircraft impact the ground reported the weather as rapidly changeable in the area. Visibility varied from clear to an estimated 50 metres vertically and 80 metres horizontally. At the time of the accident, there was no rain.

The helicopter crew assessed the cloud in the area as 1,200 to 1,500 feet overcast with clear visibility below but with rain showers.

The Meteorological Office at Bracknell provided an aftercast for the area. At 1600 hrs, there was a low pressure system centred over Northern Ireland with a weak cold front lying from Belfast through Cardigan Bay, Milford Haven and Bude. A light westerly 'warm sector' lay over the Black Mountains. The surface wind in the area was 240°/07 kt and the wind at 2,000 feet amsl was 270°/15 kt. At 2,000 feet amsl, the air temperature was 17°C and the dewpoint was 16°C. Visibility was generally 8 km but 200 metres in hill fog. Over south and west facing hill tops, cloud was broken between 1,200 and 3.000 feet amsl and scattered base 6,000 feet amsl. There would also have been some mountain waves with a maximum vertical velocity of 380 feet per minute at 4,500 feet amsl. The TAF issued at 1511 hrs for Cardiff showed the following forecast for the period from 1600 hrs on 11 September to 0100 hrs on 12 September: surface wind 230/08 kt, visibility greater than 10 km, cloud few at 3,000 feet agl; tempo between 1800 and 0100 hrs, visibility 6,000 metres and cloud broken at 1,000 feet agl. The actual report (METAR) for Cardiff at 1720 hrs showed a visibility of 5,000 metres with cloud few at 3,000 feet agl. At 1750 hrs, the METAR for Cardiff showed visibility of 5,000 metres and cloud few at 800 feet agl, scattered at 1,000 feet agl and overcast at 3,000 feet agl; QNH was reported as 1010 mb.

In accordance with CAA General Aviation Safety Sense Leaflet 14A - Piston Engine Icing, the conditions were such that moderate to serious carburettor icing could be expected at 2,000 feet amsl in the area.

Radio and radar information

The pilot's last known radio contact was with 'Wolverhampton Information'. Enquiries were made to other ATC units to establish if the pilot of G-AXTX had talked with any during his final flight. These included Flight Information Region (FIR), Swansea, Birmingham, Cardiff, Shobdon, RAF Shawbury and Distress and Diversion (D&D); none of these units had any contact with G-AXTX.

National Air Traffic Services (NATS) were able to identify a primary radar track from Clee Hill Radar, which conformed to the known timings and expected route for G-AXTX. The first radar return was seen at 1558 hrs, some 44 nm southwest of Wolverhampton, and the last one was at 1618 hrs. The recording showed that the pilot maintained a relatively straight track on a southwesterly heading at a ground speed of approximately 70 kt. The final contact was 5 km to the northeast of the accident site. No altitude information was available but the altitude at this point would have been approximately 2,100 feet amsl, based on the fact that another aircraft located some 7 miles away, and on secondary radar, was lost on primary radar at that altitude. Towards the end of the radar track, there was an indication of some possible manoeuvring for a short time. This may have been due to the pilot avoiding weather or may have simply been a radar anomaly due to interference with the high ground.

In an attempt to determine the timings and route from Shenstone to Wolverhampton, NATS were also able to identify a primary radar track to the east of Shenstone beginning at 1410 hrs; the last return was at 1415 hrs. The radar returns indicate a northerly track on initial contact with a left turn onto an approximate heading for Wolverhampton Business Airport; this would conform to the expected route for G-AXTX.

Aircraft description and equipment

G-AXTX was a low winged two seat fabric covered wooden aircraft, with a fixed main landing gear and tail wheel. It had been built in 1961, since when it had flown for a total time of 4,182 hours. It was fitted with a normally aspirated 65 hp four cylinder piston engine driving a fixed pitch two bladed propeller. The engine had been installed in 1976, and had accumulated 1,775 hrs since installation. There was no electrical system

in the aircraft and no starter motor. The fuel system was gravity fed via a pipe fitted to the bottom of the tank.

The pilot had purchased G-AXTX in November 1997 since when he had worked to improve the aircraft under the oversight of the PFA Inspector at Shenstone. The most recent improvement had been the fitment of two new magnetos and associated electrical harnesses on 8 May 2000.

The Permit to Fly for the aircraft included a requirement for the aircraft to be flown by day and under Visual Flight Rules only.

The aircraft instrumentation was basic and comprised the following: altimeter; venturi driven turn and slip indicator; magnetic compass; vertical speed indicator; RPM gauge; airspeed indicator (ASI) with one pointer and an inner and outer scale in nautical miles per hour. This ASI, shown at Figure 1, is common in glider aircraft and needs careful interpretation in that the needle points to both scales over a portion of the instrument**.** In normal conditions, the pilot would have little difficulty in assessing his airspeed but under stress or without visual references, it could be confusing.

There were two handheld GPS units and two handheld radios on board the aircraft. From subsequent interrogation of the units, it was apparent that the pilot used the Garmin GPS for the flight from Swansea to Shenstone and the Magellen GPS for the return flight. The final recorded position on the outbound flight, from the Garmin GPS, was at 1136 hrs to the northeast of Birmingham. On the return flight, the 'track log' facility on the Magellen GPS had not been selected but the GPS indicated a final position very close to the accident site. One of the handheld radios had the Swansea frequency selected and the other showed that the last frequency selected was a non-relevant navigation aid frequency.

Pilot experience

The pilot had started his flying experience on gliders at an airfield near Swansea and had attained his 'A' and 'B' certificates by May 1995; no record of his total glider flying hours was available but enquiries indicated that he did not continue much, if any, gliding after completion of his 'A' and 'B' certificates. He commenced powered flying in March 1995 at Swansea and qualified as a Private Pilot in March 1996; his flying log book indicated that he had flown regularly since the completion of the course. Personnel at Swansea who had flown with him considered him a careful pilot who was safety conscious. This view would be corroborated by the fact that he had attended two CAA Safety Evenings and by perusal of his flying logbook. This recorded regular flight checks and included a session of 'limited panel' flying; although this was in a Cessna aircraft, the instruments available in 'limited panel' would have been a reasonable simulation of what were available in G-AXTX.

Medical information

Post Mortem examination of the pilot revealed no evidence of any medical condition, which could have contributed to the accident. Death was considered to have been instantaneous at the moment of impact.

Fuel information

G-AXTX has a fuel capacity of 60 litres in the only tank giving an endurance of approximately 4 hours at 15 litres per hour. At Swansea on the day of the accident, the pilot refuelled with 12 litres of fuel; evidence from the refueller indicates that the aircraft was close to full at this point. Then, after a flight of approximately 90 minutes, the pilot 'dipped' the tanks at Shenstone and declared a total of 9 gallons (41 litres). This showed the aircraft using a total of 19 litres for about 90 minutes flying (13 litres per hour). The fuel gauge on G-AXTX was fairly basic and consisted of a metal float attached to a metal rod, which extended through the filler cap at the top of the fuel tank. The amount of fuel was indicated by the extension of the metal rod through the filler cap. However, evidence indicates that this system was not reliable and consequently the pilot maintained a high level of fuel in the aircraft tank. The pilot took an additional one gallon from the PFA inspector to bring his total to 10 gallons (45 litres) before flying to Wolverhampton.

When he landed at Wolverhampton he uplifted another 26 litres for his flight to Swansea. The flight time between Shenstone and Wolverhampton could not be accurately calculated but would have been approximately 30 minutes unless the pilot was completing the airborne portion of his 'Permit' renewal. It is reasonable to assume that he filled his fuel tank to full at Wolverhampton and therefore, had 34 (60-26) litres prior to refuelling. The aircraft therefore appeared to have used 11 litres between Shenstone and Wolverhampton (approximately 22 litres per hour), suggesting the possibility that the aircraft was beginning to use (or lose) higher than normal quantities of fuel after leaving Shenstone.

There are certain unknown factors such as the accuracy of the 'dipped' fuel assessment at Shenstone and the flight time from there to Wolverhampton. Furthermore, the overall flight time from Swansea to Wolverhampton via Shenstone was 120 to 125 minutes during which time the aircraft had used approximately 30 to 31 litres of fuel giving an overall consumption close to the normal 15 litres per hour.

Impact parameters

The aircraft had come to rest on sloping grassy ground at a height of 1,970 feet amsl in an area surrounded by higher ground. The initial impact was on the right wing tip and the ground marks indicated that the aircraft was in a nose-down attitude of 70 to 80°, with a high rate of descent but with little lateral speed. The turn and slip indicator showed a full right indication. After the initial impact, the aircraft continued sideways for approximately 2.5 metres along a track of 150°. The subsequent ground marks also indicated that the engine had then hit the ground, rebounded, and came to rest less than one metre from it's initial impact crater. During the impact the right wing had disintegrated and lay beneath the main fuselage. The left wing and rear fuselage were essentially intact.

One of the propeller blades had separated from the hub, and was located approximately 10 metres from the main wreckage. The other blade had broken, with one half still attached to the propeller hub. The lack of leading edge damage and rotational scoring indicated that the engine had been under low power at impact. The aircraft had been structurally intact before impact and there was no fire.

The fuel tank had ruptured and discolouration of the canopy perspex, which was beneath the tank, indicated that fuel had been present and had drained out of the tank after impact. There was no evidence of any in flight fuel leak from the tank or of staining of the rear of the fuselage by fuel. Approximately 0.5 litres of fuel was recovered from the fuel tank during the wreckage recovery and taken for analysis at the Fuels and Lubricants Section at DERA Farnborough. The results showed

that the fuel did not meet the required specification and there were contaminants present, however these results were considered to have been caused by contamination and/or deterioration of the fuel on site by water and exposure to the atmosphere. A sample from the fuel bowser at Wolverhampton was tested and complied with the specification requirements for AVGAS 100LL

Further engineering investigation

Examination of the engine showed that it had been mechanically sound before the accident. The engine could still be turned, although there had been an impact on the front right cylinder. The Engine Oil Temperature gauge had stuck at an indication of 70°C, which is within the normal operating range. The oil reservoir was still intact and the oil strainer revealed nothing unusual. The Engine RPM gauge showed a low power setting (780 RPM); the indicating needle had struck the face of the gauge at impact in this position. This supported the evidence from the propeller of low power at impact.

The position of the carburettor air heat control was in the 'hot' position and this was confirmed by the position of the flap within the carburettor air box itself. Thus, the carburettor air source would be from the 'hot' engine exhaust manifold, rather than from the filtered 'cold' air from the air inlet at the front of the aircraft. The carburettor was inspected by an overhaul agency but nothing was found that could have caused a malfunction.

The magnetos were tested satisfactorily although the electrical harnesses had suffered some damage during the impact. The engine spark plugs also tested satisfactorily and did not show any evidence of rich running.

There was no evidence of any pre-impact failures or defects in flying control systems.

Discussion

The aircraft had just completed the technical portion of its annual Permit To Fly renewal and no major deficiencies were noted. It had been refuelled at Wolverhampton and probably left there with a full fuel load, some 87 minutes prior to the crash; full fuel would normally allow the aircraft to fly for approximately four hours. All the available evidence indicates that the pilot was cautious and safety conscious, yet the aircraft was seen, apparently out of control, descending from cloud.

The aircraft was not cleared for flight in cloud and the limited flight instruments available would mean that any flight in IMC would be extremely difficult even for a trained and experienced pilot. The pilot of G-AXTX had some experience with limited panel flying but practising with a safety pilot is very different from suddenly encountering cloud. Loss of control after entering cloud would be very likely for a pilot with no instrument flying qualifications and particularly in an aircraft with instruments as fitted to G-AXTX. However, the questions remains as to why the pilot entered cloud and why the witnesses reported variations in the engine noise.

The evidence from the witnesses was that there was not much smell of fuel when they arrived at the crash scene. Because of this, and the uncertainty of the fuel usage between Swansea and Shenstone, and that between Shenstone and Wolverhampton, the possibility was considered that the engine may have been using more fuel than normal or that there had been a leak. However, no adjustment had been made to the aircraft at Shenstone and no evidence of rich running was found with the engine. Additionally, there was physical evidence from the canopy perspex that fuel had been present and there was no evidence of any fuel staining on the fuselage to indicate the presence of a

fuel leak. It is possible that the fuel assessment at Shenstone was not precise and the timing of the subsequent flight was incorrect; slight differences in these aspects would change the apparent fuel consumption. Moreover, the pilot had filled the aircraft with fuel at Wolverhampton and was aware that the fuel gauging was unreliable. It was therefore concluded that excessive fuel consumption/loss resulting in a low fuel quantity was not a factor in the accident.

Analysis of the fuel sample from the crash scene did indicate some contamination but this may have been caused by exposure to the atmosphere following the accident**.** Additionally, the sample from the final refuelling at Wolverhampton met the required specification and the engine had been running for 87 minutes after refuelling without apparent problems. Furthermore the evidence from the cockpit instruments indicated that the engine was turning at 780 RPM at impact. The possibility of fuel contamination causing an engine problem was therefore considered to be unlikely.

The possibility of carburettor icing was considered as, under the prevailing atmospheric conditions, moderate to serious carburettor icing could be expected at 2,000 feet amsl in the area. The carburettor air heat control was found selected to "hot", however, it is possible that this selection was made only after the appearance of the initial symptoms of carburettor icing. Carburettor icing and the distraction involved in its diagnosis and subsequent selection of "hot" air remains a possibility.

Prior to his flight from Swansea, the pilot had checked the weather and the forecast indicated no deterioration throughout the day; when he left Swansea, it was a clear, warm day. However, the weather had deteriorated in the area of the Black Mountains by the time the pilot approached there on his return journey. This should not have been particularly surprising to him as he knew the area well from his flying experience and would be aware that the weather conditions could be changeable. He had various options if he had encountered adverse weather. He could have turned and diverted to an airfield behind him, where he knew the weather was good or he could have attempted to route around the weather. There was some indication from the radar recording of manoeuvring to indicate that he took this second option. At the time, this may have seemed a sensible decision because, until then, the weather had been good and, as he was not aware of any significant deterioration in the weather, he may have considered that the cloud was restricted to the immediate area. With his knowledge of the local area he may have been confident of his ability to navigate around the weather and he may also have had an understandable desire to complete his journey without an unplanned intermediate night stop. However, at some stage the pilot found himself in an area of cloud.

The witnesses heard the aircraft circling to the south of their position. At that time, it was likely that the pilot was flying above, or possibly between, cloud layers. He would probably have been concentrating on avoiding cloud and attempting to find a route away from the cloud. The witnesses then heard the aircraft flying directly above them on two occasions before hearing the variations in the engine noise. Under such conditions and with the limited flight instruments available to him, it would have been easy to become distracted and lose situational awareness. It is also possible that, if he had encountered carburettor icing with an associated power loss, he might have been unable to prevent the aircraft from descending into a layer of cloud.

A possible sequence of events was that the aircraft inadvertently entered cloud and the pilot was then unable to retain control of the aircraft. After entering cloud, the reported variations in engine noise could have been caused by: out of control manoeuvring causing temporary fuel starvation; the possible onset of carburettor icing; or variations in throttle position by the pilot as he attempted to regain control of the aircraft.

Conclusion

No evidence could be found of an engine failure. The probability of fuel exhaustion was discounted and contamination of the fuel was considered to be unlikely, however, possibility of carburettor icing could not be dismissed. Based on his forecast, the pilot would not have expected to encounter adverse weather on his flight. When he did, he had various options open to him. It would appear that he encountered an area of cloud which he was unable to clear before losing control of the aircraft.