REPORT

**Investigation of a hang gliding accident
which occurred at Clatter, Mid Wales,
on 27th June 2010
in which one pilot suffered serious injury.**

Introduction

On 27th June 2010 the British Hang Gliding and Paragliding Association (BHPA) received reports of an air accident at **Clatter, Mid Wales** that had resulted in serious injuries to one of the pilots involved. The BHPA tasked Mr Mark Dale, BHPA Technical Manager, to investigate the accident and submit a report to the Flying and Safety Committee (FSC) of the BHPA for ratification.

BHPA investigation serial number: IR 10/060

Summary

On Sunday 27th June 2010 the third round of the British Open Series hang gliding competition was taking place at Clatter in mid Wales. Two pilots collided at approximately 400 feet above take off. One pilot was able to crash land his damaged glider, suffering bruising. The other pilot deployed his emergency parachute and descended very rapidly to the ground, suffering major injury in the ground impact.
The investigation concluded that the accident was caused by a combination of:

- a misjudgement of the outcome of rapidly changing positions and heights in and around a thermal and
- one pilot not seeing the other.

The severity of the injury sustained by one pilot was due to the use of a significantly undersized emergency parachute and a poorly designed harness.

This document is confidential until ratified.

Date ratified by the BHPA Flying and Safety Committee:

THE STRUCTURE OF THE REPORT

The structure of this report conforms to that recommended in the BHPA Technical Manual and is intended to follow the principles pertaining to AAIB reports. It is divided into four sections.

Section 1 - Factual information

Section 2 - Analysis

Section 3 - Conclusions

Section 4 - Safety Recommendations

SECTION 1 - FACTUAL INFORMATION

1.1 History of the flight

On Sunday 27th June 2010 forty six competitors were taking part in the third round of the British Open Series hang gliding competition. Thirty four pilots were in the 'flexwing class' and twelve pilots were in the 'club class'. Sunday was the second day of the meeting. A 'race to goal' task had been set for the 'flexwing' class pilots. It is not known where the goal was. It is not known what the task was for the pilots in the 'club' class, but it is believed to have been similar if not identical. The pilots had been briefed before the task to use right hand 360's, which is the normal rule. Pilots in both classes commenced launching at approximately 12:00. The conditions on the hill were variable, with lift and sink cycles, some 'punchy' thermals, light to moderate turbulence, wind varying between 8 to 17mph and switching direction, possibly wave influenced. Some pilots were able to climb out and set off on the task whilst some others sank down into the bottom landing field – and some pilots elected to top land and try again later. By 12:50 approximately eight pilots had managed to leave the hill on the tasked flight. Witness estimates on the number of pilots left airborne on the ridge or thermalling above it in the immediate vicinity vary between ten and thirty. (This variation is probably explained by the fact that these pilots were scattered from ridge height to 3000 feet ato in almost every direction.)

Pilot A had taken off at 12:26 and climbed almost immediately from take- off, reaching approx 1800feet ato having drifted downwind from the take off area. He then flew back upwind over take-off and round to the right (West) of take-off. He found no usable lift there and headed back to take-off below the top of the hill. After searching in front of take-off he found a climb just to the right of take-off and commenced climbing. At this point he had been airborne for approximately 20 minutes.
Pilot B took off at 12:48 and turned right along the ridge. After flying approximately 200 metres he commenced climbing in a thermal. Pilot A, who was higher, saw that Pilot B was climbing in a stronger core below and a hundred metres or so downwind of him, so flew over to join above. Pilot A passed over the lower pilot but encountered no lift so turned to circle back again in the area where Pilot B, who was still lower than him, was still climbing. As Pilot A completed this circle he realised that Pilot B had climbed to his level and they were now on a collision path. He attempted to avoid by tightening his right hand turn. Nevertheless the two gliders collided, with Pilot A's left wingtip and Pilot Bs left flying wire coming together. The gliders separated but were both damaged. Both continued to fly.
Pilot A's glider had damage to the left wingtip but was controllable and he flew down to top land. His decision making was partly influenced by him not having total faith in his emergency parachute, which was an old system purchased second-hand which was fitted in a tight deployment bag (not cloverleaf). Unfortunately the glider became uncontrollable during the approach and he landed heavily, suffering bruising.
Pilot B's glider had lost its left flying wire in the impact. Given the glider's topless design, the glider's structure was able to sustain gentle flight loads without this flying wire. But Pilot B realised that with the left flying wire missing, left roll corrections and left turns would be impossible as the control frame was no longer braced at this side. Mindful of the thermic weather conditions and available landing options, he decided that attempting to fly the glider down to a landing would be unlikely to succeed. He therefore elected to deploy his emergency parachute – but as he was only about 400 feet agl and was still turning right and climbing in the thermal, he delayed deployment for some thirty seconds. His climb rate was marginal so having only gained about twenty five feet of additional height, he decided not to delay further and deployed his parachute.

Once deployed, his parachute opened immediately. His harness immediately rotated him to a head-down position. Despite his attempt to push himself more upright by initially pushing on the base bar and then, having fallen through the control frame as the glider tipped nose-down, by reaching back to the uprights, he was unable to achieve a more upright position. He impacted in a head-down position and sustained serious injury.

Pilots and other persons present attended both pilots immediately.

A large red X signal was laid out at launch and a radio call was made to pilots in the air, cancelling the task and requiring all the pilots in the vicinity to land immediately.
The emergency services were contacted and attended promptly. Pilot A was evacuated by ambulance and Pilot B was evacuated by Air Ambulance.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	1	-	-
Minor / None	1	-	-

Pilot B's injuries were three fractured vertebrae, displaced shoulder blade with severed nerve, broken ribs, punctured and collapsed lung, broken bones in left hand, nerve damage in right leg, and displaced jaw.

1.3 Damage to the aircraft

Pilot A's glider lost a tip batten and tip fairing in the collision. Further damage was sustained during the ground impact.

Pilot B's glider lost its left flying wire in the collision. This wire was special thin 'competition' glider wire of 2mm diameter (2.6mm including coating). Generally 2.6mm diameter cable (3.5mm including coating) is used. The left flying wire had been struck mid-span and had failed at both ends where it entered ferrules.
Further damage was sustained in the ground impact.

1.4 Other damage

None

1.5 Personnel information

Pilot A
Pilot A was aged 41 at the time of the accident. He had 200 hours total experience spread over nine years. He holds a BHPA 'Pilot' rating.

Pilot B

Pilot B was aged 57 at the time of the accident. He had in excess of 2000 hours total experience spread over thirty two years. He holds a BHPA 'Advanced Pilot' rating.

1.6 Aircraft information

Pilot A
Glider: Aeros Stealth KPL 12m
Harness: Woody Valley Cosmic

Pilot B
Glider: Airborne Rev Medium
Harness: Woody Valley Tenax
Emergency parachute: Metamorphosi 16 gore pda (BHPA measured area 21.5m^2)
Helmet: Lazer full face

1.7 Meteorological information
This was a bright fresh day with blue skies and cumulus – and some lenticular forms. The wind speed was varying with thermic cycles between 5mph and 15mph and the direction (SW) was slightly off the face of the hill (ideally SSW). There was reasonable thermal activity (small and punchy lower down) and also clear signs of wave influence.

1.8 Aids to navigation

Not applicable.

1.9 Communications

Not relevant

1.10 Aerodrome and approved facilities

Clatter is an inland ridge site, located eleven kilometres NW of Newtown in mid Wales.

1.11 Flight recorders

Both gliders were equipped with logging GPS units.

1.12 Wreckage and impact information

Pilot B's glider had impacted approximately 650 metres North of take off. Pilot A's glider was slightly to the East of this location.

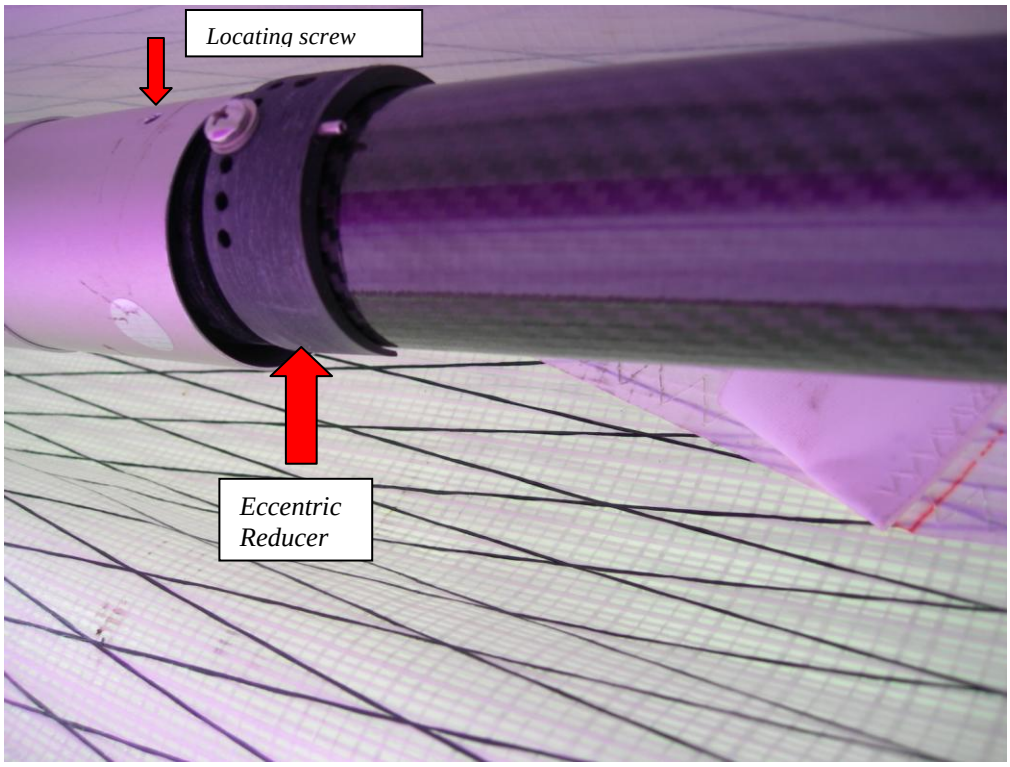
Both gliders were dismantled at the accident site, with notes taken, before being transported to a place where they were examined in detail.
Examination of the wreckage of Pilot B's hang glider revealed that the eccentric reducer rings on both leading edges were out of position. The outboard c/f leading edges are located within the inner aluminium leading edges with a clevis pin near the inboard end of the c/f tube and an eccentric reducer ring at the end of the aluminium tube. The eccentric reducer rings should be located with a self tapping screw through a

hole in the inner leading edge. On both leading edges the eccentric reducer ring (with the self tapping screw attached) was loose and had slid along the leading edge toward the tip. The screw holes were intact, so clearly these rings had not pulled out.

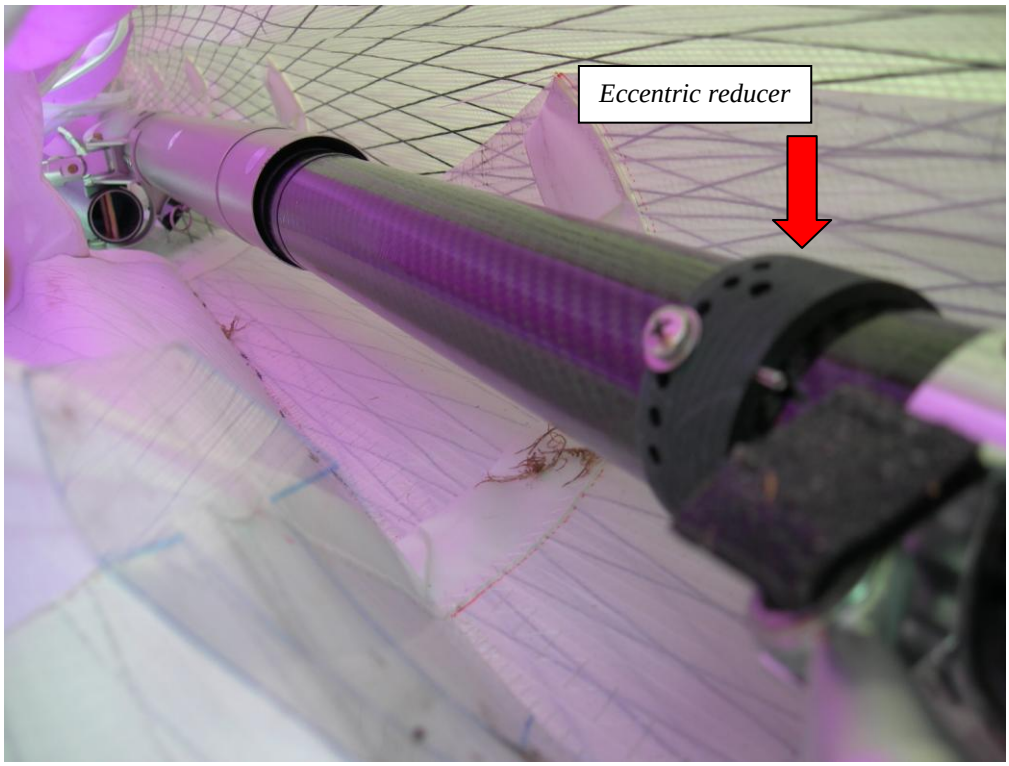
The glider had been purchased and flown by Pilot B in Australia, before he short packed it and shipped it back to the UK. The pilot had flown the glider five times since re-assembling it – one of these flights being a 100k XC flight. He is familiar with these rings and had used them on his previous glider to tune the handling. (The accident glider had flown straight, as delivered, and no tuning had been required.) He thinks it inconceivable that he could have flown the glider with these rings incorrectly installed without noticing a significant alteration in its handling.

The glider manufacturer has commented that he believes that the glider would be flyable with these rings out of position, but possibly with a reduced roll rate.

Irrespective of this 'eccentric reducer issue', it is clear that Pilot B experienced no unusual glider handling anomalies until after the two gliders collided.



Right Leading Edge



Left Leading Edge

1.13 Medical and pathological information

None

1.14 Fire

None.

1.15 Survival aspects

Pilot A believes that the lack of serious injury arising from his uncontrolled ground impact was due to a combination of this occurring on an open area of soft grass and his skill in braking falls arising from many years of martial arts training.
Pilot B's rate of descent under his deployed parachute and body position during the parachute descent are discussed later.
Pilot B's helmet sustained serious damage to the rear right side. This helmet was EN966 certified. The pilot suffered no head injury.

1.16 Tests and research

Not applicable.

1.17 Organisational and management information

The British Open (BOS) Hang Gliding Series Rules 2010 state:

2.1.24 GROUND SIGNALS - when used the following signals will be displayed in the take-off area and must be obeyed as soon as is safely possible:

DAYGLO X *Task is cancelled or suspended (e.g. conditions getting dangerous or rescue helicopter arriving). Land safely ASAP.*

The BHPA 'All Land' signal is a large H.

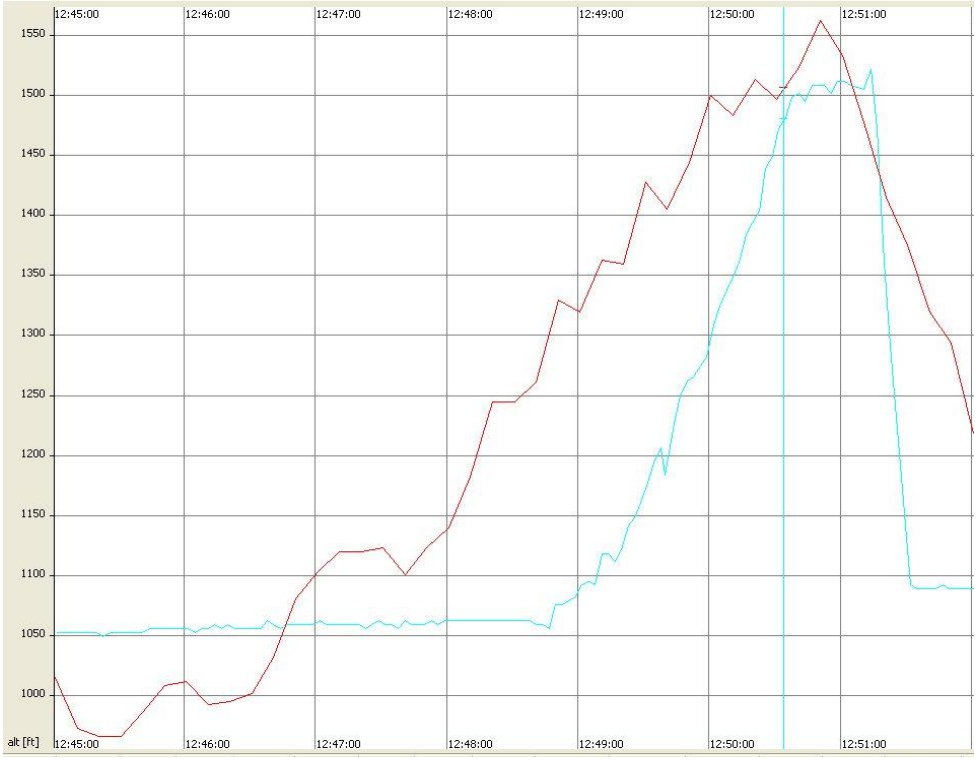
1.18 Additional information
N/a

1.19 Useful or effective investigation techniques
N/a

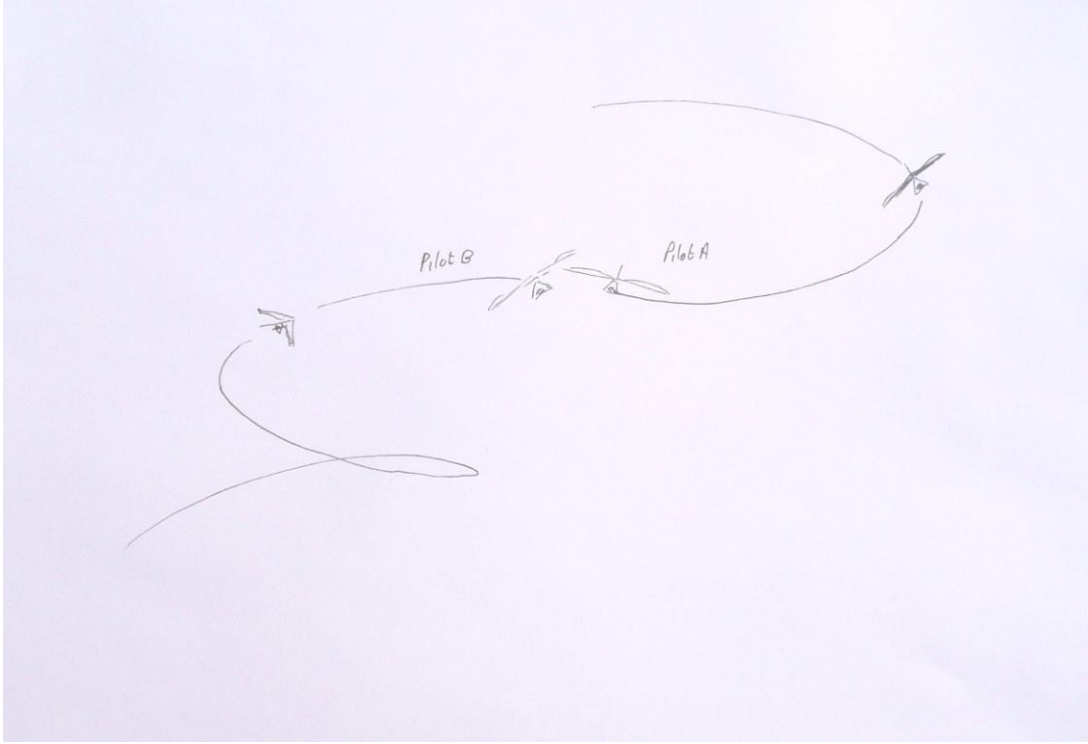
SECTION 2 – ANALYSIS

The Collision

Pilot B did not see Pilot A during the five climbing circles of his climb. This may have been due to the fact that Pilot A was higher than him and it is possible that Pilot A was masked by his wing. Pilot B's average climb rate was approximately 1.5m/s (300fpm) so it is unlikely that extreme bank angles were being used.
Pilot A did have Pilot B in view during much of the sequence, but adjudged that he was at a safe distance. Pilot A then seems to have been caught out by their rapidly changing positions and heights. Pilot A was in weaker lift fractionally downwind of the core of the thermal – whilst Pilot B was in stronger lift in the core. At 12:50 Pilot A was 200 feet higher than Pilot B. Thirty seconds later they collided. During some of the 180 degrees of turn before the collision, Pilot A's wing would have masked his view of Pilot B. And they would have had a closing speed of approximately 60mph.



Barograph traces for the two pilots. Red trace = Pilot A, Blue trace = Pilot B



Probable glider paths

Pilot B believes that his attention would mainly have been on checking the space into his turn, rather than outside his turn – but whatever the explanation, did not notice Pilot A. Meanwhile Pilot A continued his turn, knowing that there was another glider in fairly close proximity but believing that he was higher than it and sufficiently clear of it.

The situation became similar to that when two thermal cores come together. Pilots who are climbing in separate circles in each core, if at approximately the same level, have to integrate. The established safe procedure is to recognise this situation developing early and open out the turns into one big circle.

The Air Navigation Order (Air Law) contains no rules specifically on collision avoidance in thermals, nor any rules regarding collision avoidance based on relative height. But it clearly states (Section 4: 8.1.) that *'it shall remain the duty of the commander of an aircraft to take all possible measures to ensure that his aircraft does not collide with any other aircraft.'*

The BHPA Pilot Handbook contains the BHPA conventions on 'Safe Flying in Thermals'. The FAI has also put together good information on Thermalling Rules and Techniques (Chapter 17 in Section 7b of the Sporting Code). This is reproduced on the British Paragliding cup website here: http://www.bpcup.co.uk/thermalling.php.

Pilot B was very familiar with flying in Australia where there is a rule 6.7.2 '*When thermaling give way to the hang gliders and paragliders that are climbing up from **BELOW.'*** By inference, the pilot has no duty to avoid pilots above him.

The Emergency Parachute descent

Pilot B descended under his emergency parachute at a velocity of approximately 9.0m/s, as recorded by his instruments. The pilot was suspended by his harness in a head down position – and impacted in this position. Pilot B sustained very serious injury in the impact.

Both the descent rate and the head-down position were factors in this unfavourable outcome. They will be examined in turn.

Descent rate:
The likelihood of injury increases with higher descent rates. BHPA published advice is that any equipment/load combination that produces a descent rate greater than 7.5 m/s is unacceptable. A target of between 5 – 6 m/s should be aimed for**. BHPA Licensed Packers are told that 'If the equipment you are examining is smaller than that recommended in the 7m/s table you must advise the owner to re-equip with a larger canopy.'**

The parachute used by Pilot B was a Pulled Down Apex design with a measured area of 21.5m^2. Such designs have a typical Coefficient of Drag (C_D) of 1.2. Pilot B with his equipment and glider weighed approximately 105kg. Using the basic equation is: $V = \sqrt{}$ m x g / 0.5 x *p* x C_DA (simplified for practical purposes to: $V = \sqrt{}$ 16 x m / C_DA)

$V = \sqrt{}$ 16 x m / C_DA
$V = \sqrt{}$ 16 x 105 / 1.2 x 21.5
$V = \sqrt{}$ 1680 / 25.8
V = 8.07 m/s

So the rate of descent experienced in this accident (9.0m/s) was similar to, but actually slightly worse, than the figure achieved by calculation. (The discrepancy might have been due to the pilot descending through sinking air.)

Using the formula $A = (16m)/(V^2 * C_D)$ it is possible to see the size of parachute that would have brought the pilot down at the BHPA's recommended target figure of 5.5 m/s.

$A = (16m)/(V^2 * C_D)$
$A = (16x105)/(5.5^2 * 1.2)$
A = 1680/(30.25 * 1.2)
A = 1680/36.3
A = 46.3m^2

Head down position:
The BHPA parachute system target descent rate of between 5 – 6m/s is based on the pilot impacting the ground upright. In this accident the pilot impacted head first. The Tenax harness has a single suspension strop which connects to a slider on the harness back plate.

Pilot B's single suspension strop harness


Slider system in back of harness.

The parachute bridle was connected to the main karabiner at the top of this suspension strop.
In normal use the pilot adjusts his body position by pushing or pulling his upper body up or down by reacting on the base bar/uprights, and the slider moves until the pilot is balanced. In this accident the parachute deployed behind the pilot, which resulted in the slider being pulled to the maximum rearward position. With the pilot's cg ahead of the suspension point, the pilot was rotated into a fully head-down position. Also as the glider became supported by the parachute, the glider swung down into a nose-down position. Despite the pilot's considerable efforts, he was unable to alter his head-down position.

With earlier hang glider harness designs it was not possible to rotate into a head-down position and it was possible for the pilot to alter from prone to upright without reacting against the glider control frame.

Pilot B an instant before impact.

SECTION 3 – CONCLUSIONS

The investigation concluded that the cause of the incident was a combination of one pilot misjudging the outcome of rapidly changing positions and heights in and around a thermal and of the other pilot having not seen and identified this glider as a possible threat. The severity of the injury sustained by Pilot B was largely due to the use of a significantly undersized emergency parachute and a poorly designed harness.

SECTION 4 - SAFETY RECOMMENDATIONS

1. It seems potentially confusing for pilots taking part that the British Open Hang Gliding Series employs a different 'All Land' signal from the official BHPA one. It is therefore recommended that the BHPA Executive consider rationalising this signal across all competition disciplines within the BHPA.

2. No emergency parachute system should suspend the pilot head downward. It is recommended that the BHPA FSC should consider what steps should be taken to reduce the likelihood of this occurring again.

3. It is concerning that two pilots taking part in the UK's premier hang gliding competition events both had emergency systems that were not fit for purpose. Especially given that the BHPA has a network of Licensed Emergency Parachute Systems checkers. It is recommended that the BHPA Competition Panel review this situation.

4. A mid-air collision at a PG comp in 2009 led to two fatalities and this present accident could easily have had the same result. In both accidents 'club level' competitors were involved. High levels of situational awareness are required to fly safely in the conditions of a competition. Exposure to the situation is a key part of acquiring these high levels of skill. But any other strategies for building up these skills should be encouraged. It is recommended that the BHPA Competition Panel review the way that less experienced pilots are integrated into competitions.