

ACCIDENT

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| Aircraft Type and Registration: | HK36 TC Super Dimona, G-FMKA | |
| No & Type of Engines: | 1 Rotax 912-A3 piston engine | |
| Year of Manufacture: | 2000 (Serial no: 36.672) | |
| Date & Time (UTC): | 13 July 2017 at 1830 hrs | |
| Location: | Near Brimslade Farm, Wiltshire | |
| Type of Flight: | Training | |
| Persons on Board: | Crew - 2 | Passengers - None |
| Injuries: | Crew - 2 (Fatal) | Passengers - N/A |
| Nature of Damage: | Destroyed | |
| Commander's Licence: | Airline Transport Pilot's Licence and EASA Private Pilot's Licence | |
| Commander's Age: | 57 years | |
| Commander's Flying Experience: | 18,200 hours Last 90 days - 266 hours Last 28 days - 40 hours | |
| Information Source: | AAIB Field Investigation | |

Synopsis

The purpose of the flight was for the aircraft owner to undergo a biennial refresher training flight with an instructor to revalidate his class ratings. The aircraft was seen to be manoeuvring at low level shortly before it departed from controlled flight. It struck the ground in a near vertical attitude on farmland. Both pilots were fatally injured and the aircraft was destroyed. There was insufficient evidence available to determine conclusively the cause of the loss of control, but it was possibly as a result of a power-on stall.

History of the flight

The owner of G-FMKA was undertaking a biennial refresher training flight with an instructor for the purposes of revalidating his class ratings. On the day of the accident flight, the owner flew the aircraft solo from Nympsfield, where the aircraft was based, to Draycot, arriving around 1745 hrs.

The instructor had flown on three other instructional flights from Draycot earlier that day, after which he was asked to conduct this flight. The accident flight was the first time that the instructor had flown in a Super Dimona. Shortly before the flight, the instructor and owner were seen in discussion; however, the content of their discussion is unknown. The precise planned content of the flight could not be established, except that the intended length of flight was one hour.

A witness at Draycot observed what appeared to him to be normal control and engine run-up checks on the aircraft; this included operation of the airbrakes. The aircraft took off from Draycot at 1810 hrs and was seen to depart to the south, towards Marlborough. The airfield had a radio, but no RT calls were received from the aircraft and none were expected.

At approximately 1820 hrs, what is believed to be the accident aircraft was seen over Marlborough by a witness who held a PPL. He stated that he thought the aircraft was at around 1,000 ft agl and heading south. The engine could be heard running, the aircraft was in wings-level flight and all appeared normal. Shortly thereafter, the aircraft was seen manoeuvring in the vicinity of the accident site by several other eyewitnesses. All of the witnesses felt that their attention was drawn to the aircraft because it was much lower than expected. The witnesses, who were widely dispersed, also reported hearing engine noises. Some witnesses described the engine noise increasing in the latter stages of the flight.

There was a consistent view that the aircraft was in a left turn in the latter stages of flight. The closest witnesses to the accident site described the aircraft as being perhaps only 100 ft agl as it passed their house, approximately 400 metres from the accident site, and believed it was going to land.

Another witness described the aircraft as “spinning around one wing and looked very nose-down” before his view was obscured by trees. The accident site was surrounded by tall trees on three sides and none of the witnesses saw the aircraft hit the ground. The accident site was located approximately 7 miles from Draycot (Figure 1).

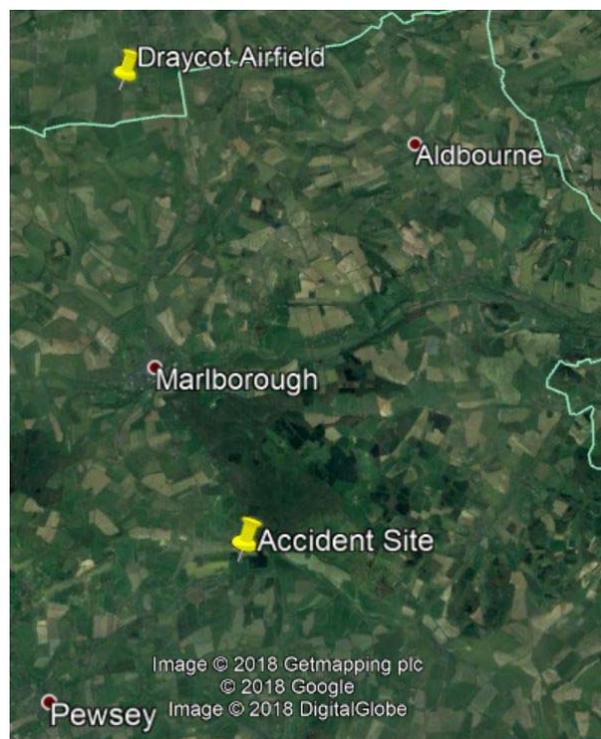


Figure 1
Accident geography

Witnesses described impact noises, followed by a small cloud of dust or smoke. Several witnesses made calls to the emergency services at approximately 1830 hrs. Witnesses who went to the accident site saw a small fire in the wreckage which then spread to the field's barley crop. Workers from the nearby farm used farm machinery to cut a firebreak to limit the spread of the fire. The two occupants had suffered fatal injuries.

Accident site

The accident site was in a gently sloping crop field near Brimslade Farm, to the south of Marlborough. This was one of several large fields in the area. The ground impact marks indicated that the aircraft had struck the ground in an extreme nose-down attitude whilst travelling at considerable speed vertically downwards. The impact speed was such that the engine section was buried back to the bulkhead.

An extensive post-crash fire had occurred, made more intense by combustion of the crop. Emergency service crews were still periodically damping down fire in the wreckage approximately 4 hours after the accident.

Site aerial imagery

An aerial survey of the accident site (Figure 2) was carried out using the AAIB's camera-equipped drone. This revealed impact markings created by the leading edges of the wings which formed symmetrical arcs centred at the point where the engine was buried. The pronounced curvature of the arcs indicated that the wings were experiencing considerable upwards bending at the point of impact. Measurements of the wing deflection were supplied to the aircraft manufacturer for analysis.

Aircraft performance

According to the analysis by the aircraft manufacturer, to produce the degree of upwards wing bending indicated by the ground impact marks, the aircraft would have to have been subjected to a positive acceleration approaching 9 g.

It was the aircraft manufacturer's opinion that such loads could not be achieved without an elevator control input.

Recorded information

A 'Flymap L' (GPS-based flight planning and navigation unit) was recovered from the accident site; however, it was damaged such that no data could be recovered from its internal memory.

The aircraft was not detected by radar, suggesting that it was flying at an altitude below the lower line-of-sight height limit for the radar heads closest to the route flown. For the radar heads of Clee Hill to the north and Bovingdon and Heathrow to the east, this means that the aircraft was probably no higher than 1,500 ft amsl (about 1,000 ft agl).

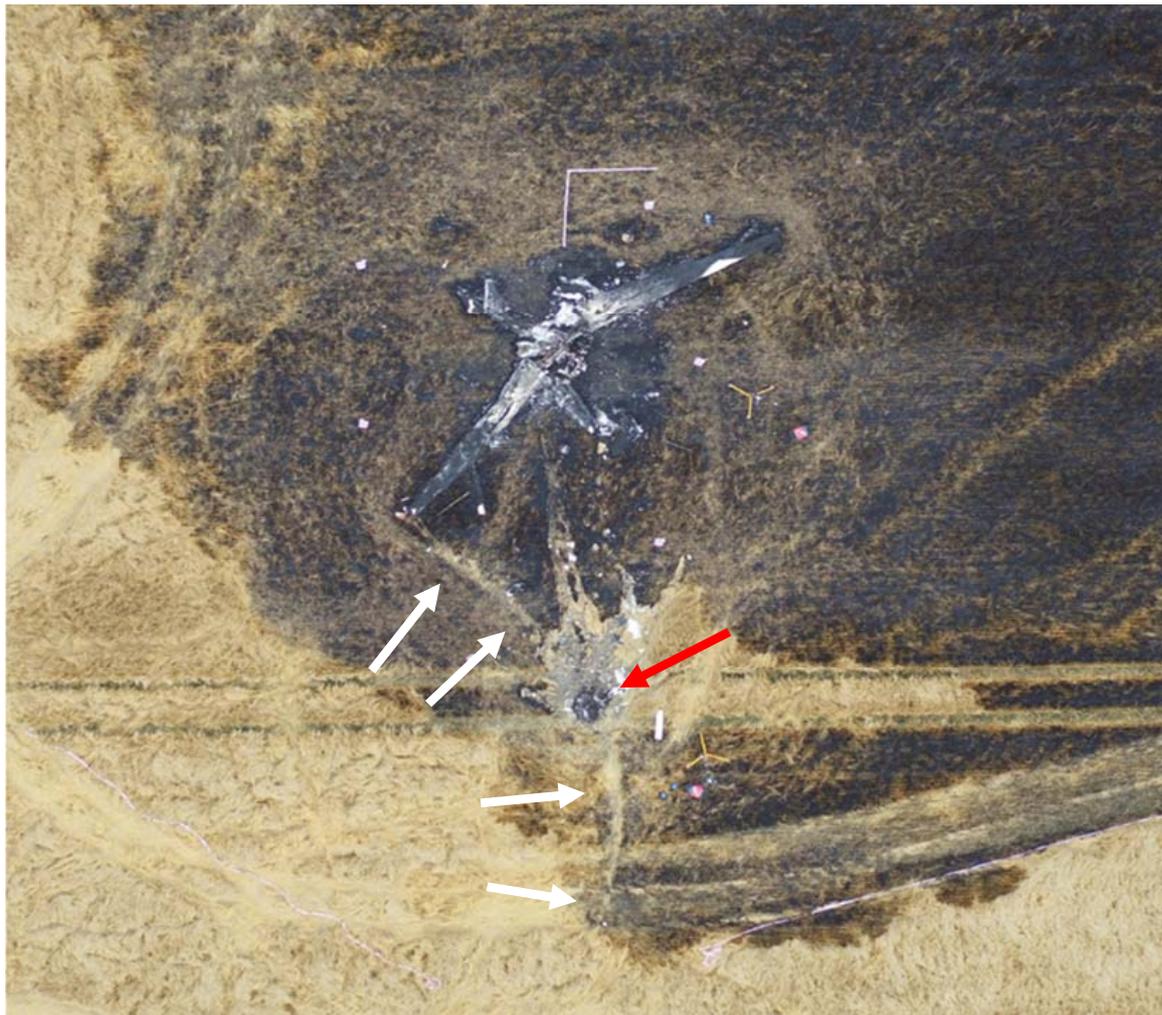


Figure 2

Aerial photo of accident site
(white arrows indicated curved impact marks from wing leading edges;
red arrow indicates engine impact location)

Aircraft information

The HK36 TC series Super Dimona (Figure 3) is certificated by the EASA as a touring motor glider (TMG). It is manufactured predominantly from glass reinforced plastic (GRP) and has conventional pitch, roll and yaw controls and upper wing surface airbrakes. The two-bladed propeller can be operated in a constant speed mode when the engine is supplying power, or may be feathered to minimise drag when the aircraft is gliding. The aircraft can be de-rigged for storage or ground transport.

The ailerons, elevator and airbrakes are operated by tubular steel push-pull rods, eye-end fittings, bellcranks and torque tubes. Most of the tubular push-pull rods are of a standard diameter and wall thickness, and most eye-ends are of a standard pattern. The rudder is cable operated.

A metal fuel tank is positioned behind the cabin area and a shelf is situated in the cabin behind the two pilot seats and above the tank.



Figure 3

HK36 TC Super Dimona (photo courtesy of Diamond Aircraft)

Super Dimona stall characteristics

Section 3.4 of the HK36 TC flight manual contains the following information regarding the aircraft's stall characteristics:

3.4.1 BEHAVIOR WITH POWER OFF

Under all loading conditions, air brakes applied or retracted, wings level flight or banked flight, the HK 36 TC goes through a horizontal stall. The ailerons keep their effectiveness even with maximum elevator deflection.

A partial loss of positive control in the stick and pedals, buffeting, and pitch angle of 20° to 30° occur during this condition.

NOTE

*During the horizontal stall, IAS rises to approximately 85 km/h
(46 kts / 53 mph).*

3.4.2 BEHAVIOR WITH POWER ON

See behavior with power off. Only at 50 % to 100 % power, wings level flight, and maximum rearward center of gravity, the airplane may perform a stall dive over the left or right wing after entering the horizontal stall if the control stick is pulled even further.

3.4.3 RECOVERY

The horizontal stall can be terminated immediately by relaxing the force on the elevator control.

NOTE

If the airplane performs a stall dive, immediately relax the force on the elevator control and pull out the airplane smoothly. If the stick is pulled further, the airplane may start to spin.

** Altitude loss resulting from stationary horizontal stall described above:
approximately 10 - 20 m-(33 - 65 ft.).*

** Altitude loss resulting from stall dive over a wing:
approximately 40 m (130 ft).'*

Aircraft maintenance and utilisation

At the time of the accident G-FMKA was in possession of an Airworthiness Review Certificate, (ARC), issued following an annual inspection. The ARC was dated 7 April 2017, valid until 27 June 2018. At the time of issue, the aircraft had carried out 1,015 hours total flying.

The annual inspection would have required de-rigging of the aircraft and removal of the seats to gain access to flying controls and various other components. It is known that the aircraft was normally hangered in a rigged state.

From the owner's flying logbook it was established that the aircraft had flown a further 10.6 hours since the ARC was issued.

Aircraft examination

Examination carried out both at the accident site and following recovery of the wreckage to the AAIB revealed that the fire had consumed most of the matrix material of the composite structure. Consequently, much of the remaining mass of glass-fibres previously forming the structure could not be identified as to their original location in the aircraft. In particular, a combination of impact forces and fragmentation together with fire had destroyed the fuselage between the engine bulkhead and the wing carry-through box. The metal fuel tank was totally disrupted.

Amongst items that were identifiable at the impact site were: both wingtips, the bulk of the tailplane and elevator, including both tailplane tips, the fin and rudder and the inboard section of the left aileron, incorporating the most inboard of the hinges. With the exception of the outboard length of the left aileron and a portion of the elevator, all control surfaces were accounted for at the accident site. The outboard section of the left aileron, beyond the operating bell crank, was not identified and an outboard section of the elevator appeared to have been destroyed by the fire. This had come to rest beneath the rear fuselage which sustained an intense fire for a lengthy period.

The severely burnt remains of the two wings were found in a relative position consistent with having been correctly attached at impact. Examination of the flying control tubes and bell cranks within the structure of each wing revealed no evidence of pre-impact failure. The extent of disruption of the fuselage, particularly in the area beneath the seats, made it impractical to carry out an effective examination of the control operating mechanism in that area. Numerous lengths of tubing terminated in fractures having the characteristics of compressive buckling preceding final overload failure (ie consistent with impact disruption.)

No specific evidence of pre-impact failure of the flying controls was found anywhere during the wreckage examination, although the extent of disruption of the midships section of the fuselage structure, the impact distortion of control tubes and the large numbers of fractures of those tubes and threaded portions of eye-ends in that section made it impossible to conclusively state that no pre-impact failure was present.

Examination of the propeller hub showed that the pitch change mechanism was seized in a position consistent with being in the normal powered flight range rather than in the feathered position appropriate to gliding flight. The seizure of the pitch change mechanism appeared to be the result of impact distortion of pitch change bearings or parts of that mechanism having occurred in the sequence during which the wooden blades had been sheared off at their root attachments. It was concluded that the seized position of the propeller hub components was at or very close to the flight pitch setting at impact.

During the examination the remains of a walking pole were found amongst the wreckage.

As the fuel quantity on board the aircraft was unknown, the aircraft's centre of gravity could not be determined.

Meteorology

Based on Met Office information, the weather was generally fine with an estimated wind of 250° at 15 kt. Weather radar imagery from around the time of the accident indicated that conditions were dry, with light to moderate showers to the east of the area.

Biennial refresher training

EASA Part-FCL paragraph FCL.740.A *Revalidation of class and type ratings — aeroplanes*, states that, for SEP¹ and TMG class ratings, the applicant shall:

'(i) within the 3 months preceding the expiry date of the rating, pass a proficiency check in the relevant class in accordance with Appendix 9 to this Part with an examiner;'

Footnote

¹ Single-engine piston.

or based on previous experience by:

- ‘(ii) within the 12 months preceding the expiry date of the rating, complete 12 hours of flight time in the relevant class, including:*
- 6 hours as PIC,*
 - 12 take-offs and 12 landings, and*
 - refresher training of at least 1 hour of total flight time with a flight instructor (FI) or a class rating instructor (CRI). Applicants shall be exempted from this refresher training if they have passed a class or type rating proficiency check, skill test or assessment of competence in any other class or type of aeroplane.’*

When applicants hold both a single-engine piston aeroplane-land class rating (denoted as SEP (land)) and a TMG rating, they may complete these requirements in *‘either class or a combination thereof, and achieve revalidation of both ratings.’*

Apart from being *‘exempted from this refresher training if they have passed a class or type rating proficiency check, skill test or assessment of competence in any other class or type of aeroplane’*, the regulations do not provide any guidance material (GM) or acceptable means of compliance (AMC) to support these requirements and specifically what should be covered in the refresher training. The content and structure of the training flight (so the instructor is pilot in command) is, therefore, at the discretion of and agreed between the pilot and instructor, but typically includes exercises such as stall recovery and practice forced landings.

Personnel

Aircraft owner

The owner had commenced his flying on gliders in 1992. Over the next 7 years he accumulated nearly 300 hours gliding, in 350 flights. He then began training on SEP (land) aircraft. He gained his Private Pilot’s Licence in 1999 and flew various aircraft types. In May 2006 he underwent an SLMG² conversion and purchased G-FMKA. In June 2014, he passed his TMG licence skills test. From 2006, he appeared to have flown almost exclusively in G-FMKA.

At the time of the accident, his total powered flying experience amounted to just over 700 hours, together with a total of approximately 415 hours and over 400 flights on gliders. The owner had flown more than 12 hours in the preceding 12 months and so he only required a minimum of 1 hour of instructional flight to revalidate his licence.

Footnote

² Self Launching Motor Glider.

Instructor

The instructor was a former military fast jet pilot and a current commercial airline pilot. His total flying experience amounted to approximately 18,200 hours. He had recently completed his training as a civilian Flight Instructor (FI) on SEP (land) aircraft which included a supervised period of 100 hrs of instructional flying. In the preceding 28 days he flew various SEP types, including his own Cirrus SR22. The instructor did not hold a TMG class rating.

Licensing requirements

Although they may appear outwardly similar in many ways, TMGs such as the Super Dimona have somewhat different flight characteristics from the more common SEP (land) class of aircraft. There are also operational differences; for example, TMGs are equipped with airbrakes or spoilers, whereas SEP aircraft are not. Licensing regulations require pilots who wish to fly TMGs to hold a TMG class rating, which requires specific training to be completed. To instruct on TMG aircraft, an instructor must hold a TMG class rating. It is a requirement of the EASA Part-FCL regulations that an instructor holds a class rating for the class of aircraft for which instruction is being given.

The owner had conducted his previous biennial refresher training in 2015, in G-FMKA, at the same flying training school where the instructor had completed his FI training. This refresher training was conducted with the Chief Flying Instructor of the school, who did not hold a TMG class rating.

The similarity between the TMG and SEP classes of aircraft has led some to believe, incorrectly, that possession of a valid SEP (land) class rating also entitles them to fly TMG class aircraft. The AAIB raised the issue with the CAA, who agreed to publish safety information to flight instructors to clarify the requirements for instruction on TMG class aircraft.

Medical and pathological information

The post-mortem reports for the pilot and instructor cited the cause of death as multiple injuries. Within the limited examination possible, there was no natural disease identified to cause or contribute to death.

Survivability

The aircraft struck the ground at high speed in a steep nose-down attitude. The post-mortem examinations of the pilots indicated that the scale of injuries resulting from the impact were not survivable.

Analysis

Engineering aspects

The vertical nature of the flight path of the aircraft at impact, coupled with the elevator input required to create the 9 g impression in the ground, is consistent with the aircraft having been beyond the vertical shortly before ground contact.

All extremities of the aircraft were identified at the accident site, indicating that no in-flight structural failure had occurred. With the exception of the outboard length of the left aileron and a portion of the elevator, all control surfaces were identified at the accident site. Since the attached section of the left aileron incorporated only one short hinge, it would be logical to expect the whole of the aileron to have separated as two independent items if the surface had failed in flight, rather than only the outboard section separating leaving the inboard section as found in the wreckage attached by a single short hinge at its inboard end. Hence there is little doubt that both ailerons were attached and complete at the time of the impact.

The absence of the outboard section of the elevator in an identifiable state is explicable since that length appears to have come to rest beneath the rear fuselage which burned for a sustained period after the impact and required frequent damping down by fire and rescue services for at least four hours after the accident. The identified section of elevator ended in an extremely fire damaged termination. The complete rudder was also identified in the wreckage.

This evidence is therefore consistent with all the flying control surfaces being attached and complete when the aircraft struck the ground.

The impact damage and subsequent fire made it impractical to determine whether any pre-accident defect was present in the flying control system. The roll controls within each wing were free from such defects, but the same could not be conclusively stated about those sections within the fuselage. The extent of bending deflection of the wing structure, evident from the aerial survey, however, can only have been achieved by a functioning pitch control system with the control stick being moved forcefully backward. This is consistent with the pitch control being fully operable and one of the occupants operating the controls.

The most likely initial location for the walking pole found in the aircraft wreckage was on the shelf behind the two pilot seats. The confined space within the cockpit, particularly when carrying two occupants, would preclude the carriage of the pole elsewhere within the aircraft. It is difficult to envisage a plausible scenario whereby the pole could have interfered with the operation of the aircraft's controls.

Operational aspects

The planned content of the flight is unknown, except that its intended duration was one hour. As it was a refresher training flight as part of the pilot's revalidation of his SEP (land) and TMG class ratings, the content was at the discretion and agreement of both the pilot and instructor.

The aircraft was seen heading south from Draycot at about 1,000 ft agl. Shortly thereafter, it was manoeuvring and turning left near the accident site at a much lower altitude that had drawn witnesses' attention. For the aircraft to have been so low, either there was a problem, or a planned manoeuvre was being conducted. If there was a problem with the aircraft, no radio call was made to indicate as such. It is possible that a practice forced landing was being conducted and there were several suitable fields available in the vicinity.

The aircraft was observed in what is believed to be powered, controlled flight until the last few seconds. One witness described what could be construed as the aircraft entering a spin, just before he lost sight of it. It is improbable that the extreme aircraft attitude was a result of intentional pilot action, as such a manoeuvre at low height would carry a very high level of risk. Therefore, it is probable that the situation arose because of a departure from controlled flight. The power-off stall characteristics of the Super Dimona are benign; however, the power-on stall is different, and in certain circumstances the aircraft '*may perform a stall dive over the left or right wing*'. A power-on stall would appear to be the most likely explanation for the sudden loss of control and resultant unusual attitude.

The weather in the area of the accident flight was clear and dry with no low cloud and light winds. It is therefore unlikely that any meteorological event affected the flight.

According to the EASA Part-FCL regulations, the instructor was not qualified to be pilot in command or give instruction on TMG class aircraft such as the Super Dimona as he did not hold a TMG class rating.

Conclusion

The aircraft departed from controlled flight at low altitude, possibly from a power-on stall, for reasons which could not be determined conclusively. There was no evidence of a pre-existing problem with the flight controls, but the possibility could not be fully excluded. The ground impact marks suggested that an attempt to regain control of the aircraft was made, but there was insufficient height available in which to complete a recovery.

Safety action

The CAA has agreed to issue advice to remind flying instructors of the requirement to hold a valid TMG class rating if they intend to exercise their flight instructor privileges on this class of aircraft.