ACCIDENT

Aircraft Type and Registration:	Schleicher ASH 25 E, G-CFST	
No & Type of Engines:	1 Rotax 275 two-stroke engine	
Year of Manufacture:	1989 (Serial no: 25073)	
Date & Time (UTC):	26 August 2020 at 1216 hrs	
Location:	Cheltenham, Gloucestershire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - 1 (Fatal)	Passengers - 1 (Minor)
Nature of Damage:	Aircraft destroyed	
Commander's Licence:	BGA Glider Pilot's Licence	
Commander's Age:	91 years	
Commander's Flying Experience:	6,007 hours Last 90 days - 14 hours Last 28 days - 3 hours	
Information Source:	AAIB Field Investigation	

Synopsis

G-CFST launched behind an aerotow tug from Aston Down Airfield with the intention of soaring along the Cotswold Ridge between Dursley and Broadway. The soaring conditions proved challenging and the glider became too low as it followed the ridge to the east of Cheltenham, an area with few options for a successful field landing. The glider collided with the top of a line of trees while the pilot was attempting to start the glider's sustainer engine and trying to find a suitable place to land. After colliding with the trees, the glider struck the ground nose-first imparting fatal injuries to the pilot. The rear seat passenger received only minor injuries.

The investigation found that the accident occurred because the glider was flown over an area where the combination of the terrain and the glider's altitude meant a successful field landing could not be assured. While the pilot had been flying under an informal age-related 'dual-only' limitation imposed by his gliding club, the investigation was not able to determine to what degree age was a factor in the pilot's decision making on the accident flight.

Following this accident, the BGA began a consultation process with their member clubs to develop policy and guidance for the management of pilots who, for any reason, might benefit from flying with a safety pilot or relinquishing PIC status.

History of the flight

The accident pilot, hereinafter referred to as the pilot, was a member of the gliding club at Aston Down Airfield. On the day of the accident he was taking part in a time and distance challenge of soaring between Dursley and Broadway along the Cotswold Ridge. The ridge is approximately depicted by the dashed blue line on the map at Figure 1.

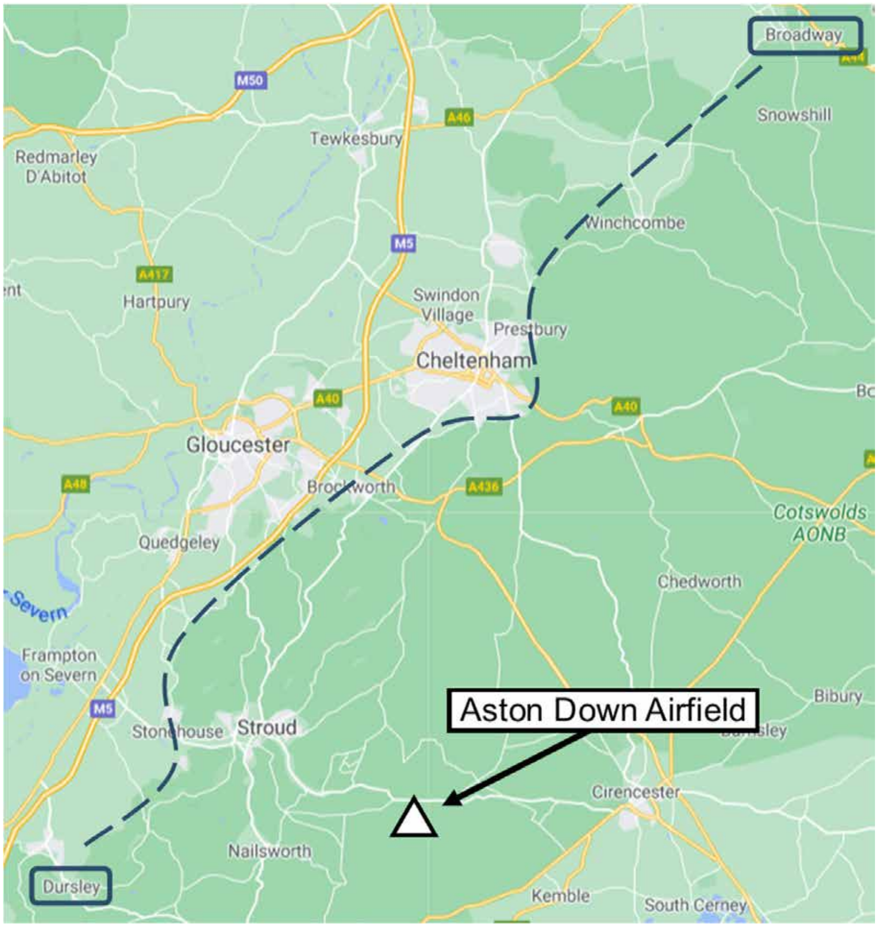

Figure 1

Challenge route between Dursley and Broadway
(©2020 Google)

The pilot was accompanied by a long-standing friend who he had asked to join him for the day's flying. The friend, hereinafter referred to as the passenger, was also an experienced glider pilot and the two had flown together many times previously.

The passenger reported that the pilot had attempted to test-start G-CFST's sustainer engine, using the in-cockpit impulse starter handle, when standing beside the glider at the launch queue. While the engine did not fully fire up, it "coughed" on the third or fourth attempt, which the pilot reportedly took as an indication of its serviceability. The passenger also confirmed that they both carried out a "harnesses and canopies secure check" during the pre-flight checks.

The glider launched behind an aerotow tug just before 1200 hrs and climbed out to the west, reaching approximately 1,500 ft aal (2,100 ft amsl) before releasing the tow in the vicinity of Woodchester (Figure 2). The passenger reported that the pilot maintained the correct position behind the tug throughout the aerotow.

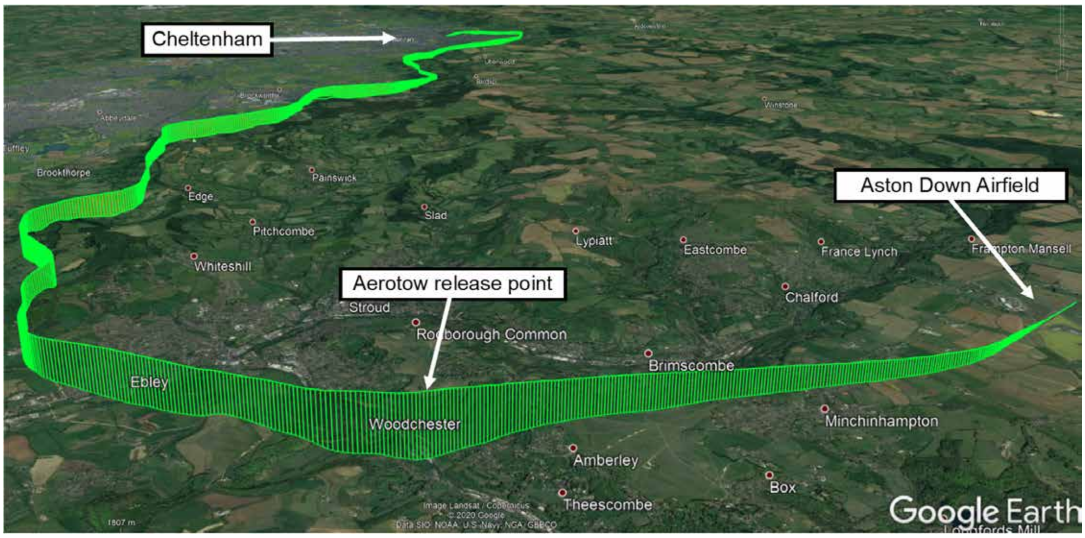

Figure 2

Flight elevation profile
(Image Landsat/Copernicus ©2020 Google)

He also reported that there was very little lift to be found as the glider tracked north-eastwards along the ridge. Crossing the 'Birdlip bowl[1]' to the east of Gloucester (Figure 3) they experienced significant "sink," losing over 350 ft in 1.8 nm.

The passenger judged that the ridge "was not working" and became increasingly concerned they were too low to continue following the route as intended. At that point he suggested to the pilot that they should "err on the side of caution" and divert to Gloucester Airport, approximately 3 nm to the north-west. Possibly because they had picked up lift while tracking northbound towards Shurdington, the pilot instead chose to continue following the ridge east of Cheltenham. While concerned that they were lower than he was comfortable with, the passenger judged that, given the shallow glide angle of the ASH 25 E, they still had just enough height to allow them to escape to the north and, potentially, land at the airstrip adjoining Cheltenham racecourse (Figure 3).

Footnote

[1] Colloquial name for the area where the ridge tracks east and then north in the vicinity of Birdlip.

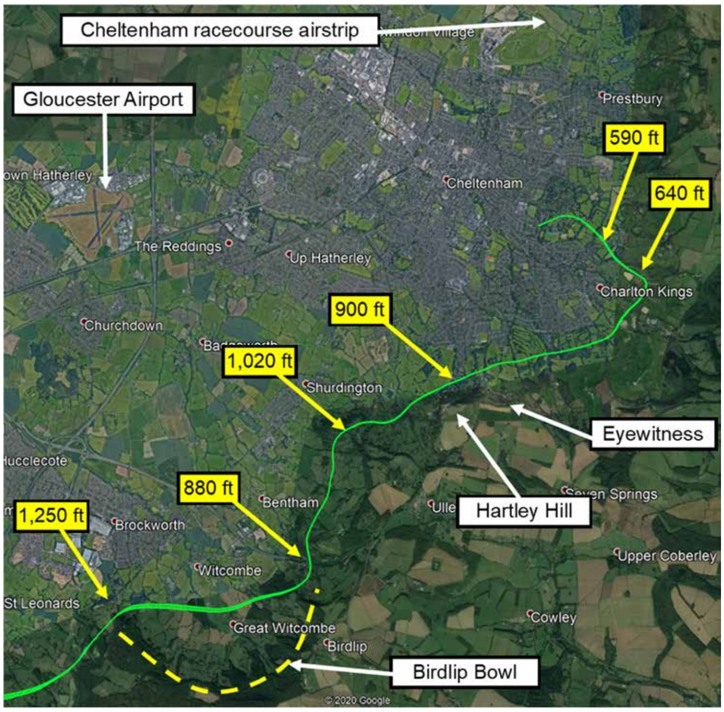

Figure 3

Overhead view of G-CFST's track and approximate navigation logger-derived altitudes (©2020 Google)

Once past Shurdington, the glider descended steadily as it tracked eastwards. An eyewitness reported being on Hartley Hill at 270 m (885 ft) amsl (Figure 3) and seeing the glider heading from west to east close to the ridge "just below" their level. The witness's estimate of the glider's altitude broadly correlated with data recovered from navigation logging devices in the aircraft.

The glider was below ridge level at approximately 4-500 ft agl as it passed east of Hartley Hill (Figure 4). As the ground rose to meet it beyond Charlton Kings, the glider's height reduced to below 250 ft agl at the point where the pilot turned to the north-west.

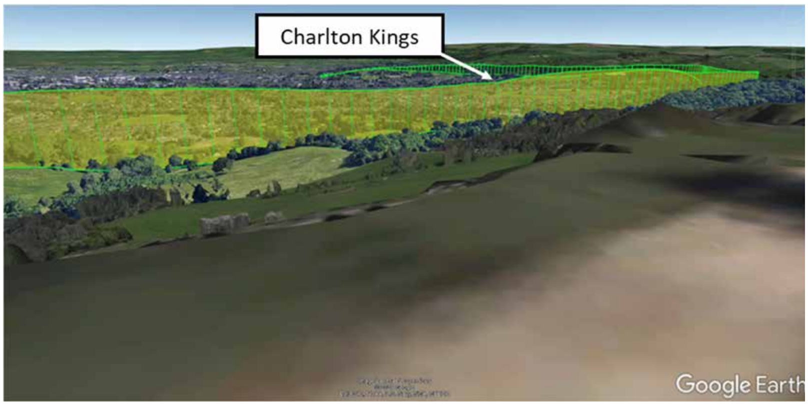

Figure 4

View of glider track looking north-east from the witness's location on Hartley Hill (Image Landsat/Copernicus ©2020 Google)

Shortly after turning away from the ridge near Charlton Kings and without informing the passenger, the pilot began an attempt to start the glider's engine and turned to the south-west. The additional drag with the engine deployed required the pilot to lower the glider's nose to maintain speed for a windmill start[2]. Despite the dive angle achieved, the passenger estimated that they were 5 kt slower than ideal for a start attempt. He could hear the engine turning over but it did not fire up and the glider was heading toward a row of trees short of a residential area. Just before the glider entered the trees, the passenger put one hand across his face to protect it and pulled back on the control column to try and stall the aircraft and drag the tail through the trees in an attempt to reduce the energy of the collision.

CCTV evidence showed the glider hitting the tops of the trees in a right-wing low attitude. It then pitched steeply upwards and yawed rapidly to the right before falling to the ground, nose-first, beyond the tree line.

The first person on scene was a witness who had been tending animals approximately 100 m from the accident site and heard the impact. He arrived at the glider within "two to three minutes" and found the pilot unconscious. The passenger was dazed but already talking to the emergency services by mobile phone. The witness then left the site to get help from his wife, a nurse, who was in their house 150 m from the glider. On arrival at the aircraft, the nurse saw that the pilot was still unconscious. She checked his pulse and found it to be present but weakening. While remaining with the pilot to comfort him, the nurse could hear a "motor" running in the fuselage. The passenger identified this as the electric fuel pump which was controlled by a switch in the front cockpit. Concerned about a potential fire risk, he asked the nurse to try and turn the pump off. Under his direction she operated a "silver-coloured flick switch" in the front cockpit but the fuel pump kept running. The passenger then reached over his shoulder and pulled at the connecting wires to both batteries to disconnect them, thereby removing the power supply from the fuel pump.

The ambulance paramedic who arrived on scene at 1236 hrs determined that the pilot had passed away. The passenger, having been initially trapped, was released from the cockpit by the emergency services and was able to walk, with assistance, to the waiting ambulance.

Recorded information

Loggers

Four flight logging devices had recorded GPS positions and other parameters during the flight. The horizontal paths differed by as much as 40 m but were usually more closely matched. The altitude profiles recorded similar vertical motion but were offset from each other by large amounts. These offsets could not be accounted for by using different commonly used datums[3]. The altitude profile of one of the loggers, a Naviter Oudie (referred to as logger A), was consistent with the departure airfield elevation and used for further flight path analysis. The flight path is shown in Figure 5.

Footnote

2 Procedure and speeds for a windmill start are covered in the section on 'glider description' in this report.
3 The datum defines zero elevation which may or may not coincide with local sea level.

Figure 5

Accident flight

One of the loggers, a Cambridge GPS NAV Model 25 (referred to as logger B) also recorded pressure altitude. Correcting this for terrain elevation at the start of the flight results in an altitude profile that broadly agrees with the GPS altitude profile of logger A. The correction does not account for any changes in the ambient conditions during the flight or the fact that the sensor measures the cockpit static pressure and not the external pressure via a static port.

Logger B also recorded an Environment Noise Level (ENL) parameter, also described as the Engine Noise Level. This is used to establish whether an engine is used during a competition flight. It has an internal microphone which captures the ambient noise and the logger processes the signal into a single value that is recorded whenever a geographic position is logged. This is not in specific units but can be compared to previous flights and documentation relating to acceptability as a competition logger.

Three loggers recorded ground speed and the equivalent data was derived from the flight path recorded by the fourth. The ground speed values were closely aligned. Pertinent data from the loggers is shown in Figure 6.

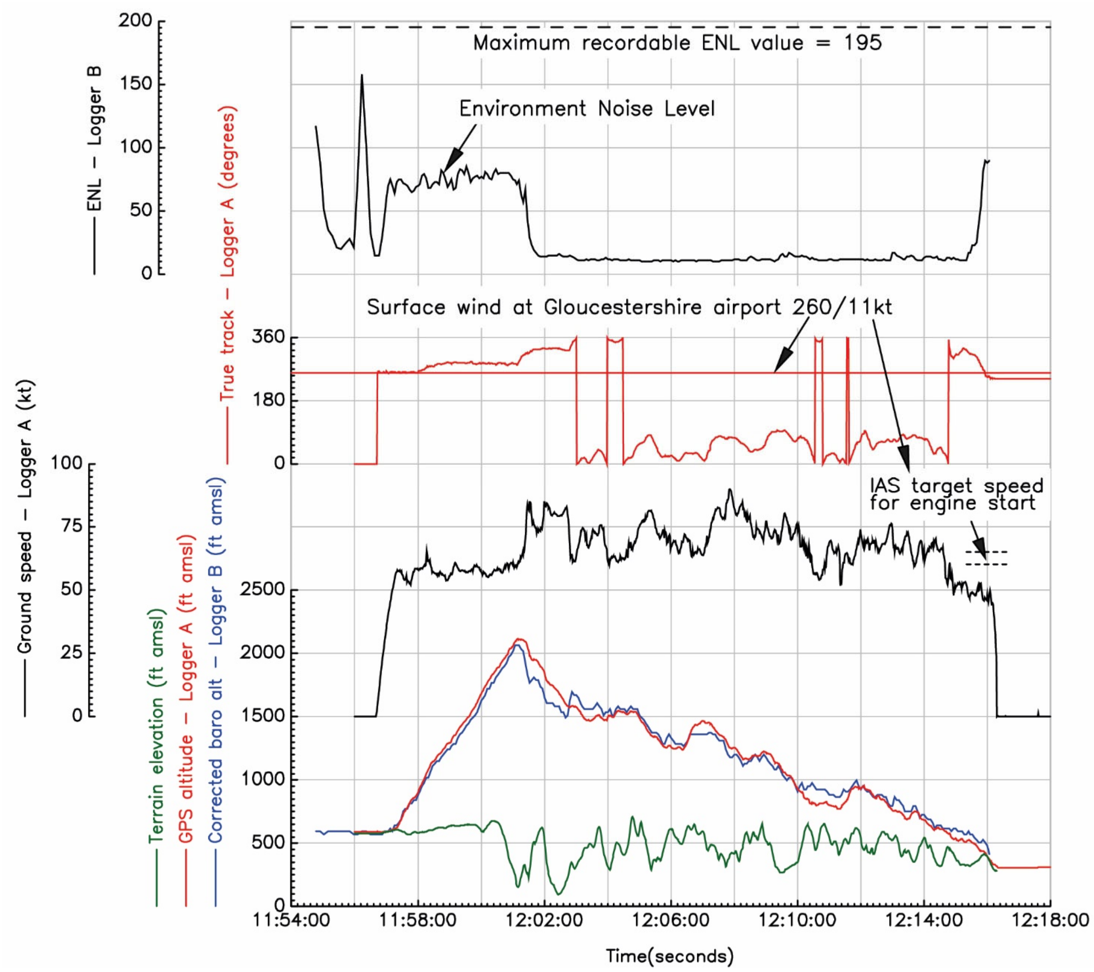

Figure 6

Accident flight recorded parameters

The glider takeoff run started at 1156 hrs, it climbed at approximately 388 ft/min and reached a peak recorded GPS altitude of 2,110 ft amsl. This was followed by a generally descending flight path with small further climbs.

Noise level

The ENL values recorded during the accident flight were compared to the previous flights downloaded from the logger and were found to be broadly similar for the majority of the accident flight. The ENL values of 90 recorded at the end of the accident flight are more than the normal noise generated by the glider in the final approach but less than that generated during the landing run. For the logger, the typical range of ENL values expected while running a two-stroke engine is over 150 and typically 180 or more, but this is not specific to G-CFST.

Figure 7 shows the ENL value increasing relative to the final flight path. It is likely that the increased values recorded at the end of the accident flight are associated with the deployment of the engine, but it is not known if it reflects an attempt to start the engine, or is just an increase in aerodynamic noise.

Figure 7
ENL values at the end of the flight

CCTV

The final part of the flight was recorded by two CCTV cameras. The final moments are partially obscured by trees but provide sufficient information to establish the fundamental final manoeuvre. The details are provided in the History of the Flight section of this report.

Glider description

General

The ASH 25 E is a two-seat, mid-wing, self-sustaining, powered glider, designed and manufactured by Alexander Schleicher GmbH & Co. It is of predominantly glass fibre construction and has a 25 m wing, T-tail and retractable landing gear. Each wing has an inner and outer section, with the structural and flight control joint at 3.8 m span.

Flying controls

With the exception of the rudder, the flight controls are actuated using a combination of pushrods and bell cranks. The rudder is operated by steel control cables. Three trailing edge flaps, which also function as ailerons, extend over the full span of each wing. Each wing has a double-panelled airbrake that extends from the upper surface.

Seat restraints

Both seats are equipped with a four-point harness. A rotary buckle, also known as a quick release fitting (QRF), is incorporated as part of the right lap strap. Turning the QRF in either direction simultaneously releases both shoulder straps and the left lap strap. A rectangular tab at the 12 o'clock position on the QRF allows the wearer to release only the shoulder straps, by hooking a thumb or finger behind the tab and pushing forward (Figure 8).

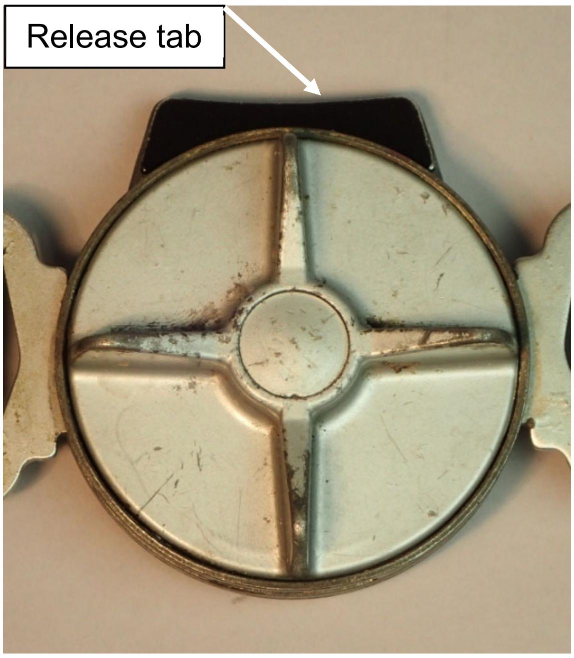

Figure 8
Seat harness QRF

The shoulder straps are mounted on a metal bar above each seat. Structural attachment for each lap strap is achieved by a metal shackle and bracket, which is integrally mounted in a composite plate bonded to the cockpit wall.

Sustainer engine

The glider is equipped with a Rotax 275 two-stroke, single-cylinder sustainer engine driving a two-blade, fixed-pitch, wooden propeller. The engine is normally stowed inside the fuselage behind the cockpit and the extension/retraction mechanism is electrically powered.

The engine can be operated from the front cockpit only. An engine control unit on the right armrest comprises the main switch for the engine electric system, a red pilot light which illuminates when the main switch is ON, an ignition toggle switch and an EXTEND/RETRACT rocker switch (Figure 9).

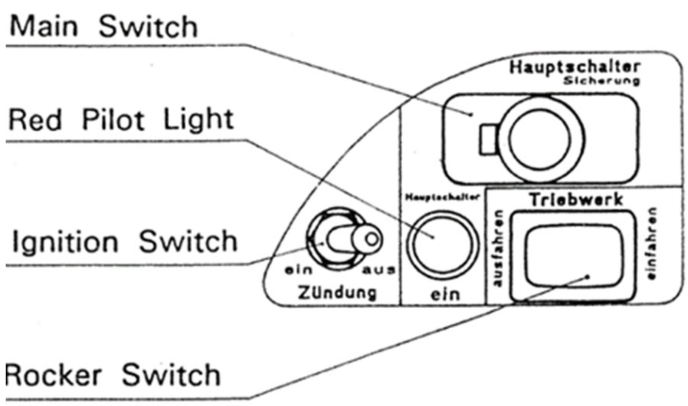

Figure 9

Engine control unit

The cable-operated throttle, choke and propeller brake are actuated by levers mounted on the right side of the cockpit wall. A pull-start handle mounted in the right footwell, operates an impulse starter. G-CFST's engine had been retrofitted with a cable-operated decompressor valve to assist engine starting, removing the need to use the engine pull-start handle in flight (Figure 10).

G-CFST was fitted with an 8.5 litre composite fuel tank in the wheel well and a 15 litre flexible fuel bag in the left wing. The fuel shutoff valve is operated by a lever on the left side of the cockpit and the electric fuel pump is operated by a toggle switch on the front instrument panel.

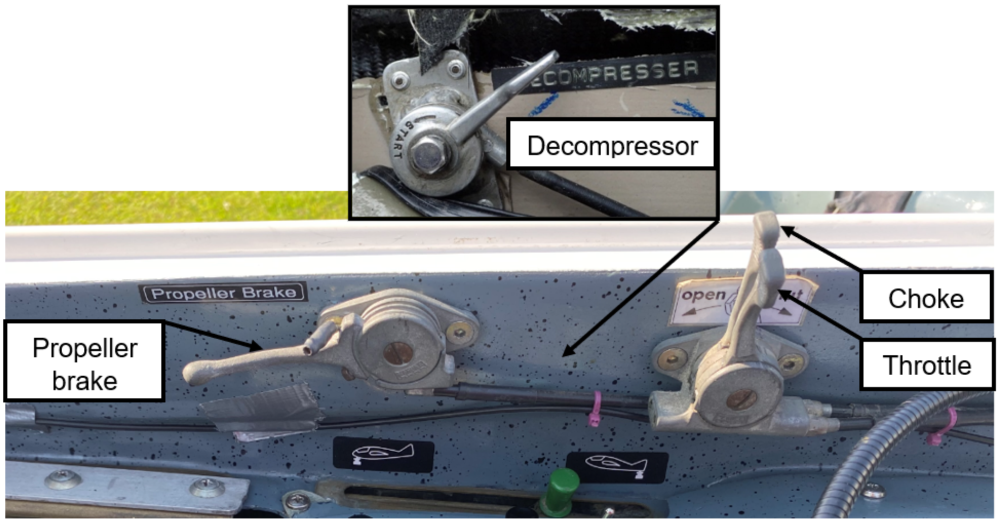

Figure 10

Engine controls on another ASH 25 E (main image)
showing position of decompressor lever on G-CFST (inset)

Engine starting

The ASH 25 E flight manual[4] describes the following initial actions for extending and starting the engine, whether inflight or on the ground:

- *Fuel shut-off valve:* OPEN
- *Main switch:* ON *(red pilot light)*
- *Continue to press switch on "*EXTEND*" setting until signal sounds for about one second*
- *Ignition:* ON
- *Propeller brake:* OFF *(released)?*

For an inflight start, the following actions are then required:

- *Air speed 110 to 120 km/h (60 to 65 kt)*
- *Throttle 1/3rd forward*
- *Choke:* OPEN *(fully forward!)*
- *Firmly pull starter until engine turns over*
- *Reduce airspeed and apply full throttle (watch the rate of revolutions!)*

The flight manual procedure does not cover the use of a decompressor. In the case of G-CFST's engine, the decompressor would be held OPEN by the pilot as the glider was being dived to achieve an airspeed of 60 – 65 kt. This removes cylinder compression, allowing the propeller to windmill in the airflow. The lever would then be moved to the START position, closing the decompressor and allowing the engine to start.

Starting the engine on the ground requires slightly different throttle and choke settings and three to four strong pulls of the pull-start handle.

Flight manual cautions

The flight manual contains two cautions relating to the operation of the ASH 25 E's engine:

> *'The power-plant of a powered sailplane must not be regarded as a life insurance, for instance for crossing unlandable areas.'*

> *'If the situation is so critical as to make a crash landing likely as no landable terrain can be reached, the power-plant should be retracted - even with the propeller out of vertical or not quite stopped - about half-way. This not only improves the gliding performance…but also reduces the risk in case of a crash landing.'*

Footnote

4 Flight manual for Powered Sailplane ASH 25 E, Alexander Schleicher GMBH & Co., Segelflugzeugbau, D-36161 Poppenhausen/Wasserkuppe, dated October 1989.

Accident site

The accident site was in a narrow sloping field on the edge of Cheltenham, within the grounds of a school. It was bordered to the north and west by residential areas and to the south and east by school grounds (Figure 11).

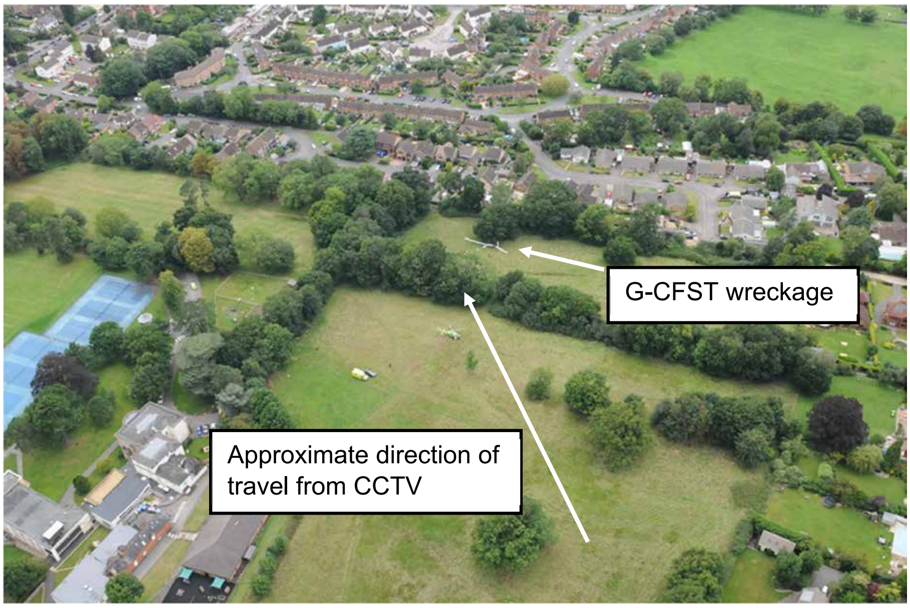

Figure 11
Accident site

The wreckage of the glider was situated below the canopy of a large oak tree. Several large branches had broken and fallen on top of the wreckage, indicating that the glider had struck this tree. It was also apparent that the tops of some of the trees which formed the boundary with the adjacent field had been trimmed (Figure 12). Damage to the leading edge and lower surface of the outer right wing was consistent with it having struck the tops of these trees. This was subsequently confirmed by CCTV recordings.

Figure 12
Trees struck by the right wing from above (left) and from the adjacent field (right)

An impact crater approximately 45 cm deep corresponding to the profile of the glider's nose, indicated that the glider had struck the ground in a steep, almost vertical nose-down attitude. A clear indentation in the grass had been made by the leading edge of the left wing. Disruption to the front cockpit included crushing of the sidewalls and disturbance of the flight control runs, seat structure and floor but the cockpit retained a substantial degree of structural integrity. The shoulder straps on the pilot's harness were found undone, but the lap straps were engaged in the QRF. Neither the first people on scene nor the first responders had released the pilot's shoulder straps.

The engine was deployed but the engine pylon had bent forward approximately 90° from its normal deployed orientation, such that the engine was lying parallel to the top of the glider above the rear cockpit (Figure 13). The landing gear was retracted. The tail boom had fractured just behind the engine bay and the left outer wing had separated at the wing joint, leaving a section of broken spar protruding from the inner wing. The control rods for the airbrake, aileron and flap were bent rearwards and had exited through the trailing edge wing structure at the location of the wing break. The left airbrake was extended.

The presence of all major components of the glider and the compact distribution of wreckage indicated that the glider had been structurally intact prior to striking the trees.

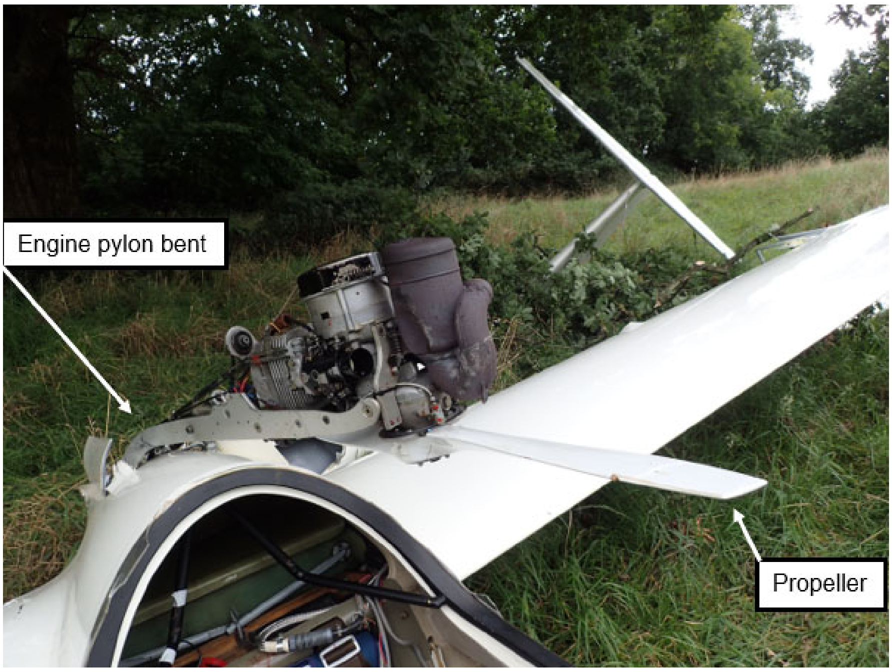

Figure 13
G-CFST wreckage showing position of engine

Detailed aircraft examination

Engine, engine controls and fuel

The engine was free from external damage but the damage sustained by the extension actuator and pylon was consistent with it being in the extended position when the ground impact occurred. The propeller was intact and largely undamaged with the exception of two small cracks in the hub and a small nick on the trailing edge of one blade. There was no evidence of rotational scoring which might be expected if the propeller was rotating at impact.

Apart from the ignition switch, which was in the OFF position, the position of the engine controls was broadly consistent with the expected positions for engine starting. There were 6.5 litres of fuel in the fuselage tank and 8.5 litres in the left wing tank. Both the fuel shutoff valve and its selector lever were found partially open. The operating linkage runs inside the front seat left armrest which had been disturbed during the impact, so it was not possible to determine its pre-impact position. The fuel pump switch was found in the OFF position.

Damage to the engine support structure precluded running the engine in the installed condition. The engine, engine controls and fuel pump were removed from the wreckage to facilitate a ground run. The engine started on the fourth pull of the pull-start handle and appeared to operate normally. Due to the propeller damage the engine was only run for a matter of seconds, so its continued operation was not assessed.

Flying controls

It was not possible to determine the pre-accident position of the flying controls due to the extent of the disruption to the control runs, but the left airbrake most likely extended when the left outer wing separated.

Seat harnesses

The structural attachments for the shoulder straps at each seat and those for the lap straps on the rear seat, were intact. The composite mounting panels for the left and right lap straps of the front seat, had each separated from the cockpit wall at the bond line.

The fabric straps appeared to be in good condition. Identification labels on several of the straps were missing, faded or torn, but were legible and indicated that they were manufactured in 1989. Both QRFs functioned normally when operated and the release tabs required positive operation to release the shoulder straps.

Aircraft performance

Gliding performance

Interpolation of the performance charts (Flight Polars) in the ASH 25 E flight manual indicated achievable glide ratios of approximately 1:45 at 70 kt and 1:50 at 60 kt for G-CFST at a representative all-up-weight in the clean configuration or with soaring flap selected. While the flight manual does not contain performance tables for flight with the engine deployed and not running, other ASH 25 E pilots estimated that it reduced the achievable gliding range by approximately 60-70%.

Field landing performance

Two pilots with experience of flying the ASH 25 E expressed the view that, depending on available headwind, slope and surface characteristics, the minimum strip length for a field landing in G-CFST would be between 1,000 and 1,500 ft.

Using the sustainer engine

BGA guidance

In their Managing the Flying Risk document, the BGA offers guidance for pilots flying sustainer gliders which includes the following:

> *'Accident report data indicates that most problems occur due to a late decision to start the engine…Having a pre-considered and personally agreed minimum height for engine start – effectively a pilot's own 'red line' - is very important. …. Recognize* [sic] *that descending beneath this height effectively discards the engine option…As should always be the case when flying cross-country, constantly monitor the available landing options. Have a landing option selected before deploying the engine.'*

Club guidance

The gliding club's Chief Flying Instructor (CFI) would informally brief club pilots new to sustainer aircraft that, when contemplating deploying the engine in flight, they should assume that it will not start and to configure for a field landing before deploying the engine. He also suggested that they use 1,500 ft as a minimum height to commence a start and if they are below that height, they should commit to a field landing with the engine stowed.

Experience of engine operation on G-CFST

A review of the pilot's flying logbooks showed that he had the habit of annotating 'E' against flights on G-CFST where he had used the engine, but the last such annotation was against a flight in December 2018. It was not determined whether he did not use the engine in flight after this date, or whether he stopped annotating this in his logbook.

G-CFST's co-owner had flown many hundreds of hours in the glider with the pilot and normally occupied the rear seat. If it became necessary to use the engine in flight, he would typically fly the glider to achieve the necessary airspeed, while the pilot operated the engine controls. He stated that the engine could sometimes be problematic; it did not always fully extend, required a lot of height to start and sometimes did not start. It was also difficult to start on the ground.

The passenger, who was familiar with flying in G-CFST with the pilot, also reported that the engine very often didn't start. He estimated that height loss when starting the engine in flight was typically 400 - 500 ft but recalled one occasion, when the engine had not been used for some time, where the pilot attempted to start the engine at 4,000 ft and it was 1,500 ft before it fired.

Meteorology

The weather at the time of the accident was reported as "good, with moderate westerly winds." A weather observation from Gloucester Airport taken four minutes after the accident recorded a wind velocity of 260°/11 kt and no significant cloud below 3,200 ft.

Glider pilots can record their flights on the BGA Ladder[5], an '*informal, year-long soaring competition intended for UK-based glider pilots.*' In addition to logging time and distance achievements, they can also add comments on, for example, the weather conditions they experienced. The following notes were uploaded by three glider pilots who were flying in the vicinity of Cheltenham on the day of the accident:

> *'The best lift was south of Cheltenham but it looked mostly unlandable there'*

> *'Not quite enough wind from the right direction for ridge to work properly, a lot of wave interference, lots of spreadout[6] and weak thermals all made it rather challenging'*

> *'…ridge not quite working then a combination of spreadout and wave interference'*

Personnel

Pilot

The pilot was the holder of a BGA Glider Pilot's Licence with three Diamond Badges[7]. He started gliding in 1973 and had amassed over 6,000 flying hours. Of those hours, more than 4,400 were logged in multi-seat gliders. He was a well-respected member of the gliding club whose members spoke highly of his flying ability and dedication to gliding.

On a series of winter check flights, in November 2019, the instructor noted an occasional lapse in decision making which he attributed to the pilot "showing the signs of ageing." His handling skills were still of a good standard and, with the pilot about to embark on a period of dual flying in Australia over winter, a decision on how best to manage the situation was deferred. The pilot then did not fly in the UK again until after the national COVID-19 lockdown restrictions were eased in May 2020. He initially regained currency by flying in the club's gliders before returning to the air in G-CFST on 7 June.

In early July the pilot was involved in a potential upset on an aerotow where the towing pilot released the tow cable because the pilot got too high behind the tug. Following the incident, the club imposed a 'no-aerotow' restriction on the pilot, but later revised it to 'dual-only[8]' limitation. The club's rationale for the limitation was twofold; to address any pilot incapacitation risk due

Footnote

5 https://www.bgaladder.net [accessed 2 November 2020].
6 Where convective clouds spread out under an inversion creating a layer of stratocumulus cloud which wholly or partially blocks the sun's rays from the surface, thereby reducing thermal convection.
7 Goal Diamond for a flight of over 300 km, Distance Diamond for a flight of over 500 km and Height Diamond for climbing to 5,000 m.
8 Requiring him to only fly G-CFST when accompanied by an experienced pilot capable of landing the glider in an emergency.

to the pilot's age and to help or prompt his airborne decision making should it be necessary. This was a proactive informal risk mitigation measure by the club and there was no policy, procedure or precedent for the arrangement. The club described themselves as "feeling their way" in managing the situation and were planning to review the appropriateness of the limitation as the gliding season progressed. It was anticipated that, if deemed necessary, the next step would have been to prevent the pilot from acting as PIC. The club expressed the view that higher level guidance for the management of ageing pilots would be welcome.

Before the accident flight, the pilot had flown on four occasions with four different pilots after the 'dual-only' restriction had been established. The fourth occasion was with the club CFI on 2 August 2020. While he had appeared to take the 'dual-only' limitation well, the pilot disagreed with the need for it and wanted to prove to the CFI that it was not necessary. None of the pilots who had flown with him on the three previous occasions had raised any concerns with the club over the pilot's flying but had informally mentioned occasionally prompting him for a decision. Having subsequently flown with the pilot, the CFI remained of the opinion that, while still up to solo standard, he would nonetheless benefit from someone accompanying him to help manage his flights.

Passenger

The passenger reported that, on their many previous mutual flights, he and the pilot would regularly share the flying and navigation tasks. He was aware that the club had required the pilot to be accompanied when flying G-CFST but had not been specifically briefed as to why. His assumption was that it was a pilot incapacitation precaution and to assist with heavy manual tasks like ground handling and raising the landing gear in flight.

Prior to the accident fight, they last flew together in May 2018 in the passenger's Duo Discus glider.

Ageing pilots

Human performance limitations in relation to flying are widely documented in aviation textbooks and guidance literature such as the CAA's *Flight Crew Human Factors Handbook*[9] and *The Skyway Code*[10]. Decision making is discussed in both publications and was an important area of focus for the investigation.

Older pilots are not necessarily less-safe pilots and poor decision making can affect pilots of all age and experience levels. Nonetheless, age-related deterioration in eyesight, hearing, mobility, memory, cognition and decision making are recognised as having an impact on piloting ability. Data from the CAA's website[11] for the years 2000, 2011 and 2018, indicates that the average age of non-commercial pilots in the UK is increasing (Figure 14).

Footnote

[9] *CAP 737 Flight Crew Human Factors Book*, published by the UK CAA. Available at https://publicapps.caa.co.uk/docs/33/CAP%20737%20DEC16.pdf [accessed 4 February 2021]

[10] *CAP 1535 The Skyway Code Version 2*, published by the UK CAA. Available at https://www.caa.co.uk/General-aviation/Safety-information/The-Skyway-Code [Accessed 8 February 2021]

[11] CAA-published data on the age and sex of the UK holders of National and EASA non-commercial pilots' licences with a valid medical certificate. Available at https://www.caa.co.uk/Data-and-analysis/Approved-persons-and-organisations/Datasets/Licence-holders-by-age-and-sex [accessed 22 February 2021]

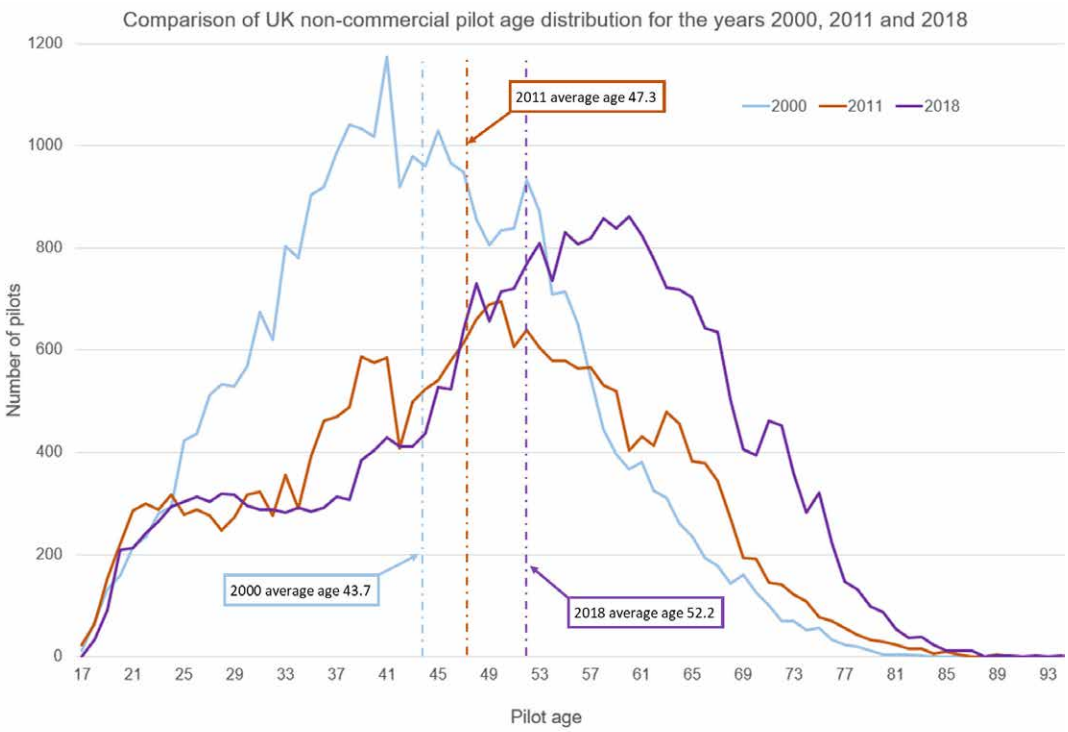

Figure 14

Age distribution of non-commercial UK pilots for the years 2000, 2011 and 2018

Although the broad effects of ageing are well known, there is great variability on how any specific decline will affect an individual pilot and chronological age is not a reliable metric to predict age-related impairment. As quoted in an AOPA[12] Air Safety Institute research review on the subject of 'Ageing and the General Aviation Pilot'[13] , '*Not only does age affect the different cognitive functions to different degrees, the time of onset of significant age effects also differs across cognitive functions.*'[14] While experience, knowledge, aptitude and wellbeing can offset or delay the effects of ageing, there will inevitably come a point where the most sensible option for an individual is to retire from flying as PIC.

One challenge for organisations supervising ageing pilots is that if a pilot has a valid medical and can pass periodical flying checks it is difficult to argue for grounding them when subjective concerns are raised. Unless precipitated by an accident or incident, without an objective metric for making the decision, it relies on individual pilots to be honest with themselves and for supervisors to be candid enough to reach a shared acknowledgement that their days as PIC are over. Family, friends and peers can play a part in encouraging and supporting pilots when that decision has to be made. This is especially important for pilots not affiliated to clubs or sporting associations.

Footnote

[12] Aircraft Owners and Pilots Association, an American political organisation advocating for general aviation.

[13] *Ageing and the General Aviation Pilot* published by AOPA. Available at https://www.aopa.org/-/media/files/aopa/home/pilot-resources/safety-and-proficiency/accident-analysis/special-reports/1302agingpilotreport.pdf?la=en [Accessed 5 February 2021]

[14] Tsang, Pamela S. Age and pilot performance. In '*Aviation Training: Learners, Instruction and Organization*', edited by Ross A. Telfer and Phillip J. Moore. Aldershot: Avebury Aviation, 1997. Pages 21-39.

Following this accident, the British Gliding Association began a consultation process with its member clubs with the aim of developing formal guidance to support the management of pilots of any age who might benefit from flying with a safety pilot or relinquishing PIC status.

Medical

Injuries to persons

In his post-mortem report, the pathologist found that the pilot died from '*the combined effects of multiple traumatic injuries*.' There was no indication of medical impairment or incapacitation of the pilot before the final collision.

The post-mortem examination did not reveal any definitive evidence to suggest that the pilot had been wearing his harness shoulder straps at the time of the accident but could not exclude the possibility. The pathologist's report further indicated that, discounting injuries potentially sustained as a result of his upper torso being unrestrained, the pilot's other injuries would not have been survivable.

The passenger sustained only minor injuries and there were no third-party casualties.

Medical requirements for glider pilots

For pilots holding a BGA Glider Pilot's Licence the medical requirements are detailed in the BGA's Laws and Rules (BGA Operational Regulations)[15] which state:

> *'[Regulation 14] …To fly a glider solo or with another pilot, a pilot needs to hold a driving licence…Additional and higher requirements apply to instructors and those pilots carrying passengers. Details of all acceptable and alternative means of compliance are contained in 'BGA Pilot Medical Requirements.'*

The pilot was not an instructor neither was he carrying an inexperienced passenger; therefore, the medical requirements that applied to him were those in Paragraph 3 of the *BGA Laws and Rules* (BGA Pilot Medical Requirements)[16]:

> *'Acceptable evidence of fitness for pilots of gliders; solo flight or with another pilot: A driving licence issued by an EU nation (or the UK or the Crown dependencies).'*

The pilot held a current UK driving licence which was due to expire on 11 May 2023.

Footnote

[15] *BGA Laws and Rules: BGA Operational Regulations Version 1.1,* Effective date 29 Feb 2020. Available at https://members.gliding.co.uk/library/bga-requirements-guidance/operational-regulations-of-the-bga [accessed 29 September 2020].

[16] BGA Laws and Rules: BGA Pilot Medical Requirements, Version 1.3, Effective date 25 Aug 2016. Available at https://members.gliding.co.uk/wp-content/uploads/sites/3/2015/04/Medical-Requirements.pdf [accessed 29 September 2020].

Assessment of ongoing medical fitness

BGA member clubs can place more stringent medical restrictions on individual pilots should it be deemed necessary. The BGA recommendation is that medical advice should be sought before additional limitations are imposed.

The club had not imposed a recognised medical restriction on the pilot and he had not declared any medical condition that would affect his fitness to fly. The post-mortem report did not reveal any pre-existing medical conditions pertinent to flying and the pathologist did not find any '*obvious features of disease that would be likely to significantly impair or diminish his judgment or cognitive faculties*.'

Medical requirement for a safety pilot

Where the holder of a Class 2 or LAPL[17] medical certificate is considered at increased risk of incapacitation compared to his peer group the awarding medical examiner can impose an Operational Safety Pilot Limitation (OSL). Under the EU regulatory framework[18], '*the holder of a medical certificate with an OSL limitation shall only operate an aircraft if another pilot fully qualified to act as pilot-in-command on the relevant class or type of aircraft is carried on board, the aircraft is fitted with dual controls and the other pilot occupies a seat at the controls.*'

In their Safety Pilot Information Sheet[19], the CAA define a safety pilot as '*a pilot who is current and qualified to act as Pilot-In-Command (PIC) on the class/type of aeroplane and carried on board the aeroplane for the purpose of taking over control should the person acting as the PIC become incapacitated*.' They are not a designated flight crew member and hold the legal status of passenger.

There is no equivalent OSL process or procedure for pilots who are flying under the BGA rules and exercising the privileges of a self-declaration medical.

Organisational information

Regulatory body

At the time of the accident, the BGA was the sporting body overseeing gliding in the UK. Pilots exercising the privileges of a BGA Glider Pilot's Licence were required to comply with the BGA Laws and Rules. In addition to their Laws and Rules, the BGA publish several protocol documents as guidance for pilots. One of these documents, Managing the Flying Risk[20], aims to '*provide pilots and clubs with guidance on how to better understand, minimise and manage the hazards associated with gliding operations, including with powered gliders and tug aircraft. It does not replace any existing law, which should always take precedent*.'

Footnote

17 Light Aircraft Pilot's Licence.

18 Commission Regulation (EU) No 1178/2011 Annex IV, Subpart B, Section 1, MED.B.005.d.2.ii dated 25 November 2011. Available at https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011R1178&from=EN [accessed 5 November 2020].

19 20130121SafetyPilotInformationAndBriefingSheet.pdf v7.1 dated January 2013. Available at: https://www.caa.co.uk/WorkArea/DownloadAsset.aspx?id=4294974324 [accessed 1 October 2020].

20 Managing the Flying Risk v14,1 effective date 12 July 2020. Available at https://members.gliding.co.uk/library/bga-requirements-guidance/managing-flying-risk-guidance [accessed 29 September 2020].

Crew status for single-pilot operations

For a single-pilot operation such as gliding, apart from pilots on an instructional flight with a flying instructor, the only defined crew role is that of PIC. While the PIC can ask anyone on board to assist with the operation of the aircraft, that does not confer crew status on the individual, even if they are a qualified pilot on type or acting as a safety pilot under the OSL provisions.

Crew resource management

Crew Resource Management (CRM) is the effective use of all resources available to a pilot to assure a safe and efficient flight, thereby contributing to better decision making by helping to reduce error and stress. While CRM training was initially developed to improve multi-crew cooperation many elements can be read across to single-pilot operations. Effective CRM combines various skill areas including, situational awareness, workload management, planning and briefing, decision making and communication. The Skyway Code and CAP737 are two of the readily available reference documents which discuss CRM and its applicability to GA and glider flying.

For pilots flying solo, advice from instructors and fellow club members, the assistance of air traffic control and aviation reference documents are examples of supplemental resources that can be accessed before, during and after flight.

Section 12 of Managing the Flying Risk is dedicated to the topic of qualified pilots flying together in two-seat gliders (mutual flying) and addresses some of the associated CRM considerations. It highlights the importance of agreeing who will act as PIC and discussing how either pilot can raise their concerns effectively when airborne. Passengers who are also pilots can offer invaluable assistance provided the ground rules for collaboration and communication are clearly understood.

Other than for pilots on flying instructor training programmes, glider pilots do not routinely undertake CRM training.

Other information

Ridge soaring - general

The term ridge soaring relates to gliders taking advantage of lift generated on the windward side of an escarpment or line of hills when the wind is blowing approximately perpendicular to the high ground. The optimal lift zone is generally found above the windward slope just below the ridge line and extends upwards, angled into wind (Figure 15). Beyond the ridge line the air descends again to follow the terrain, leading to lee side sink. To gain maximum benefit from ridge soaring pilots aim to fly parallel to the ridge and within the optimum lift zone. The amount of lift generated and position of the optimal zone depend on the wind profile and the terrain characteristics of the ridge. With a wind direction more than 45° off perpendicular to the ridge the lift generation process is less effective. Variable physical characteristics of the ridge can affect the lift generating capability for a given wind direction.

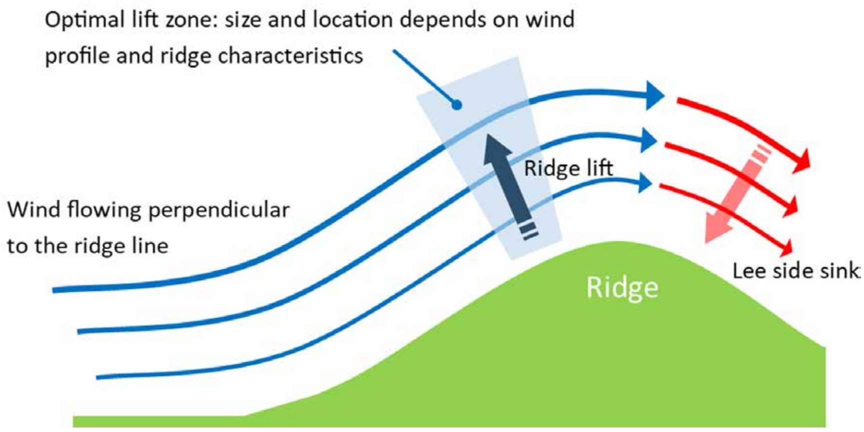

Figure 15

Cross section of imaginary ridge showing lift and sink zones

Lee side sink can be a particular issue when crossing spurs or bowls, such as the one at Birdlip. Crossing a bowl, a glider would experience uplift approaching the boundary spur and then downdraught as it entered the bowl (Figure 16). Taking a direct route across the mouth of such a bowl is the recommended approach[21] to avoid the lee side sink.

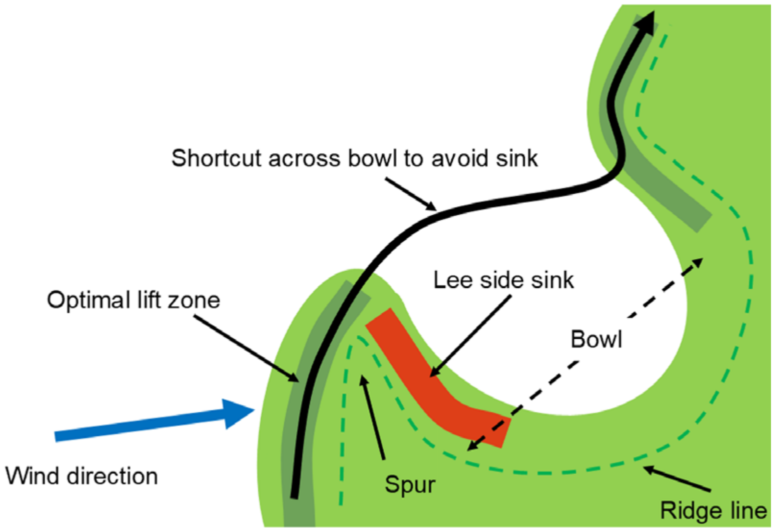

Figure 16

Simplistic view of bowl effect vs ridge lift

Soaring on the Cotswold Ridge

The irregular profile of the Cotswold Ridge and its location in the lee of the Brecon Beacons can give rise to unpredictable and unreliable soaring conditions. As the ridge line changes direction the upslope lift can vary significantly. With a westerly wind, lee wave effects downstream from the Welsh hills can produce interference that reduces available lift. Having

Footnote

[21] FAA Glider Flying Handbook, Chapter 10: Soaring Techniques. https://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/glider_handbook/media/gfh_ch10.pdf [accessed 29 September 2020].

flown from Aston Down for most of his gliding career, the pilot was familiar with the challenges posed by the Cotswold Ridge. Fellow club members referred to him as “an aficionado on the ridge.” Given the pilot’s extensive experience of soaring on the ridge, it is possible that he had developed his own ‘gate-height[22]’ for committing around the Cheltenham Bowl and that he was above it on the accident flight. The investigation was not able to determine if this had been the case. The club’s instructors did not conduct soaring training on the ridge and did not issue gate-height guidance to pilots using it.

While there are areas where towns and villages abut the lower slopes, for most of its length there are ample options for gliders to land out on fields to the west of the ridge. One area where options are limited is where it passes to the east of Cheltenham. Between Hartley Hill to the south and Prestbury to the north, the built up area of Cheltenham occupies most of the land below and to the west of the escarpment. If flying above ridge level, pilots would have an option to head east to the flatter land beyond the summit, otherwise, turning back towards Shurdington or heading north towards the racecourse beyond Prestbury are the shortest available escape routes.

Seat harness and QRF

QRFs similar to that used on G-CFST are common in many aircraft and glider types. The BGA provided anecdotal information that some UK glider owners using similar QRFs had experienced inadvertent operation of the release tab and had since had this function inhibited. The harness manufacturer, which purchases the QRFs from another supplier, advised that it had previously developed a modification to inhibit operation of the release tab. This was done at the request of several glider manufacturers, to prevent the shoulder straps coming undone in aerobatic flight. The modification is incorporated as standard from new on certain aerobatic-rated gliders and is available on request for individual glider owners.

The investigation considered whether the pilot’s shoulder straps could have become disengaged during the accident sequence, due to inadvertent operation of the release tab either as a result of impact loads or other factors.

The pilot had been wearing a USB logger device on a lanyard around his neck. Because it was obscured by clothing, the logger’s position with respect to the QRF was not observed at the accident site. Prominent areas on the back face of the QRF are intended to guard against forward release of the tab (Figure 17). The shape of the logger was such that it could fit in the recess behind the release tab. Post-accident simulations showed that the reclined seating position in the ASH 25 E and length of the lanyard meant that the logger could rest in proximity to the QRF. There were many variables such as exact seating position and height of the wearer and the logger was easily dislodged with movement if positioned behind the QRF. It was therefore considered unlikely that the logger could have interfered with the release tab on the QRF, but the possibility could not be ruled out.

Footnote

22 Threshold altitude, below which he would not attempt to circumnavigate the Bowl.

Figure 17

Seat harness QRF showing rear face (left) and USB logger (right)

The harness manufacturer stipulates a recommended maximum life of 12 years for the harness, including the QRF. Historically the BGA has permitted seat harnesses to be operated 'on condition' subject to annual inspection and agreement by the certifying engineer. G-CFST's Self Declared Maintenance Programme (SDMP) included a documented deviation from the recommended harness life.

The QRF manufacturer advised that it was designed to be an 'on condition' product, with no recommended service life. It indicated that service-related wear of internal locking pins can occur in QRFs with long term usage and these would typically be replaced on QRFs returned for overhaul. It did not find any reports in its records relating to unintended release of the shoulder straps, either due to wear or other reasons.

G-CFST maintenance

General

G-CFST was manufactured in 1989 and was jointly owned by the pilot and another club member. The pilot assumed the role of 'lead' owner, holding the aircraft documents and maintenance paperwork. The glider underwent its most recent annual inspection and Airworthiness Review Certificate (ARC) renewal on 24 March 2020, at which time the BGA inspector also created a SDMP, on behalf of the owners. At the time of the accident G-CFST had accumulated 3,974 flight hours and 1,692 launches.

Engine maintenance requirements

The ASH 25 E maintenance manual[23] originally required that the engine was overhauled every 300 hours or six years, whichever occurred first. The Rotax 275 operator's manual

Footnote

[23] Maintenance manual for the powered sailplane ASH 25 E, Alexander Schleicher GMBH & Co., Segelflugzeugbau, D-36161 Poppenhausen/Wasserkuppe, dated January 1995.

specified that this should be done after 300 hours of operation. The engine manufacturer subsequently ceased to support the Rotax 275 and this requirement was replaced by Service Bulletin (SB) 505-010R1 dated 5 September 2006[24], which provided an updated 'on condition' maintenance schedule requiring maintenance inspections at one, two, three, five and six year intervals. SB 505-010R1 was categorised as 'mandatory' by the engine manufacturer but it was not mandated by an airworthiness directive (AD).

Generic Requirement (GR) 24 '*Light aircraft piston engine overhaul periods'* of Civil Aviation Publication (CAP) 747 *'Mandatory Requirements for* Airworthiness' contains provisions for the maintenance and operation of light aircraft piston engines beyond their maximum overhaul life. Rotax engines were initially excluded from GR 24, but in 2013, Rotax 275 engines installed in powered gliders became eligible to be operated 'on condition' under the provisions of GR 24. This required continued compliance with SB 505-010R1.

On its website, the BGA publishes a Compendium, which is a collection of documents intended to help members identify relevant airworthiness information for a particular aircraft or engine. With respect to the Rotax 275 the Compendium refers to two BGA Technical News Sheets (TNS) 5-2006 and 1-2013 which each refer to SB 505-010R1 and indicate that the maintenance schedule described therein applies to all BGA aircraft with applicable engines.

On 24 March 2020, following the introduction of Part M Light (Part-ML)[25] under Regulation (EU) 2019/1383, GR 24 ceased to be applicable to EASA aircraft types, including gliders. Under Part-ML, continued 'on condition' operation of an engine beyond its recommended overhaul life requires the owner to declare and sign a deviation from the manufacturer's recommended maintenance in the aircraft's SDMP.

Engine maintenance

The BGA inspector had carried out the annual inspections and ARC renewal on G-CFST since 2016. G-CFST's engine had been operated 'on condition' for many years and the inspector commented that it was in reasonable condition when he became involved. During G-CFST's recent annual inspection, the BGA inspector serviced the engine which involved replenishing the gearbox oil, cleaning the spark plug and checking the operation of the decompressor, fuel pump and engine extension/retraction system. He also carried out a cylinder compression test, noting the compression as 50 psi. This was typical of the engine maintenance he carried out at each annual inspection.

Footnote

[24] SB 505-010 is applicable to the Rotax 275, 501, 505 and 535 models and was subsequently updated to Revision 1 (SB 505-010R1) on 4 May 2007. It is available on the Rotax website by searching for Service Bulletins relevant to the 505 model: https://www.flyrotax.com/services/technical-documentation.html

[25] Part-ML is a continuing airworthiness standard for all EASA-regulated general aviation light aircraft (including gliders) which formally transfers responsibility for all aspects of owning and maintaining an airraft to the aircraft owner. It requires aircraft to be subject to a minimum inspection programme, which may be incorporated within an SDMP. Part-ML allows owners flexibility to develop a maintenance programme specific to their particular aircraft and to declare deviations from recommended maintenance. Deviations must be agreed by the certifying engineer, documented within the maintenance programme and signed by the owner.

The BGA inspector commented that he had not noticed any substantial degradation in its condition during this time[26], nor had the owners reported any significant engine problems to him. He was aware that the engine was a source of worry for the owners as it was increasingly difficult to find spare parts. As such they were trying to limit the amount the engine was run to prolong its life. There was an engine hours logger fitted to the glider but the owners considered it unreliable and there was no information relating to engine operating hours recorded in G-CFST's logbook. Only the second of G-CFST's two logbooks was located covering the period from 2015 onwards.

The BGA inspector stated that he inspected the engine each year based on the generic engine inspection requirements of BGA Glider Maintenance Programme and those listed in the Rotax 275 Operator's Manual. These inspection items were carried across when he created the SDMP. He was not aware of SB 505-010R1 or the information in the BGA Compendium which referred to it. Neither G-CSFT's logbook nor the associated work packs for previous annual inspections made reference to SB 505-010R1[27] and G-CFST's owners had not identified its existence to him. As it was not mandated by an AD, he did not come across SB 505-010R1 when he searched for ADs applicable to G-CFST. As a consequence, there were some inspections that were not performed.

When creating G-CFST's SDMP he did not include a deviation for operation of the engine beyond the manufacturer's recommended life, as the engine had already been operating 'on condition' for many years and he considered there would be no change to this under the SDMP.

Analysis

General

Ground marks and the distribution of the wreckage showed that the glider struck the ground in a steep nose-down attitude and was structurally intact before it struck the trees. Examination did not reveal any pre-accident defects which would have affected the controllability of the glider.

Engine

Although the engine was deployed, it was not operating at the time of the accident. With the exception of the ignition switch, which was OFF, the configuration of the engine controls was broadly consistent with an attempt to start the engine. The ignition switch is visually similar to the fuel pump switch and it is possible it was moved post-accident during attempts to turn off the fuel pump.

The engine was reported by several sources to have been difficult to start, both in the air and on the ground and did not start when the pilot attempted to start it prior to the accident flight. During post-accident testing, the engine started on the fourth pull of the pull-start

Footnote

26 The paperwork for the 2019 annual inspection noted the cylinder compression as 4 Bar (58 psi) and as 5 Bar (72.5 psi) in 2016, 2017 and 2018.

27 A work pack from 2008 made reference to a '6-year check' being performed on the engine.

handle, in line with the ground start procedure from the flight manual. In the installed condition, the pull-start cable undergoes several changes of direction. With the engine and its controls removed from the glider for testing, a direct, in-line, pull force could be applied to the starter, which may have contributed to the ease of starting. Continued operation of the engine was not assessed.

Ground testing could not replicate the elapsed time or height required to start the engine in flight, nor take account of using the decompressor. But it indicated that the engine was most likely capable of starting, given available height and time to perform the required sequence of actions and the appropriate airspeed.

Observation on engine maintenance

The engine was no longer supported by the engine manufacturer and it had been operated 'on condition' for many years. It was inspected and serviced annually, including at the recent annual inspection. The engine had not been inspected in accordance with a required SB and G-CFST's recently-created SDMP did not include a documented deviation from the manufacturer's recommended engine maintenance schedule.

These aspects were not causal or contributory to the accident but are reported as they may have relevance to other gliders equipped with engines which were operating 'on condition' prior to the introduction of Part-ML.

> Following this accident, the BGA undertook to write to all BGA Inspectors and owners of gliders with engines that are no longer supported by the engine manufacturer, to remind them of the maintenance requirements and the need to document any deviations from recommended maintenance in the aircraft's SDMP.

Survivability

The pilot's shoulder straps were found undone and had not been released by personnel attending the pilot after the accident. It was not established whether the pilot did not secure them prior to the flight, intentionally released them during the flight or if they became disengaged during the accident sequence. Anecdotal information from the BGA indicated the potential for inadvertent operation of the release tab on this type of QRF and a modification to prevent this was available from the harness manufacturer. It was considered unlikely that the USB logger worn around the pilot's neck could have interfered with operation of the release tab, but the possibility could not be discounted. The post-mortem examination indicated that the extent of the injuries sustained by the pilot were such that they could have resulted in a fatal outcome, even if effective upper body restraint had been present.

With the engine deployed, the impact forces caused substantial damage to the pylon, such that the engine came to rest just above the rear cockpit. In this case the passenger did not suffer injuries as a result. However, it underlines the importance of the guidance in the flight manual to stow the engine if a crash landing becomes inevitable, as a means of reducing the risk of injury to occupants.

Licensing

The pilot held a valid BGA Glider Pilot's Licence.

Medical

Under the BGA Laws and Rules, the pilot was required to self-declare his medical fitness to fly and had done so in February 2019. The pilot held a current driving licence at the time of the accident, thus satisfying the medical requirements stipulated in the BGA's Rules and Laws.

While the club had imposed a 'dual-only' limitation on the pilot because he was "showing signs of ageing," the pilot did not have an identifiable medical condition that would have stopped him from driving or flying. With a valid driving licence and no known declarable medical condition, the pilot's self-declaration medical was valid on the day of the flight.

Club imposed limitation

The 'dual-only' limitation imposed on the pilot was a pragmatic first step towards mitigating potential risk associated with the perceived impact of age on the pilot's decision making. The intention had been to review the measure as the gliding season progressed. The club did not have a formal process to follow and described themselves as "feeling their way" regarding how best to proceed. At the time of the accident flight, the club management did not consider there was enough evidence on which to base a decision to prevent the pilot flying as PIC.

Crew status

The pilot was PIC for the accident flight and the rear seat occupant held passenger status, with no legal authority to override decisions made by the PIC. The passenger was aware of the 'dual-only' limitation on the pilot but had not been formally briefed in his capacity as accompanying pilot. He was not acting in a recognised safety pilot role.

Intervention

Successful and timely in-cockpit intervention by a non-handling pilot, even in a multi-pilot environment, can be difficult to achieve. When the non-handling pilot is flying as a passenger in a single-pilot operation they have no legal authority to interfere with the conduct of the flight, intervention can only be effective if the PIC empowers the passenger to raise concerns. Even when empowered, deference to a more experienced and capable colleague, friendship and a PIC-to-passenger authority gradient are some factors that caninhibit effective intervention. The BGA's guidance on mutual flying recommends airing such topics on the ground before flight as a way of bolstering CRM and avoiding the potential for later awkwardness. It also reminds pilots that the final decision for any course of action is the responsibility of the PIC.

Having flown together on many previous occasions the two friends did not feel the need to discuss the specifics of cockpit management, authority gradient or empowerment before the accident flight.

Gliding performance

The wide variability between the altitude measurements from the various navigational recorders on the glider meant that an accurate calculation of G-CFST's achieved gliding performance was not possible. Loggers A and B broadly correlated with the eyewitness account of the glider passing 'just below' his level on the 270 m contour line at Hartley Hill and were used as the basis for an indicative analysis of the flight's vertical profile but definite conclusions could not be drawn.

Comments from pilots posting on the BGA Ladder confirm the passenger's observation that the Cotswold Ridge was not generating good soaring conditions on the day of the accident. Nonetheless, having released the aerotow at 2,100 ft amsl, the glider covered 16.5 nm before the engine was deployed at an altitude of approximately 590 ft, equating to an average achieved glide ratio of 1:65. It could not be determined to what extent ridge lift, rather than simply tailwind, contributed to this figure.

G-CFST was below ridge height as it flew parallel to it south of Cheltenham. During this leg, the wind direction meant that the ridge would not be expected to produce significant lift, but the pilot might reasonably have anticipated that they would gain height tracking northbound from the Charlton Kings area.

The passenger considered it probable that the pilot expected, even if the ridge wasn't working well, that he would have enough height to reach the racecourse for a field landing. A simplistic comparison of the notional glide performance of G-CFST is included at Figure 18. This shows that from an assumed altitude of 885 ft (270 m) abeam the witness on Hartley Hill, a 1:50 glide path would have been sufficient to maintain terrain clearance when following the hypothetical yellow track line to the racecourse. This calculation does not take account of obstacles, such as buildings or trees, on the flightpath or of any head or tailwind component. Data from the loggers placed the aircraft just below 800 ft passing the witness. The five logger-derived altitude reference points depicted in orange indicate that, likely due to a tailwind, G-CFST was achieving a greater than 1:50 glide ratio around the bowl before the engine was deployed.

From Point 5 on the graphic, while the racecourse airstrip was theoretically in range, the pilot had no contingency height in reserve. Heading north from Point 5 would have looked daunting, requiring descent from approximately 230 ft agl towards hostile[28] rising ground. Terrain clearance at the highest ground elevation on track would likely have been less than 100 ft. From that point, with the terrain gradient approximating close to 1:50, and without factoring in trees and buildings en route, unless it found additional lift, the glider would have been at ultra-low-level for the remainder of the flight (Figure 19).

Footnote

[28] An area with no viable options for a successful field landing.

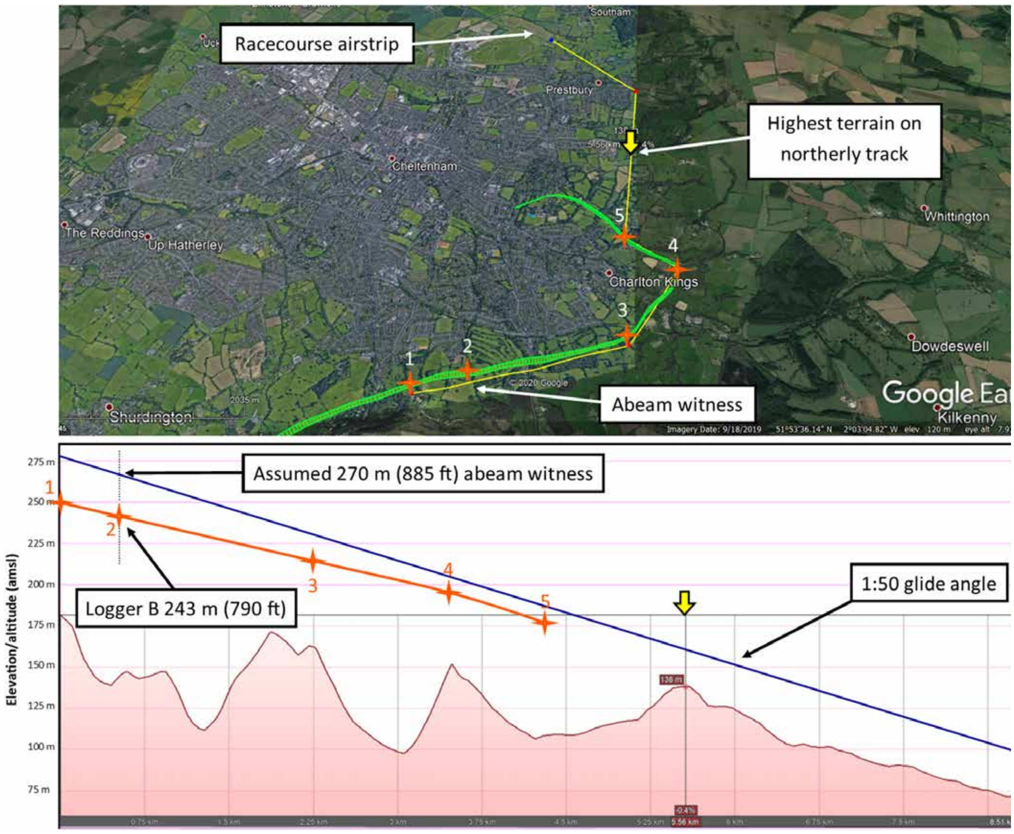

Figure 18

Glide angle and terrain elevation profile comparison (Image ©2020 Google)

Figure 19

View to the south-east from Cheltenham racecourse
(Image Landsat/Copernicus ©2020 Google)

A comparative analysis for escaping to the south-west is at Figure 20. Assuming a 1:50 glide ratio with engine stowed, at 50 kt airspeed and compensating for a 15 kt headwind[29], the glider would theoretically have achieved a 1:35 glide angle over the ground. Starting from an altitude of 590 ft and following the yellow track line on Figure 20, a 1:35 descent profile appears insufficient to clear the built-up area of Cheltenham. While the glider may have been unable to reach open ground beyond the town, it could have reached the playing fields in the middle of the built-up area. Although reachable, none of the playing fields were long enough in which to safely land an ASH 25 E.

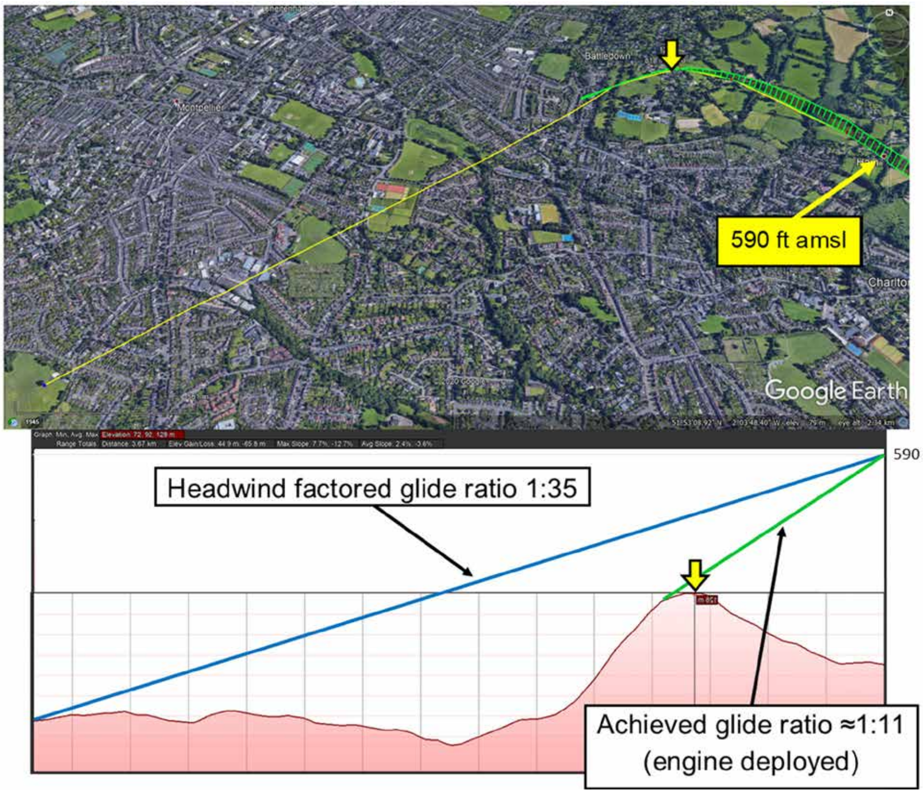

Figure 20

Comparison of notional 1:35 glide angle vs terrain profile across Cheltenham
(Image ©2020 Google)

Engine deployment

The ASH 25 E is an early example of a glider with a sustainer engine and the procedure to start the engine in flight is more time consuming and complex than that on many more modern types. The time taken to deploy the engine and the several steps needed result in unavoidable height loss during a start attempt. When the engine did not start immediately, there would have been insufficient time remaining to follow the steps required to stow the engine. After engine deployment the average glide angle achieved approximated to 1:11.

Footnote

29 Based on the reported wind of 260°/11 kt at Gloucester Airport.

Pilot decision making

The investigation was not able to determine why, having found the soaring conditions unfavourable, the pilot continued following the ridge behind Cheltenham from an altitude which left limited options for a successful outcome. The passenger reported recognising that continuing would be hazardous and prompting the pilot to divert to Gloucester Airport but was not able to convince the pilot to accept his advice.

Once committed behind Cheltenham at low altitude, the pilot found himself faced with three unappealing options as he passed Charlton Kings:

- To descend towards rising hostile ground to the north, trusting that he would have enough height to clear the high ground short of Prestbury and be able to reach a safe landing area beyond.
- To turn into wind over Cheltenham and hope to have enough height to clear the built-up area for a potentially compromised field landing, either in the playing fields or on open ground beyond the town.
- To attempt an engine start at a height from which success would be highly unlikely.

Anecdotal evidence was that the pilot knew starting the engine would require in excess of 400 ft. At the point of engine deployment, the glider was approximately 200-250 ft agl and heading towards rising ground, making a successful start highly improbable. How the pilot arrived at the decision to deploy the engine could not be determined, but the investigation considered it an indication that he thought the other options were untenable and that starting the engine was the only avenue left to try. Being unaware of the intention to deploy the engine, the passenger was unable to influence the pilot's decision to trade the glider's remaining height for an engine start outside viable deployment parameters.

While acknowledging the known effects of ageing on a pilot's general cognitive function, the investigation did not find direct evidence linking the pilot's age to his decision making on the accident flight.

Conclusion

The accident occurred because the glider was flown over an area and at an altitude where a successful field landing could not be assured. While the pilot had been flying under an informal 'dual-only' limitation related to the perceived effects of ageing, the investigation was not able to determine to what degree age was a factor in his decision making on the accident flight. With an ageing pilot population, the effective and fair management of those with declining physical and cognitive capabilities is likely to remain an ongoing challenge for supervisors and regulators. Formal guidance, such as that proposed by the BGA, could help those empowered with overseeing GA and gliding operations make more informed and transparent supervisory decisions in this regard.

Failing to recognise when they are approaching the point of no return for continued safe flight is not the sole purview of ageing pilots; it is a constant hazard in all forms of aviation and for pilots of every experience level. Effective CRM is an important risk mitigation tool for single-pilot operations, not just something to be employed by multi-pilot crews. While passengers do not have legal authority to intervene, if properly empowered as part of an effective CRM strategy, they can make a valuable contribution to the safe conduct of flights.

Safety action

Following this accident, the British Gliding Association:

- Began a consultation process with its member clubs with the aim of developing formal guidance to support the management of pilots of any age who might benefit from flying with a safety pilot or relinquishing PIC status.

- Undertook to write to all BGA Inspectors and owners of gliders with engines that are no longer supported by the engine manufacturer, to remind them of the maintenance requirements and the need to document any deviations from recommended maintenance in the aircraft's SDMP.

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