

Accident

Aircraft Type and Registration:	Beagle B121 Series 2 Pup, G-AZCZ	
No & Type of Engines:	1 Lycoming O-320-A2B piston engine	
Year of Manufacture:	1970 (Serial no: B121-167)	
Date & Time (UTC):	3 March 2024 at 1630 hrs	
Location:	Near Cardiff Airport	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - None	Passengers - 1 (Minor)
Nature of Damage:	Damaged beyond economic repair	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	28 years	
Commander's Flying Experience:	83 hours (of which 8 were on type) Last 90 days - 4 hours Last 28 days - 4 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

Synopsis

The pilot had planned to fly to Sywell from St Athan but due to weather, altered course and landed at Duxford Airfield. The pilot's fuel planning did not take full account of the additional fuel required to fly on to Duxford, unusable fuel, or fuel usage during the ground and initial climb phases. No fuel was uplifted at Duxford. During the approach to land at St Athan, the engine suffered from a loss of power which was most likely due to fuel starvation. The pilot subsequently landed the aircraft in a field, during which the aircraft tipped over. The passenger was injured, and the aircraft damaged beyond repair.

History of the flight

Background

The pilot had recently joined a syndicate to fly G-AZCZ. His previous flying experience included an Icarus C42 and more recently a Piper PA-28, in which he had completed his PPL (A) training and thereafter had flown as part of another syndicate. The pilot also held a restricted instrument rating. Differences training for G-AZCZ was provided by the aircraft's owner, who had flown for about two hours with the pilot. The pilot advised that this had included the need to ensure that the fuel tank selector in the cockpit was correctly set as it was possible to rotate the selector past the detents for each tank. G-AZCZ was fitted with two 12 imperial gallon (imp gal) (54.6 litre) tanks and the fuel selector could be set to direct fuel from the left, right or both tanks. The pilot had also been given advice not to rely on the accuracy of the fuel tank quantity indications displayed in the cockpit.

The flight

The pilot had planned to fly with his passenger from St Athan Airfield, where the aircraft was based, to Sywell Aerodrome before returning to St Athan later the same day. The route to Sywell was to be almost direct, at about 115 nm. The weather forecast showed a slight westerly wind, providing a tailwind outbound and a headwind for the return flight. The pilot advised that the aircraft was fully fuelled prior to departure, which he had calculated would provide sufficient endurance to complete both flights without uplifting fuel at Sywell.

The pilot stated that his fuel planning was based on a fuel usage of 6.5 imp gal/hour. This was the value specified in the Approved Flight Manual (AFM) for when flying at 4,000 ft amsl and 99 KIAS in ISA conditions, at an engine speed of 2,300 rpm with the mixture leaned. The temperature at St Athan was 7°C and the calculated takeoff weight was 793 kg (the MTWA was 873 kg).

The pilot was aware that fog had been reported at Sywell, but this was due to clear, and the weather was also better further to the east at Duxford Airfield. He decided that upon reaching the Daventry VOR he would obtain a weather update from Sywell, after which he would either continue or alter route to Duxford. The pilot stated that he had not calculated the additional fuel required to reach Duxford; Sywell is 14 nm from the Daventry VOR and Duxford is just over 46 nm.

G-AZCZ commenced taxiing at 1100 hrs and took off 13 minutes later. Figure 1 provides the track of the aircraft during the flight. The aircraft climbed to 5,000 ft amsl and, as it approached Cravens Gorse hang glider site located to the east of Gloucestershire Airport, it climbed to 5,500 ft amsl. After passing Cravens Gorse, the aircraft descended to 3,800 ft and levelled off. When it was overhead the Daventry VOR the pilot altered course towards the north and contacted Sywell. The weather had not improved as anticipated and the pilot subsequently altered course towards the south, flying over Milton Keynes before turning east to Duxford, where it landed at 1248 hrs. The flight time was 1 hour 35 minutes, and the flight distance was 170 nm. During the flight the pilot stated that he had leaned the engine mixture and alternated regularly between the left and right fuel tanks; he did not operate the aircraft with the tanks set to both.

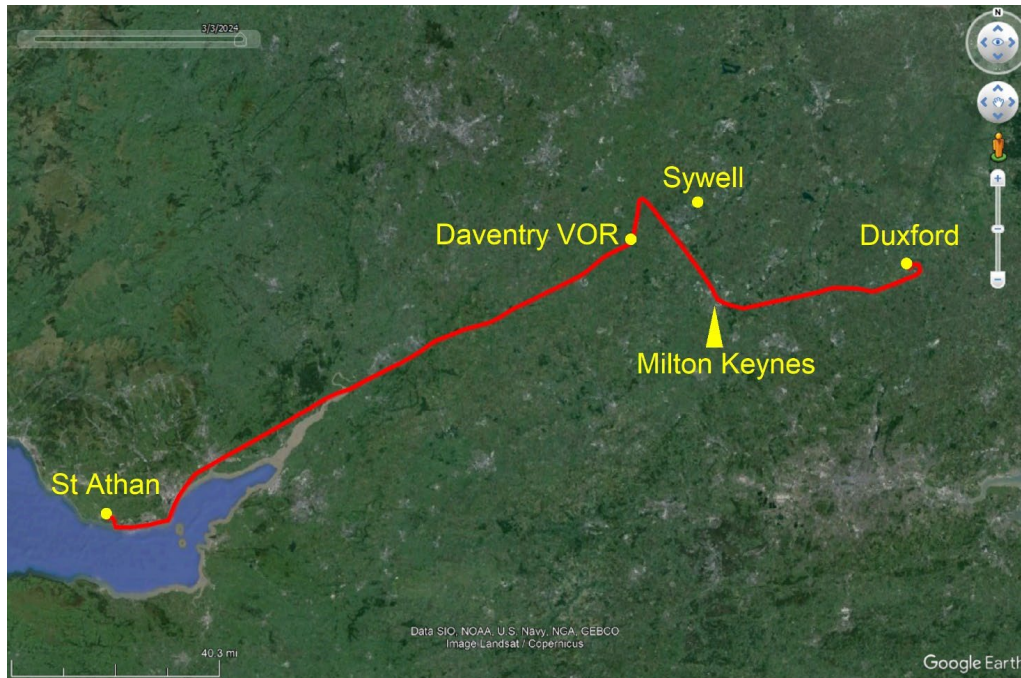


Figure 1

GNSS flight track from St Athan to Duxford
 (©SIO NOAA U.S Navy, NGA GEBCO, Image Landsat / Copernicus)

After several hours on the ground at Duxford, the pilot planned his return route, which was initially to fly to St Neots, then turn west to the Daventry VOR before following a direct route to St Athan. The pilot stated that he had calculated the flight would require about 10 imp gal. Based on his estimate of fuel used during the outbound flight, he calculated that this would leave about 4.5 imp gal remaining on arrival at St Athan.

The pilot reported that he did not check the fuel indicators in the cockpit prior to departure because he was not confident of their accuracy but had visually checked the fuel tanks during his preflight checks. Unlike the PA-28 he was more familiar with, G-AZCZ's fuel tanks were not fitted with a filler neck quantity indicator (known as "tabs" on the PA-28). However, the pilot advised that he had visually estimated the fuel quantity in each tank. This was made by lowering the securing chains of the fuel filler caps into the tanks to estimate the relative level of the fuel from the top of the filler orifice. He advised that he had not been shown or used this procedure before but that it appeared to support his estimate of the remaining fuel and decided that it was not necessary to uplift fuel at Duxford.

The aircraft started to taxi at 1453 hrs and took off at 1500 hrs, initially climbing to 2,500 ft amsl followed by a further climb to 3,500 ft amsl as it passed St Neots. Figure 2 provides the track of the aircraft during the flight. As the aircraft approached Gloucestershire Airport, the pilot changed from the left to the right fuel tank. Between five to ten seconds later the engine started to lose power. The pilot checked the instruments and saw that the fuel pressure was low, following which he identified that the fuel selector was not correctly positioned into the detent for the right tank. Having corrected this, engine power was restored. The pilot advised that he had initially considered diverting to Gloucestershire Airport but, satisfied that he had identified the problem, decided to continue to St Athan.

As the aircraft approached the Severn Bird Sanctuary the pilot climbed the aircraft to 5,000 ft amsl before then starting a gradual stepped descent to 1,500 ft amsl. The aircraft was subsequently cleared for a straight in approach to land on Runway 25 at St Athan. The pilot stated his normal practice was to change fuel tanks during the approach checks and recalled changing from the right to the left tank, for which he reported that he had checked the cockpit gauge which showed 2 imp gal in the left and 4 imp gal in the right tank. The aircraft was now at a height of about 1,100 ft agl and about 2.4 nm from St Athan and 1.5 nm from Cardiff Airport.

Approximately five to ten seconds after selecting the left fuel tank the engine started to lose power. The pilot saw that the fuel pressure was indicating zero and so checked that the electric fuel pump was ON; which it was. He recalled that he had then possibly changed back and forth several times between the left and right tank, but the engine did not regain power. The pilot declared a MAYDAY and, being aware that he was closer to Cardiff Airport, turned towards Runway 12. As the aircraft descended, the pilot was not certain that it would make the runway and so decided to land in a field. During the landing roll the nosewheel dug into the soft ground and the aircraft tipped over. The pilot was uninjured, but his passenger suffered an injury to her shoulder. The emergency services and a SAR helicopter arrived on site shortly after and provided medical assistance.

The total flight time of the accident flight was 1 hour 35 minutes, and the flight distance was 148 nm.



Figure 2

GNSS flight track from Duxford to St Athan
(©SIO NOAA U.S Navy, NGA GEBCO, Image Landsat / Copernicus)

Accident site

The aircraft (Figure 3) was recovered to St Athan the day after the accident. This was performed with the assistance of staff from the maintenance organisation that had maintained the aircraft. It was reported that the aircraft's fuel tanks were intact and both fuel tank filler caps were fitted and secure. There was no smell of fuel or evidence of fuel contamination of the surrounding soil. When the fuel tanks were inspected prior to removing the wings, they were found to be empty of fuel.



Figure 3
Accident site

Recorded information

GNSS derived position and altitude data for the flight from St Athan to Duxford and the accident flight were recorded by a navigation application on the pilot's tablet computer.

The average ground speed during the flight from St Athan to Duxford was 107 kt and during the accident flight it was 93 kt. This was consistent with the pilot's report of having flown at about 100 KIAS and with a light westerly wind.

Aircraft information

From 2001, de Havilland Support Limited (DHSL) based in the UK were the CAA approved organisation that acted as the Type Certificate holder for the Beagle Pup aircraft type. In 2007 the EASA adopted the Beagle Pup, following which the type became an EASA-regulated 'orphan' aircraft that operated in Europe on a Restricted Certificate of Airworthiness under

Specific Airworthiness Specification (SAS) SAS.A.082. SASs were used by EASA during its early inception as a transition measure to allow continued operation of certain aircraft without a Type Certificate and for those without a Type Certificate Holder.

Following the UK's exit from the European Union, regulation of the Beagle Pup aircraft type was returned to the UK CAA, who adopted SAS.A.082 verbatim. The aircraft type remains an 'orphan' with no Type Certificate Holder.

Unusable fuel

The AFM did not refer to unusable fuel but SAS.A.082 included a cross reference '(See Note 1 for data on unusable fuel)'. However, SAS.A.082 Note 1 referred to Airworthiness Directives (ADs) of which none related to unusable fuel. The UK CAA subsequently provided a historical copy of the Beagle Pup FAA Type Certificate Data Sheet (TCDS) A22EU, which had subsequently been superseded by SAS.A.082. The TCDS specified that the unusable fuel weight was 7 lb. This value was reflected on G-AZCZ's weight and balance sheet, which also stated that 7 lb (3.2 kg) of fuel was unusable; this equates to approximately 1 imp gal (~0.5 imp gal per tank).

The accident pilot advised that he was not aware of what volume of fuel was unusable on G-AZCZ.

The AFM and SAS.A.082 included information on fuel capacity, with the AFM stating that the aircraft was fitted with two 12 imp gal fuel tanks. However, the SAS specified that the fuel capacity of 24 imp gal was '*Usable*' whereas the AFM was ambiguous in that it did not clarify if 24 imp gal was usable or included the 7 lb (~1 imp gal) of unusable fuel.

The CAA was made aware of the differences between SAS.A.082 and AFM concerning unusable fuel, for which the CAA stated that they will be working with the EASA and DHSL to correct. This activity is expected to take six months.

Fuel planning

Based on a total usable fuel volume of 23 imp gal and the pilot's planned fuel usage of 6.5 imp gal/hour, this equated to a maximum endurance of 3 hours 32 minutes.

The AFM did not specify fuel planning information for the ground phase (engine startup, taxi and ground power check). However, historical data showed that the aircraft manufacturer had nominally allowed 0.5 imp gal for the ground phase during its flight test program. Fuel usage data for the takeoff climb was provided in the AFM. This specified that at a takeoff weight of 800 kg, climbing¹ from sea level to 2,000 ft would require 0.35 imp gal and from sea level to 4,000 ft was 0.7 imp gal.

Footnote

¹ Based on ISA conditions, at an airspeed at 70 KIAS with the flaps retracted, full throttle and carburetor heat set to cold.

The total recorded flight time from St Athan to Duxford and the subsequent accident flight was 3 hours 10 minutes. This equated to 20.6 imp gal at 6.5 imp gal/hour. This would have provided a planned 2.4 imp gal remaining. However, if an allowance of 1 imp gal for the ground phases and 1.4 imp gal for climbing to the planned cruise altitude of 4,000 ft is applied, the planned fuel would be equal to a total useable fuel quantity of 23 imp gal. If the actual usable fuel is 24 imp gal, this would have provided approximately 1 imp gal of planned fuel remaining.

The CAA Skyway Code² states that '*you are not recommended to land with less than 30 minutes fuel for a VFR flight*'. The CAA considers the Beagle Pup type to be a Part 21 aircraft for which the 30 minutes of fuel is a requirement³, but clarified that it is only a recommendation for non-Part 21 aircraft. At a fuel usage of 6.5 imp gal/hour, this equates to just over 3 imp gal of usable fuel required.

Conclusion

The evidence indicates that the loss of engine power was most likely due to fuel starvation.

The possibility that the pilot had not correctly set the fuel selector to the left tank during the approach checks was considered. However, the pilot stated that he thought this was less likely as, following the previous mis-setting earlier in the flight, he had paid special attention to ensuring the fuel selector was correctly positioned into the appropriate detent.

The other possibility is that the useable fuel in the left tank had become fully depleted. The pilot was not aware that nearly 1 imp gal of fuel was unusable and had not allowed for additional fuel usage during the ground or initial climb phases. The retrospective fuel planning also indicates that based on a usable fuel capacity of 23 imp gal, the total planned fuel was equal to the total available fuel on board. It is however possible that some useable fuel remained in the right tank but changing back and forth between tanks, as recalled by the pilot, would have likely extended the time required to restore fuel to the engine.

As was also the case for the original departure from St Athan, the calculated weight of the aircraft was less than the MTWA when the fuel tanks were fully fuelled, and with the pilot and passenger onboard. Therefore, there was no limitation on uplifting fuel whilst at Duxford, and this would have provided a greater safety margin.

This accident highlights the need for effective pre-flight fuel planning, which includes allowance for unusable fuel and fuel used during ground and initial climb phases.

Footnote

² <https://www.caa.co.uk/our-work/publications/documents/content/cap1535s/> [accessed 16 April 2024].

³ https://regulatorylibrary.caa.co.uk/965-2012/Content/Regs/19060_NCOOP125_Fuel_and_oil_supply_aeroplanes.htm [accessed 4 July 2024].