Glider Type and Registration (Tail No):	Hoffman H36 Dimona G-BLCV
Engine:	1 x Limbach L2000 – EBIC piston engine
Year of Manufacture:	1984
Time (local) and Date:	15:00 hrs 5 April 2016
Location:	2NM North of Raglan, Monmouthshire
Type of flight (actual/intended):	Training (field selection exercise for Bronze Cross-Country endorsement)
Persons on Board:	2
Injuries:	**Instructor**: Broken collar bone **Student**: Hairline fracture in one vertebrae
Nature of Damage:	Severe damage, beyond economic repair
Commander's Qualifications:	Full Cat and MGIR
Commander's Age:	64 years
Commander's Flying Experience:	**Total all types:** Gliders – 1,793 hours Power - 503 hours **Total on Type:** 265 hours **Last 6 months:** Gliders – 6 hours Power - 10 hours
Information Source(s):	Information supplied by the pilot/student, examination of the wreckage and follow-up enquires

Synopsis

The aircraft, with an instructor and glider pilot student on board, suffered a complete loss of engine power as it attempted to climb away from a field selection exercise. As the terrain ahead was unsuitable for a forced landing, the instructor attempted to turn back. In doing so, a high rate of descent developed and the right wingtip struck the ground, the aircraft spun around and landed heavily, causing injuries to the occupants and severe damage to the aircraft.

History of the flight

The purpose of the flight was the training of a student for the field selection part of the BGA Bronze Cross-Country Endorsement. The aircraft had taken off with the fuel tank approximately half full, which was more than enough to complete the intended sortie, and was making an approach to a fifth field approximately 1 hr after taking off from Usk. The approaches and climb-outs from the previous four selected fields were reportedly conducted without incident and this aircraft had regularly been used for field selection exercises for some 12 years. Prior to the descent and approach to the fifth field, which was commenced from approximately 1,800 ft agl with the student flying, the instructor changed the propeller pitch from coarse to fine. Pitch change is accomplished by reducing the engine speed to below 1500 rpm at 60 kt and momentarily pulling and releasing the pitch change handle, see Photo 6. The pilot reported that when in fine pitch, the engine speed then indicated 1800 rpm, a speed consistent with a partial throttle setting. It was confirmed at this time that the electric fuel pump remained on. (A carburettor air heat system is not fitted to this engine).

With the throttle set at idle, the student continued to fly the approach until a point was reached where the instructor was satisfied that he could have landed safely in a glider, so she took control to climb away. However, there was no response from the engine when the throttle was moved forward; the throttle reportedly felt normal. The engine speed at this time was seen to indicate 700 rpm, and pumping the throttle had no effect. As there was insufficient distance remaining in which to safely land and the field was bordered by trees and power wires, the instructor initiated a turn to the right from a height estimated at 80 ft, hoping that the down sloping field would 'buy enough time' to get the engine running. However, the landing options with a downslope, with a tailwind and with very small adjacent fields, were extremely limited. During the turn the rate of descent increased, resulting in the right wing tip contacting the ground. The ensuing groundloop resulted in severe damage to the right wing, landing gear, fuselage and propeller. Both the instructor and student were injured and assisted by local responders before being taken to hospital. The pilot recollected the following immediately after the accident:

> *"I climbed out, but *** (P2) stayed in, saying he was winded. He commented that he thought I should turn off the switches - good point. So from outside the aircraft I turned off the ignition switch and the master switch. I didn't turn off the fuel pump, or the fuel shutdown switch (between the seats…….."*

Aircraft Details

The following details are copied from the CAA G-INFO database.

Manufacturer: HOFFMANN FLUGZEUGBAU FRIESACH GMBH

Type: HOFFMANN H 36 DIMONA

Serial No.:36113

Aircraft Class: FIXED-WING SELF-LAUNCHING MOTOR GLIDER

EASA Category:CS-22A: Sailplane or Powered Sailplane - Utility Category

Engines (Propellers):1: 1 x LIMBACH L 2000-EBIC (HOFFMANN HO-V 62R / L160T)

MTOW:770kg Total Hours:2379 at 31/12/2014

Year Built:1984

Approved Maint. Programme:None

CofA / Permit:EASA Certificate of Airworthiness EASA ARC Expiry:31/08/2016

Aircraft examination

The aircraft was substantially damaged in the accident and is beyond economic repair. One propeller blade had broken off and was in three sections, the right wing was damaged, the fuselage was severed behind the cockpit and both landing gear legs had broken off, Photo 1. It was recovered by a maintenance/repair organisation who reported that, as the fuel drain valve had been wiped off in the accident, there was no fuel in the tank but that there was good evidence that a reasonable quantity of fuel had drained out onto the ground. The pilot reported that the fuel gauge was indicating approximately ¼ full prior to commencing the approach. There had been no fire. Also, when recovered, it was reported that the master switch and the magneto switch were both found in the OFF position.

Photo 1. Overview of the damage to G-BLCV after recovery

Examination of the two bladed in-flight adjustable (fine, coarse and feather positions) Hoffman propeller indicated that one blade had not contacted the ground, and was completely undamaged. The other blade had broken off, was covered in dried mud and was in three sections, Photo 2. There was no evidence of any circumferential scoring or leading edge damage on this blade tip, all of which indicated a lack of any significant propeller/engine rotation at the time of ground contact, see Photo 3.

Photo 2. Broken, not shattered, propeller blade

Photo 3. Propeller tip area. Note the absence circumferential scoring/LE damage.

There was no evidence from the wreckage examination or from the pilot's report to suggest any and pre-impact problems had occurred with the aircraft, apart from the failure of the engine to respond. As the engine itself (and ancillary equipment) appeared undamaged and remained securely mounted to the airframe, the opportunity was taken to conduct a functional test by installing an identical time expired but serviceable propeller, see Photo 4.

Photo 4

After fitment, the engine was rotated by hand and it was established that all four compressions felt normal. After the drain valve leak had been sealed, fresh AVGAS 100LL placed in the tank, and a set of jump leads were connected to the battery. The master switch was moved to ON and, at this point, the carburettors were primed by the electric fuel pump, which functioned normally, and all engine instruments became 'live'

With the ignition toggle switch set to ON, the engine started without delay and settled at 1100 rpm with the throttle closed, following which it responded normally the throttle movement, see Photo 5.

Photo 5. Engine idling at 1100 rpm with the throttle closed.

All instrument indications appeared normal. Several starts were made and, throughout, no defects could be identified with the engine operation. It was noted that although the ignition toggle switch was recessed slightly into the panel, it was devoid of any guard to minimise inadvertent operation, see Fig 6.

The possibility of an intermittent electrical /wiring fault in the ignition system having developed was raised. As the magneto is electrically independent from the aircraft's wiring, very little wiring is involved. In order to stop the engine, the wire from the LT side of the magneto coil would need to be 'earthed'. This wire was connected to one terminal of the ignition switch, and an ‘earthing’ wire connected from the other terminal to ground. This is the normal way of stopping this engine as, when the ignition switch is moved to OFF, ie, a circuit is made between the LT coil and ‘earth’, the HT sparks are inhibited. Any intermittent or permanent break in these two wires would allow the magneto to operate normally, but switch operation to OFF under this circumstance would not cause the engine to stop. An internal failure of the switch could possibly earth the magneto, but this was found to operate normally on test. Also, no evidence was seen of any wire defect.

Fig 6. Propeller pitch change handle and adjacent ignition switch

Flight Tests

A flight test was conducted with a motorglider fitted with the same engine model and an identical propeller, to determine the characteristics of the engine at idle in the descent. On the ground in fine pitch, the engine idled at 1100 rpm. When flown at 60 kt in a descent from 2000 ft with the throttle closed and the propeller set in coarse and then fine pitch, the tachometer indicated at around 1200 rpm and 1400 rpm respectively. When the engine had cooled to a stable temperature, the ignition switch was moved to the OFF position, whereupon the engine continued to windmill at around 1100 rpm when in fine pitch. The airspeed needed to be reduced below 60 kt for the windmilling engine to naturally slow to a stop. It was noted that although there was a detectable difference in the sound of the engine between ignition ON and OFF, mostly due to its lower rotational speed, this difference was not considered particularly obvious.

Weather

An aftercast of the weather in the area of the accident was requested from the MET Office through the offices of the AAIB. The content of this is reproduced below.

> ***Aftercast: Raglan Monmouthshire, around 1400 UTC on 5 April 2016.***
>
> *All figures are in Appendix 1.*

Review of Meteorological Data

***Figure 1**. This is the surface analysis chart valid at 1200 UTC on 5 April 2016, a weak ridge of high pressure covers the Raglan area, with a series of weather fronts moving east shown to the west of Ireland.*

***Figures 2 and 3.** These are the MSG Infra Red satellite image valid at 1200 UTC and 1500 UTU on 5 April 2016. Both of these pictures show well broken cloud over the south coast of Wales as indicated by the dark grey colouring. Further inland there is evidence of some convective cloud as indicated by the lighter grey shading.*

***Figure 4 and 5.** These are the High resolution MSG Visible satellite image valid at 1200 UTC and 1500 UTC on the 5 April 2016. These images confirm little or no cloud near to the southern coast of Wales, but with shallow cumulus development over the Raglan area.*

***Figure 6.** These are the TAFs and METARs for Bristol, Cardiff and Gloucester between 1020 UTC and 1750 UTC on 5 April 2016. Winds at Bristol and Cardiff are generally westerly at between 12 to 15KT whilst they were northwesterly at Gloucester and lighter at between 8 to 11KT. All stayed dry with no precipitation being reported mostly giving nil significant low cloud although Bristol did report CB at 1450 UTC and Cardiff gave FEW TCU 1450 UTC until 1620 UTC.*

***Figure 7.** These are the synoptic reports from Shobdon, Hereford and Sennybridge for the period 1100 UTC and 1700 UTC on 5 April 2016. These show generally west or northwesterly winds at between 8 to 11KT at Shobdon and Hereford, but with lighter winds at Sennybridge of between 3 to 5 KT. Conditions were good, and no significant low cloud was reported.*

***Figure 8.** This is the F215 Forecast chart valid at 1200 UTC on 5 April 2016. The incident occurred in zone A where the forecast was as follows: Visibility of 30 KM with nil weather. Isolated 7KM in showers of rain, these mainly to the east of Monmouthshire. Scattered to broken cumulus and stratocumulus with bases 1500 to 4000 feet, tops 5000 to 7000 feet, and moderate icing and turbulence. Isol scattered to broken stratus base 400 to 1000 feet, tops 1500 feet until 1100 UTC. The freezing level was around 3000 to 4000 feet.*

Summary of findings

The weather conditions on the 5 April 2016 across the area were generally good, with little significant low cloud indicated. There was a small risk of a rain or rain and snow mixed shower in the area as indicated by the F215 but the conditions at all of the available observation sites remained dry, although Bristol did report CB for one observation and Cardiff reported TCU for a time during the afternoon. Winds were mostly from between 260-310 degrees, with speeds between 10-15KT, with some lighter conditions indicated from Sennybridge.

An examination of the weather conditions across the area and at the location of the incident confirms they were consistent with the expected forecast conditions from the F215 chart and the TAFs.

Appendix 1.

Figure 1. *Surface analysis chart valid at 1200 UTC on 5 April 2016.*

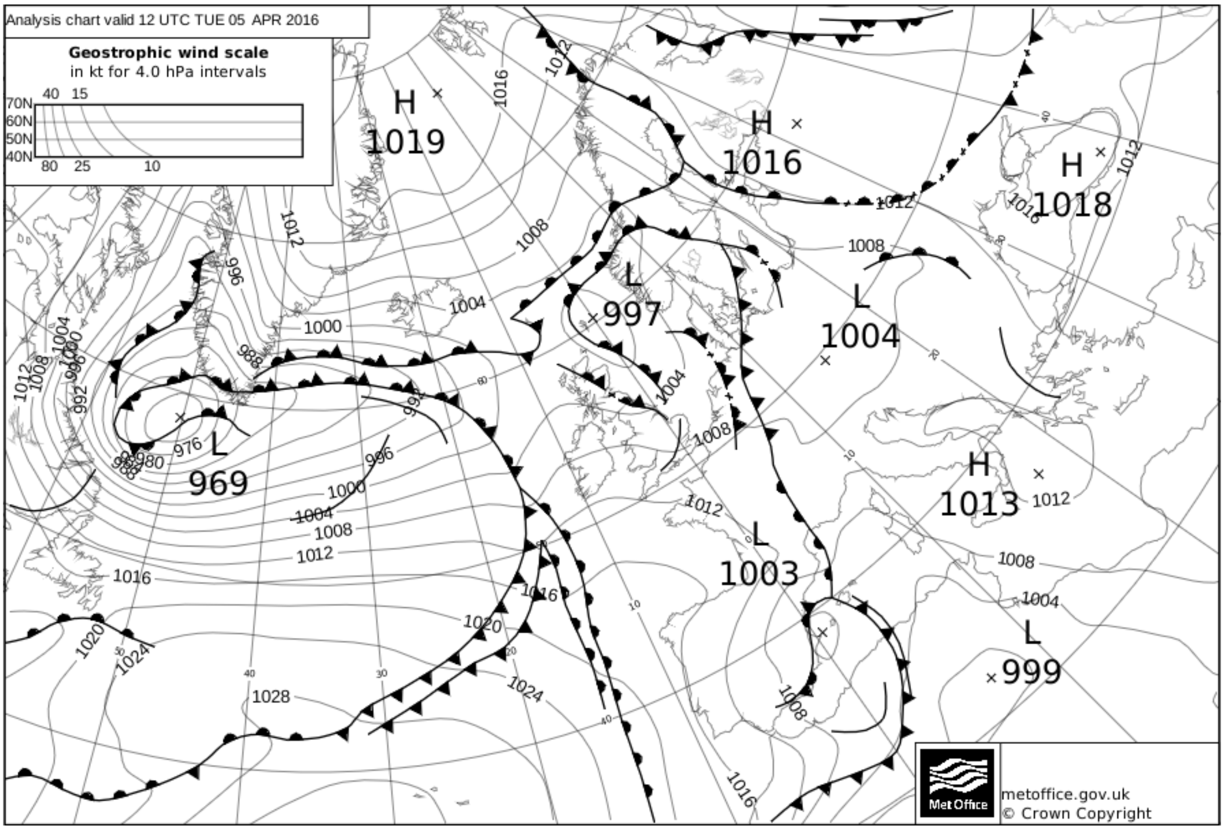


Figure 2. *MSG Infra Red satellite image valid at 1200 UTC on 5 April 2016.*

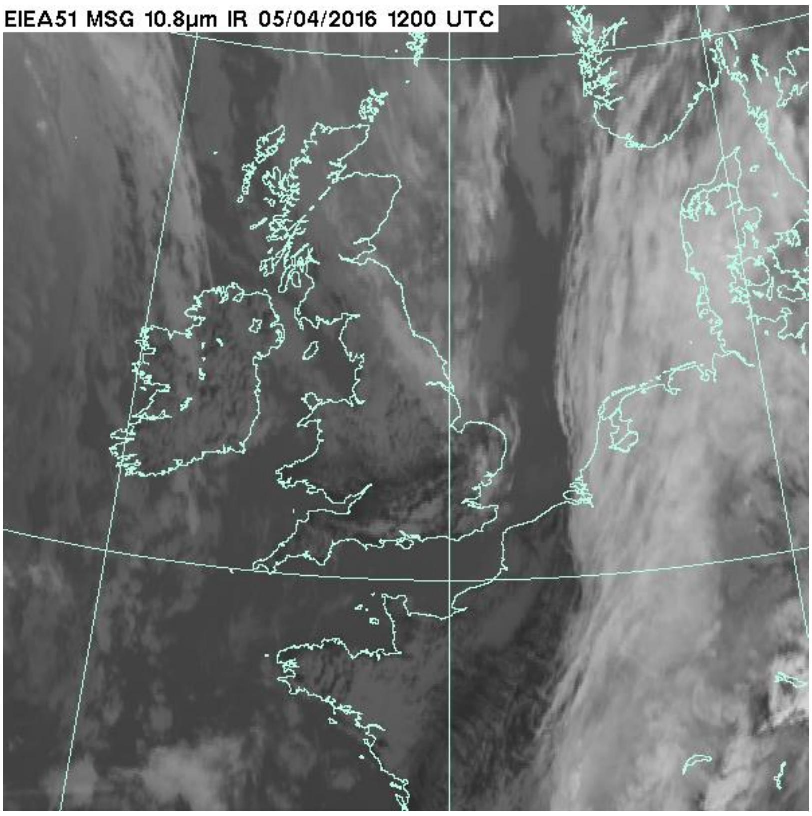


Figure 3. *MSG Infra Red satellite image valid at 1500 UTC on 5 April 2016.*

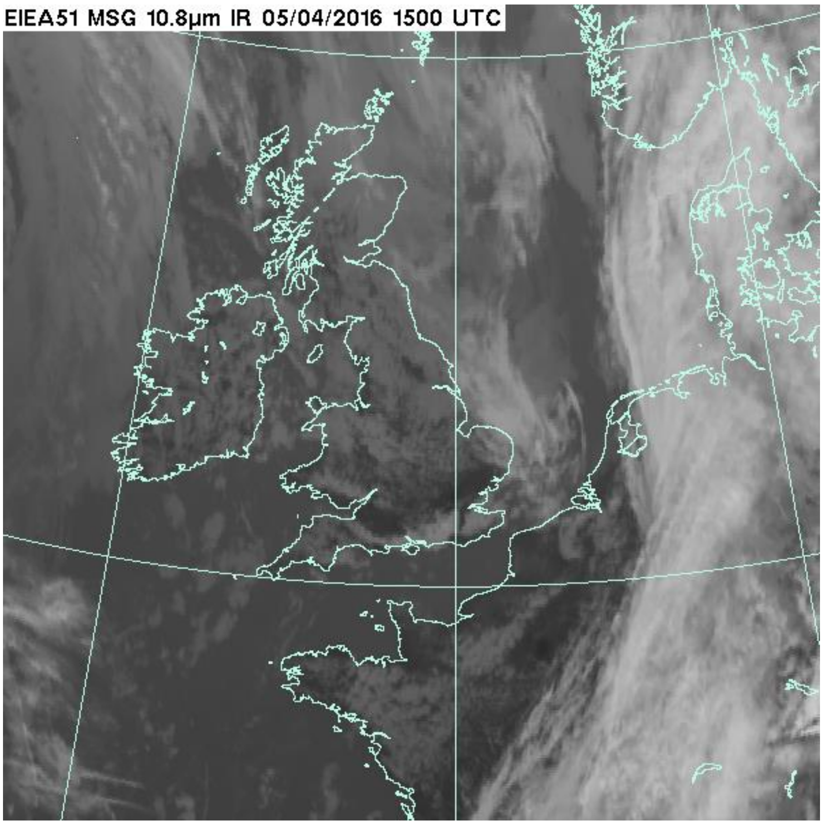


Figure 4. *High resolution MSG Visible satellite image valid at 1200 UTC on 5 April 2016.*

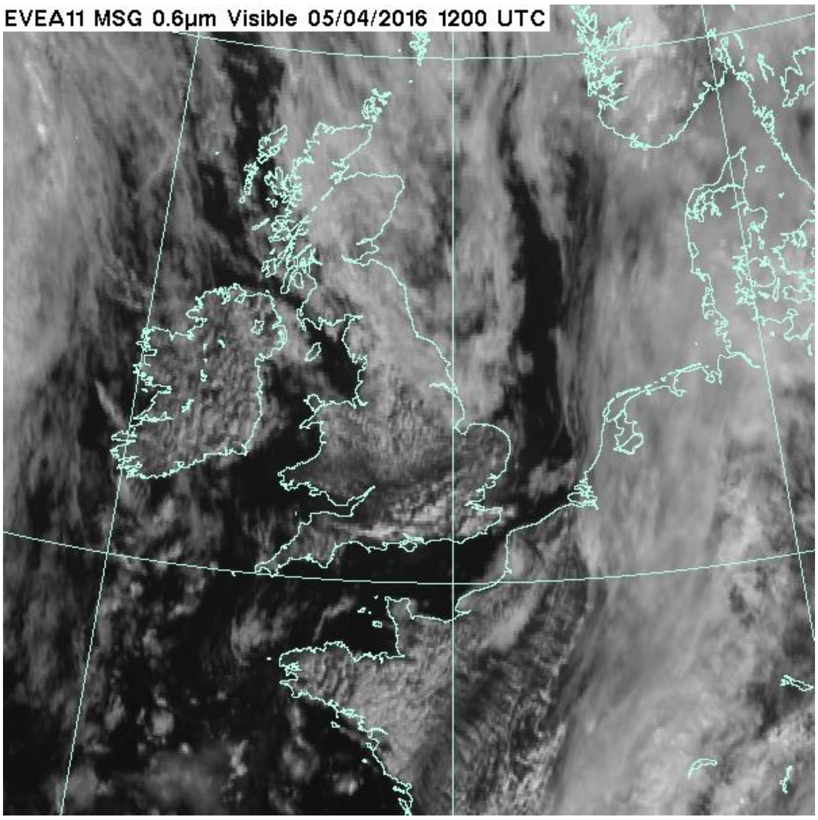


__Figure 5.__ High resolution MSG Visible satellite image valid at 1200 UTC on 5 April 2016.

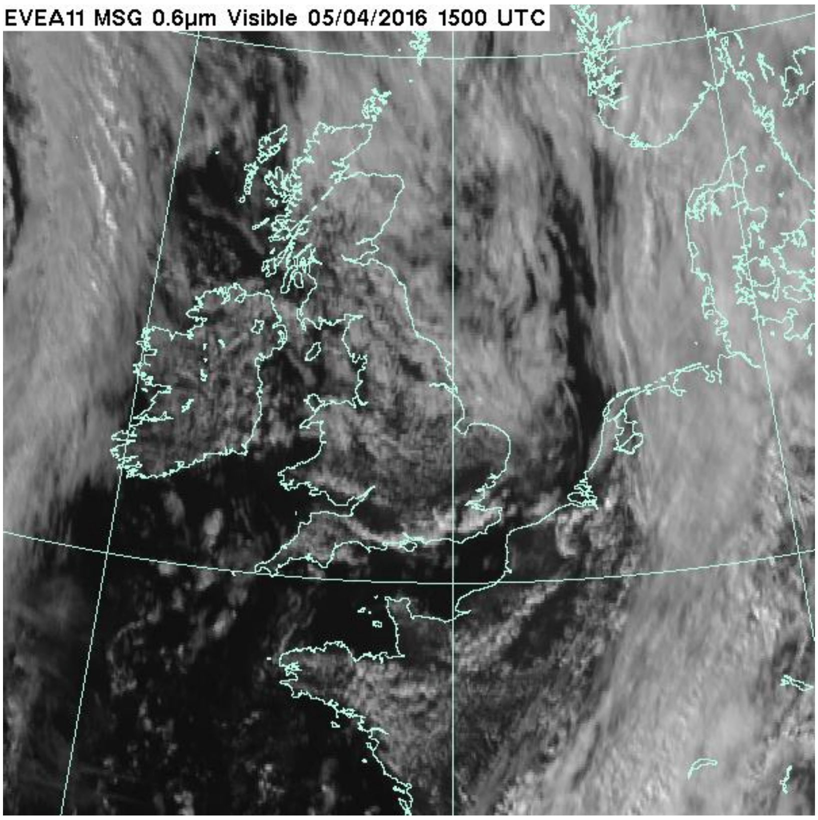


Figure 6. *METARs and TAFs for Bristol, Cardiff and Gloucester between 1320 UTC and 1420 UTC on 5 April 2016.*

Bristol

051320Z EGGD EGGD 051320Z AUTO 26012KT 9999 FEW024 12/05 Q1009

051350Z EGGD EGGD 051350Z AUTO 26012KT 9999 NCD 12/05 Q1009

051420Z EGGD EGGD 051420Z AUTO 24013KT 9999 FEW027 12/05 Q1009

051101Z EGGD EGGD 051101Z 0512/0612 26012KT 9999 FEW012 SCT028 TEMPO 0604/0606 8000 -RA BKN008 PROB30 TEMPO 0604/0606 4000 RADZ BR BKN003 BECMG 0605/0608 27022KT PROB30 TEMPO 0606/0612 27025G35KT 7000 SHRA BKN014=

Cardiff

051320Z EGFF EGFF 051320Z AUTO 26012KT 9999 NCD 12/07 Q1009

051350Z EGFF EGFF 051350Z AUTO 27015KT 9999 NCD 12/07 Q1009

051420Z EGFF EGFF 051420Z AUTO 27015KT 9999 FEW012 11/08 Q1009

051101Z EGFF EGFF 051101Z 0512/0612 25012KT 9999 FEW014 SCT030 TEMPO 0603/0606 8000 -RA BKN010 BECMG 0604/0607 26022KT PROB30 TEMPO 0604/0606 4000 RADZ BR BKN008 PROB30 TEMPO 0605/0612 27025G35KT 7000 SHRA BKN014=

Gloucester

051320Z EGBJ EGBJ 051320Z 29010KT 260V320 9999 SCT045 14/03 Q1008

051350Z EGBJ EGBJ 051350Z 31010KT 9999 SCT045 13/02 Q1008

051420Z EGBJ EGBJ 051420Z 31011KT 9999 SCT045 14/03 Q1008

Figure 7: *Synoptic reports from Shobdon, Hereford and Sennybridge for 1400 UTC on 5 April 2016*

Shobdon

051300Z 03520 46782 /2910 10118 20028 39963 40082 51004 333 55307 21807 83/50 555 7/093

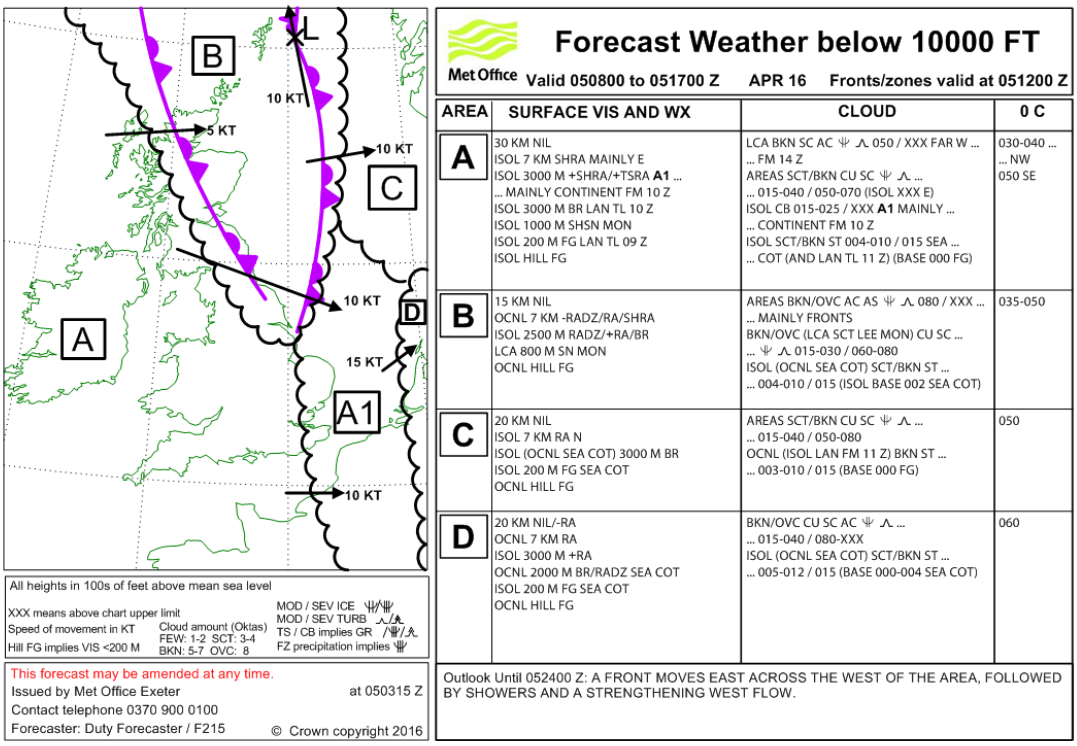
Hereford

051300Z 03522 45684 /2812 10130 20036 39995 40086 51004 333 85/47 555 7/095

Sennybridge

051400Z 03507 46682 ///// 10100 20017 39724 40091 53002 333 81/36 555 7/093

Figure 8. *F215 Forecast chart valid at 1200 UTC on 5 April 2016.*

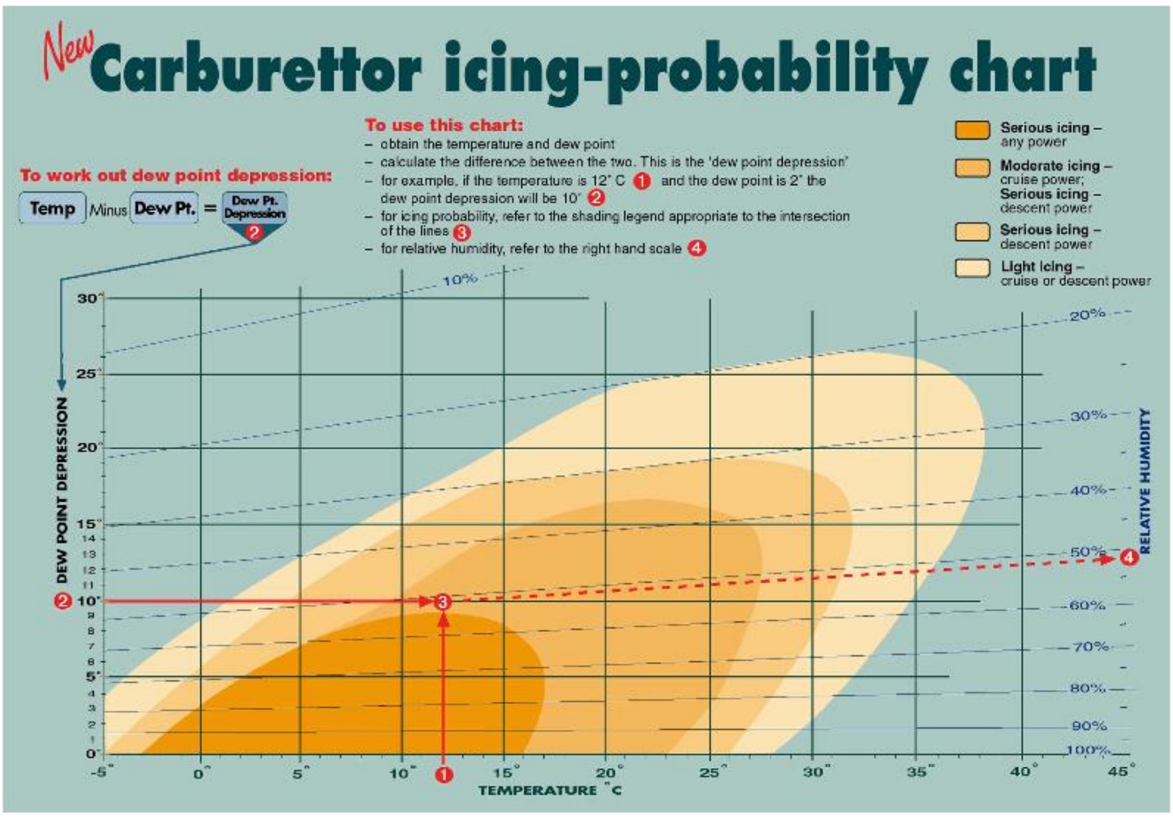


Analysis

No evidence of any pre-impact technical defect was found as a result of the engine examination, therefore other factors were considered.

As the aircraft been in the air for approximately 1 hour prior to the accident and had made four previous approaches to fields, there seem little or no possibility that any known problems had been encountered with the aircraft, its systems or engine/propeller prior to, or during, the fifth approach. Indeed, the pilot did not report anything amiss until opening the throttle and would, presumably, not have continued with the approach to low level if she felt the aircraft was not functioning normally.

The weather aftercast indicated temperatures in the area of 12/13 deg C, with dew point 'depressions' of between 7 deg C (Bristol), 5 deg C (Cardiff) and 11 deg C (Gloucester) around the time of the accident. The accident site was very approximately equi-distant from these stations and the associated RH values of around 50% - 72% (see the chart below) would ordinarily indicate the possibility of serious carburettor icing, particularly at idle power. Although this possibility appears likely, various factors mitigate against it. Firstly, four previous idle power approaches had been made in the same area with no apparent indications of icing on the go-around. Secondly, upon application of power, some response from the engine might be expected unless any icing was so severe as to preclude the engine from producing any power at all. However, if the ambient conditions were so severe, then icing would highly likely have occurred on the previous approaches. Thirdly, this aircraft has been used over many years conducting such training and reportedly does not seem prone to suffer from carburettor icing. No hot air system is fitted, as the air intake filters are at the back of the engine near to the firewall in a region of naturally warmed air. The MG used in the tests is similarly configured and also not fitted with a carburettor air heating system. It is also reported not to be prone to such icing.



With the propeller and engine combination installed in this aircraft, which was the same as in the test aircraft, one would expect at 60 kt IAS an engine speed of around 1400 rpm with a fully closed throttle and the propeller in fine pitch. With a ‘dead’ engine, then a slightly lower figure was indicated in the test flight of around 1100 rpm. When the airspeed was maintained or increased then the engine continued to windmill, without any significant indication that it was ‘dead’ apart from a change in its tone.

Upon opening the throttle, the pilot reported that there was no effect on the engine at all, but did recollect seeing an engine indication of 700 rpm shortly before impact with the ground. This speed is unlikely to be seen in normal flight except momentarily as the engine slows to a stop. The assessment of the propeller damage showed the engine to be stopped a few seconds later when it struck the ground. It therefore seems reasonable that when an overshoot was attempted, but without any engine power, the aircraft slowed and it is possible it was then that the engine ran down to a stop from a stable windmilling condition. It has to be assumed that the pilot was content with the operation of the engine during the descent and that it had not noticeably slowed during this time.

At a height of 1800 ft, the pilot reported that the propeller was set to fine pitch prior to the descent. With reference to Fig 6, this is accomplished by reducing the engine speed to below 1500 rpm and pulling then releasing the Prop Pitch handle. This handle is immediately adjacent to the single toggle magneto switch. Although slightly recessed into the panel, it is noted that the switch is ‘unguarded’ and, potentially, could be vulnerable to inadvertent operation. However, the pilot states that she clearly remembers moving the ignition and master switches switch to OFF immediately after vacating the aircraft, indicating that the magneto switch had been set to ON at the time of the accident. The OFF position is down.

Conclusions

The examination of, and test running of, the engine showed it and is associated systems to be without identifiable fault. Therefore other reasons for the failure of the engine to respond when required were considered. Two possibilities were identified and, although each had the potential to result in the lack of engine response, various factors mitigated against these and meant that a definitive cause of the loss of power could not be established. Nevertheless, two safety recommendations are made to the BGA.

Safety Recommendation 1.

The BGA should publish a reminder to operators of motorgliders (and tugs) of the potential for carburettor icing to inhibit proper operation of the engine, particularly if prolonged descents are made at idle power. In addition, such a reminder should include the following:

If a hot air system is fitted, a prolonged descent will very likely result in a cool exhaust manifold and insufficient heat may be available to clear any icing if hot air is selected. Whether a carburettor hot air system is fitted or not, assurance that the engine will respond to the throttle should be carried out during the descent by occasionally and briefly demanding high power at heights that would enable the aircraft to make a successful forced landing in the chosen or adjacent fields should the engine fail to respond adequately.

Safety Recommendation 2.

Consideration should be given by the BGA technical committee, on a case by case basis, whether motor gliders fitted with toggle type magneto switch(es) should be modified with an appropriate switch guard to minimise the possibility of inadvertent operation.