ACCIDENT

Aircraft Type and Registration:	Glaser-Dirks DG-100 glider, G-DDFN
No & Type of Engines:	None
Year of Manufacture:	1975 (Serial no: 30)
Date & Time (UTC):	4 August 2012 at 1131 hrs
Location:	Pluckerston Farm, Kirriemuir, Angus
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Bronze gliding certificate
Commander's Age:	59 years
Commander's Flying Experience:	28 hours (of which 5 were on type) Last 90 days - 2 hours Last 28 days - 1 hour
Information Source:	AAIB Field Investigation

Synopsis

Whilst turning to the right, the glider was seen to enter a spin from which it recovered after about two turns. The glider was seen to fly normally for about a minute and it then entered a second spin, from which it did not recover. The pilot was fatally injured.

History of the flight

The pilot had joined the gliding club at Drumshade in April 2010 and followed a structured period of training, gaining his Bronze gliding certificate in July 2011. He purchased G-DDFN in August 2011 and kept it, rigged, in a hangar at the gliding site.

On the day of the accident, the pilot was the first to arrive at the gliding site and was seen by another member at about 0900 hrs, working on the club tractor. He was intending to carry out a 100 km cross-country flight, which included a 50 km leg, as part of a requirement for a Silver gliding cerificate. Club members assisted him to move his glider to the launch point, where he carried out the daily inspection and control checks. The airbrake stowage boxes in the wings had a significant amount of water in them due to recent rain, which was removed using a sponge and the boxes dried.

The weather was good, with visibility in excess of 10 km and cloud generally 'broken' at 1,500 to 3,000 ft, with some showers forecast. At the time of the accident the visibility was good and the cloud base above 2,500 ft.

At about 1115 hrs the glider was positioned for a winch launch on the easterly runway. The launch appeared normal, with the glider releasing at the top of the climb. Club members did not continue to watch the glider but concentrated on preparing the other gliders for flight.

Recorded information was available from an electronic flight logger recovered from the aircraft. The recorder contained a track log of the entire accident flight, with GPS-derived position, groundspeed, altitude and pressure altitude. The data is illustrated in Figure 1, showing the track over the ground.

The launch and subsequent manoeuvres including the accident were observed by a witness who was at the eastern end of the strip. He saw the glider flying in right-hand orbits to the northeast before appearing to enter a steep nose-down spin. The glider recovered after what he estimated to be about two turns and headed away from the field, to the north, before making another orbit to the right. The witness described the orbits as having a "gentle bank angle". The glider then appeared to enter another spin, from which it did not recover, and was seen to impact the surface of a crop field.

The witness alerted the club members to the accident and they contacted the emergency services before attending the scene. The pilot had been fatally injured in the impact.

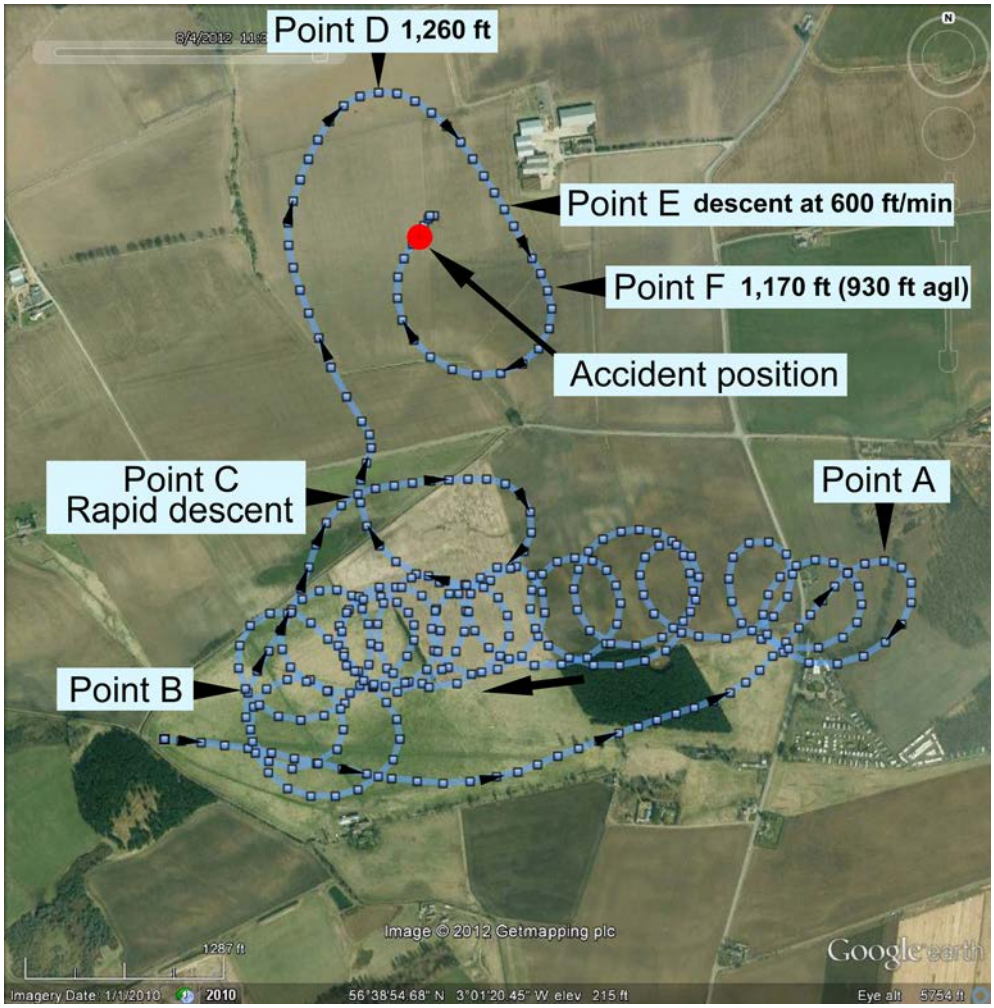

Figure 1

G-DDFN – Flight recorder GPS track

Medical and pathological information

A post-mortem examination was carried out by a forensic pathologist. The pathologist established that the pilot had died as the result of injuries received in the accident, which the pathologist considered non-survivable. While there was some evidence of hypertensive heart disease, which could have produced an incapacitating episode, the circumstances of the accident, including the aircraft recovering from one spin, suggested this was unlikely to have been a factor.

The toxicological analysis confirmed the presence of the pilot's prescription medication and there was no evidence of other drugs or alcohol.

Video of previous flights

The pilot had been in the habit of wearing a head-mounted camcorder. There was no video recording of the accident flight but on-board video recordings of five previous flights were on the memory card. These showed that the pilot, when orbiting to the left or right to gain height in thermals, maintained his airspeed between about 40 kt to 45 kt and used approximately 30° angle of bank. Entry into a turn was typically smooth with some adverse yaw initially[1] but when established in the turn it was correctly balanced with rudder.

Flight Handbook for DG-100

The Flight Handbook does not promulgate a stalling speed but an independent flight test document stated:

> *'Level flight stall occurred at about 36 kts. Very little buffeting preceded the stall.'*

Deliberate spin entry and the procedure for spin recovery are set out in the Flight Handbook:

> *'1. Spins:*
>
> *Entry: Start a slow pull-up. When the aircraft starts to buffet apply full back stick with rudder in the desired direction of rotation.*
>
> *Recovery: Rudder in the direction opposite to rotation, pause, then ease the stick forward. When rotation stops, neutralize rudder and gently recover from dive.'*

From discussion with pilots who had flown the DG-100, its handling qualities were described as benign and docile.

Recorded information

Introduction

As noted above, recorded information was available from a flight recorder[2] recovered from the aircraft. The recorder contained a track log of the entire accident flight, with GPS-derived position, groundspeed, altitude and pressure altitude recorded once every two seconds. A portable data assistant device[3] (PDA) operating a navigation application[4] was also recovered. The pilot had entered a triangular route of approximately 63 nm (116 km) into the PDA, with the first leg to Alyth, second leg to Fordoun and return leg to Drumshade.

The data is illustrated in Figure 1, showing the track over the ground, and Figures 2 and 3, showing time-history plots of track, groundspeed and altitude parameters.

Footnote

[1] The tendency for the aircraft to yaw in the opposite direction to the turn.

Footnote

[2] EW manufactured microRecorder approved by the International Gliding Commission (IGC).

[3] Hewlett Packard IPAQ model 4700, provided with a GPS signal from the EW manufactured microRecorder.

4 XCSoar.

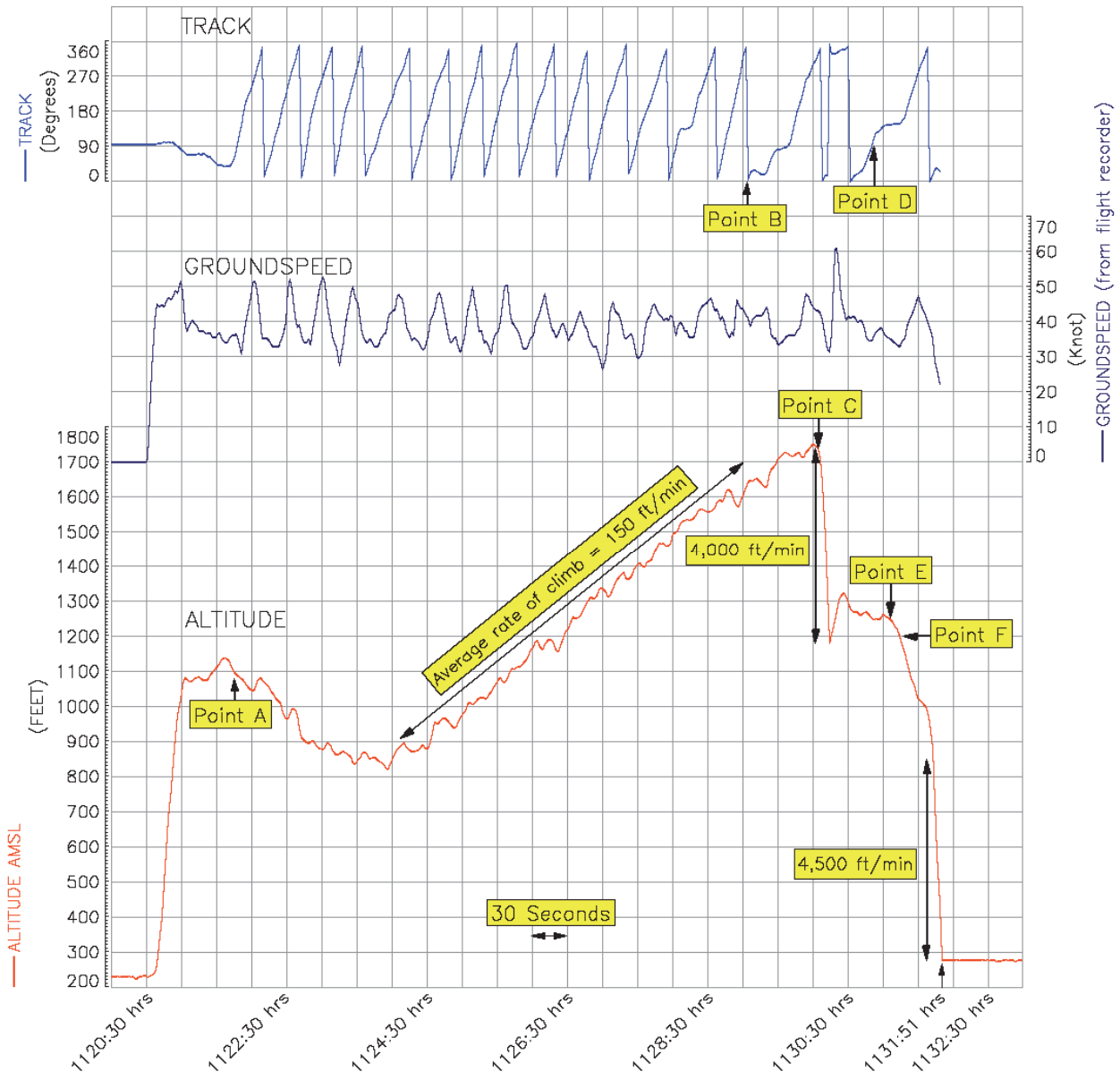

Figure 2

G-DDFN –Altitude, track and groundspeed
(Takeoff to ground impact)

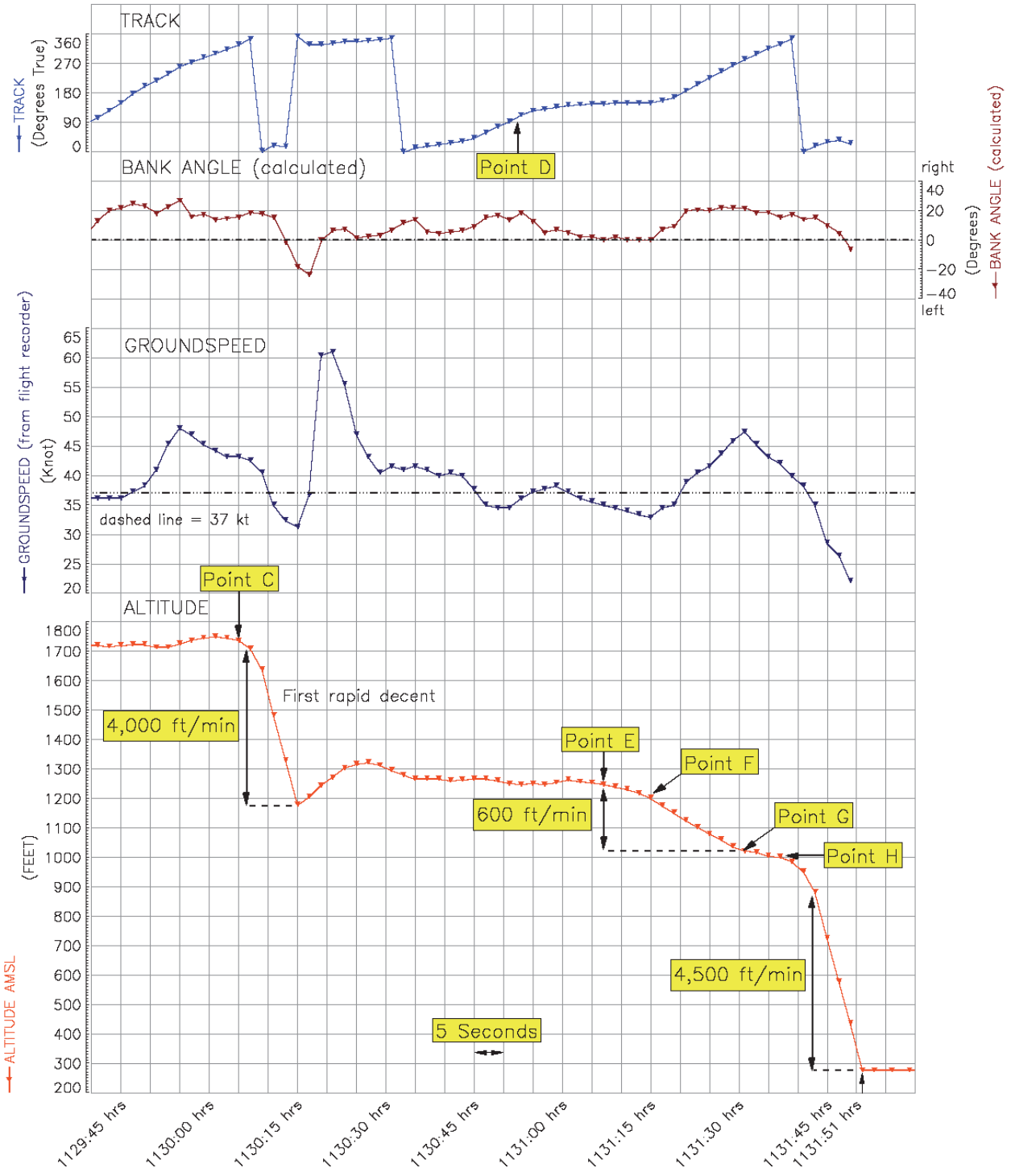

Figure 3

G-DDFN – altitude with track,
groundspeed and bank angle (calculated)
(Final minutes of flight)

Interpretation

The track log commenced at 1119:35 hrs, with the glider at the threshold of the easterly grass runway. The glider was then launched to an altitude of 1,080 ft (about 850 ft gl) and flew to the east of the airfield ('Point A' in Figures 1 and 2). Having descended, after launch, to an altitude of about 825 ft (600 ft agl), the pilot then flew a continuous series of clockwise thermalling turns, climbing at an average rate of 150 ft/min, carried to the west by the wind. Analysis of this period of thermalling flight indicated an average bank angle[5] of about 21° and an average airspeed of about 39 kt.

At 1129:05 hrs the glider was at 'Point B', about 220 m to the east of the airfield's western boundary at an altitude of 1,640 ft (1,400 ft agl). It then flew north, still climbing and made a turn to the right; at 'Point C' the aircraft reached its maximum altitude of 1,750 ft (1,540 ft agl), with airspeed calculated as about 36 kt, and a bank angle of about 18°. The glider then started to descend rapidly, reaching a rate of about 4,000 ft/min (~66 ft/sec). After six seconds, and at an altitude of 1,180 ft (970 ft agl), the descent was arrested and the glider recovered to about 1,270 ft (1,050 ft agl) with the airspeed stabilised at about 45 kt.

The glider then flew north for a further 30 seconds before making a gradual right turn towards the airfield; it was 0.7 nm from the airfield and at an altitude of 1,260 ft (940 ft agl) ('Point D'). A few seconds later, with the airspeed at about 40 kt, it started to descend at a rate of about 600 ft/min (10 ft/sec) ('Point E') and as the glider descended, the airspeed also slowly reduced. About ten seconds later, at 'Point F' and 1,170 ft (930 ft agl), it started a gradual right turn at a bank angle of about 20°.

Footnote

[5] The calculated bank angle is based upon a level, balanced turn having been flown. The bank angle referenced in this report is an approximated value only.

After 14 seconds the descent rate briefly reduced to about 200 ft/min and the glider then descended rapidly, at a rate of about 4,500 ft/min (75 ft/sec) before impacting the ground[6]; the time of impact was 1131:51 hrs.

Flight recorder altitude recording

The flight recorder incorporates an internal sensor for the measurement of pressure altitude. The unit was taken to the manufacturer where the pressure altitude recording function was demonstrated to be accurate to within 35 ft when set at altitudes of 2,000 m (6,562 ft) and below. A test simulating a rapid descent was also conducted. The unit tracked the descent profile with an average accuracy of 43 ft.

Engineering

Aircraft information

The DG-100 is a single-seat 15 m wingspan sailplane of glass-fibre construction. It has a 'T-tail' configuration, with an 'all-flying' tailplane, which is equipped with full span trailing edge anti-balance/trim tabs. The aircraft is fitted with airbrakes, which operate on the wing upper surfaces.

G-DDFN was constructed in 1976 and the most recent aircraft log book entry, which was for the Annual Inspection and Airworthiness Review Certificate (ARC), was dated 18 May 2012, with the ARC expiring on 15 June 2013. The most recent flight listed in the log book occurred on 12 April 2012, with the aircraft at a total of 1,127 hours and 1,093 launches.

Footnote

[6] At impact, the flight recorder GPS-derived position was in error by 75 m north of the actual impact site. The flight recorder continued to operate after the impact, during which, the GPS position gradually updated to that of the actual impact site. It is most likely that this error was a result of optimal satellite reception having been lost during the final descent, with the aircraft in a spin. As such, the accuracy of the groundspeed and calculated airspeed may not be relied upon during the final descent.

Accident site details

The aircraft had crashed into a field of standing barley approximately 0.5 nm north of Drumshades airfield. It was a compact site and the marks on the ground made by the aircraft, together with the disposition of the wreckage, indicated a steep nose-down attitude at impact. The mark made by the outer portion of the right wing leading edge was heavily bowed, curved up towards the tip. The aircraft nose had broken off in the impact and was buried in the ground to a depth of around 0.6 m. and orientation of the nose indicated an impact heading of 310º, although it was apparent that the aircraft had subsequently rotated to the right by approximately 70º. The mark made by the outboard portion of the left wing reflected the fuselage rotation and was straight rather than bowed. The fuselage was partially broken open where the wings were attached but had remained intact aft of this point.

The evidence at the site was consistent with the aircraft being in a spin to the right at impact, with initial ground contact being made by the right tip, followed by the nose and, finally, the left wing. The bowed shape of the right wing imprint is likely to have been made as a result of the leading edge progressively contacting the ground as the aircraft rotated.

Both airbrakes were found in their extended positions. The associated operating linkage was distorted at several locations, caused by contact with adjacent parts of the airframe, for example the wing root structure at the point through which each airbrake operating rod passed. The positions of these distortions relative to the structure indicated that the linkage had been displaced towards the 'airbrakes open' limit of the available travel, indicating that the airbrakes had been deployed at the time of the impact. In the cockpit, the airbrake handle is a short steel tube welded at approximately 90º to the operating rod, which moves in a fore-aft direction in a slot on the left side of the cockpit. The plastic cover from the handle was found on the cockpit floor and the handle itself had been distorted in a forward direction, indicating that the pilot may have had his hand on the airbrake control at the time of the impact.

Detailed examination of wreckage

Following an on-site inspection, the aircraft wreckage was recovered to AAIB's facility at Farnborough for a more detailed examination, principally of the structure and flying control system. This examination showed that all the damage to the structure and flying control system was consistent with the final impact with the ground and did not indicate any pre-existing defect or failure.

The airspeed indicator was mounted in the instrument binnacle in front of the pilot; although the glass face was broken, it was otherwise intact. After being connected to a calibrated pitot tester it was found to be accurate to within 2-3 kt. Much of this discrepancy was accounted for by a loose indicating needle, which most probably was a result of the mechanism being subjected to a severe blow during the impact.

The connection of the static vent to the airspeed indicator terminated in chambers within layers of fibreglass on either side of the nose. These were checked and found to be free from obstructions.

In summary, the examination of the aircraft did not reveal any evidence of a pre-impact failure or defect that could have had a bearing on the cause of the accident.

Airbrake deployment prior to final descent

A copy of the flight recorder record was provided to the aircraft manufacturer, to determine whether the airbrakes had been open in the moments prior to the final

descent, when the rate of descent had been 600 ft/min and the calculated airspeed was about 40 kt ('Point E' in Figures 1, 2 and 3). The manufacturer concluded that either the airbrakes had been open, or the aircraft had experienced rapidly sinking air at this point.

An evaluation flight was flown in the same model at a similar weight to that of the accident flight. With the airbrakes in the fully open position and the rate of descent established at between 650 ft/min and 700 ft/min, the airspeed stabilised at about 50 kt. The manoeuvre was flown twice, with the same result. It was also found that if the airbrake handle was unlocked and the pilot then released his grip of the handle, the airbrakes would open to between one-quarter and one-third of their fully open position when the aircraft was at an airspeed of 40 kt and in wings-level flight, such as preceding the second spin.

Analysis

The pilot was properly licensed to conduct the flight and the aircraft, as far as could be established, was serviceable. The weather was suitable for the flight being undertaken and the pilot had carried out the necessary flight planning.

From witness reports and the track log data, it appears that the winch launch and initial thermalling flight were normal, with an average climb rate of about 150 ft/min. The average airspeed in this period was only a few knots above the '1g' stalling speed for the glider, about 36 kt, but this is usual for a glider in weak soaring conditions, with the pilot trying to fly at close to the 'minimum sink' airspeed. However, at about 'Point C', turning to the right, the speed probably decayed and the glider entered a spin, from which the pilot was able to recover. The height loss during the recovery was 500 ft.

After that initial spin, the pilot flew to the north before making a turn to the right onto a south-south-easterly track. From the flight evaluation manoeuvres performed later, the combination of rate of descent and airspeed suggests that the airbrakes may have been fully open at that stage, likely to have been a deliberate action by the pilot. At this point, it appears that the pilot was probably returning to the gliding site, perhaps as a result of a medical problem or the unsettling experience of the inadvertent spin, to join the circuit on the downwind leg at the normal initial height of 500 ft agl. At 'Point F' the glider was at 930 ft agl so using the airbrakes to lose the height would have been reasonable. At 'Point H' the glider was still at 750 ft agl and levelled off in a turn to the right. Whether this was intended to be another orbit to lose more height is not known but the airspeed was about 40 kt, still close to the stall. It could not be determined whether the airbrakes had been closed or were still extended to some degree at this point - but the glider entered a second spin from a height of 750 ft agl and did not recover. It is possible that the airbrakes had remained open, or they opened unintentionally because they had not been fully 'locked' after the intentional descent. In either case, this would have caused an increase in the stalling speed as well as increasing the height needed to recover. The airbrakes were found to be open at impact and although unlikely, the pilot may have opened them during his attempted recovery from the spin.

The post-mortem examination of the pilot identified a heart condition but it is unlikely that this would have contributed to the accident, although this, or another medical effect, could not be ruled out. Further, it is reasonable to assume that the pilot, having entered and recovered from the first spin, would have paid particular attention to ensuring that a safe airspeed was maintained. The fact that the pilot appears not to have retracted and

locked the airbrakes when levelling off, and allowed the airspeed to decay, may further indicate that the pilot's performance was in some way impaired.

Conclusion

The investigation concluded that the glider entered a spin due to the low airspeed whilst turning to the right, with the airbrakes extended to some degree. No specific reason was identified for the decay in airspeed leading to this spin. The aircraft did not recover from the spin and the extension of the airbrakes may have delayed the spin recovery.