British Hang Gliding and Paragliding Association

REPORT

Investigation of a Powered Paraglider incident which occurred at Stanton under Bardon, Leicestershire, on 19th February 2017 in which a pilot was fatally injured.

Introduction

On 19th February 2017 the British Hang Gliding and Paragliding Association (BHPA) received reports of an air incident at Stanton under Bardon, Leicestershire, that resulted in the death of a pilot. The BHPA tasked Mark Shaw, BHPA Technical Officer, to investigate the incident and submit a report to the Flying and Safety Committee (FSC) of the BHPA for ratification.

BHPA investigation serial number: GBR-2017-4254

Summary

On 19th February 2017 at 2:30pm, a pilot flying a powered paraglider undertook a spiral dive from approximately 1,100ft above ground level, and during his descent collided with another powered paraglider. The first pilot's spiral dive continued to ground level, whereupon he impacted the ground and sustained fatal injuries. The pilot of the other aircraft landed safely and was uninjured. The Investigation concluded that the incident occurred as a result of the pilot undertaking a rapid height loss manoeuvre from which he was unable to recover before impacting the ground.

This document is confidential until ratified.

Date ratified by the BHPA Flying and Safety Committee: 15th May 2017.

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 of Air Accident Investigation Branch reports. It is comprised of the following 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.

Pilot A (the incident pilot) launched his powered paraglider from a field at Odstone, Leicestershire, with Pilots B, C, D and E. Their intention was to make a cross-country flight to a landing field several kilometres east of the incident site. Pilots B, C, and D described the conditions in which they launched as being near perfect, with an 8-12 mph steady breeze from a westerly or north-westerly direction. The pilots reported the conditions in the incident area (7km east-northeast of the take off) to be much the same.

Leading up to the incident, Pilot A was seen performing wing-over acrobatic flight manoeuvres at low level. When Pilot A was flying over the field where the incident occurred, Pilots B and C were in reasonably close proximity, and Pilots D and E were approximately one kilometre away.

Pilot A was seen by Pilot C to perform a spiral dive and then climb under power to an altitude of about 1,100ft above ground level, approximately 100ft higher than Pilot C. Pilot A was then seen to make two wing-overs before entering another spiral dive. At approximately 300ft above ground level, whilst still in the spiral, Pilot A's wing collided with Pilot B's wing, and they were seen to rotate together through one or two rotations before separating as Pilot B's wing deflated and re-inflated. Pilot A's spiral dive continued and he impacted the ground. Pilot B's wing returned to normal flight and he and Pilot C both landed to attend to Pilot A. The emergency services were summoned but Pilot A died at the impact site from the injuries he sustained.

1.2 Injuries to persons.

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

1.3 Damage to the aircraft.

Pilot A's paraglider wing sustained minor damage from the impact or subsequent recovery, including severed lines and small tears to the left hand wing tip area.

Pilot A's paramotor unit was seriously damaged by the impact, with particularly extensive damage to the right hand side of the cage. The motor assembly mounts had sheared off their frame. The carbon "E-Prop" propeller blades had both broken, between 200mm and 400mm from the hub.

Pilot A's electronic flight instrument was damaged and found to be non-functioning after the incident.

Pilot B's paraglider wing sustained minor damage from the impact, and his paramotor sustained no damage.

1.4 Personnel information.

Pilot A was a 42-year-old male with a body weight of 76kg. He was not a BHPA member and did not hold any recognised ratings. The Investigation was not able to establish Pilot A's flying experience as a flight log record was not available but it was reported that he began training on powered paragliders approximately 18 months prior to the incident. Evidence from the other pilots present at the incident (who had flown with Pilot A on previous occasions) suggested that Pilot A had accumulated in the region of 50 to 100 hours' powered paraglider flying, was known to fly regularly and undertake acrobatic manoeuvres.

Pilot B is a current BHPA member, holding a Pilot (Power) rating.

1.5 Aircraft information.

Pilot A's paraglider wing is a Dudek Snake 18 (18 square metre wing area), with serial number P-109762, manufactured in November 2014. This wing type holds a DGAC manufacturer's declaration certificate, but is not independently tested or certified to EN 926-2 (the European flight safety characteristics standard for paragliders). The Snake 18 has a manufacturer's declared flying weight range of 55 to 120 kg.

Visual inspection of the wing revealed that it was in good condition apart from damage sustained during the incident or subsequent recovery.

The paramotor unit is a Techno-Fly Octagon 190 with an Air Conception harness. It was not possible to test the operation of the unit due to the extensive damage it had sustained as a result of the incident, although there appeared to be little wear on visible moving parts, indicating either a fairly new or lightly used paramotor, or one that had been well maintained.

Pilot A was equipped with an Apco Mayday 20 emergency parachute, and an EN 966 certified helmet.

1.6 Meteorological information.

Historical data for the area was obtained from the Met Office.

19/02/2017 at 14:00
Westerly wind 6mph, good visibility
10 deg. C. surface temperature
1021 millibars pressure
White medium level cloud.

The conditions described by Pilots B, C, and D were consistent with the historical data.

1.7 Incident Site information.

The incident site (see Figure 1, below) is a gently sloping field approximately 1.5km southwest of the village of Stanton under Bardon. It is surrounded by flat or gently sloping farmland. Apart from a line of high voltage power cables running approximately north-south at the far edge of the adjacent field, there are very few obstacles.

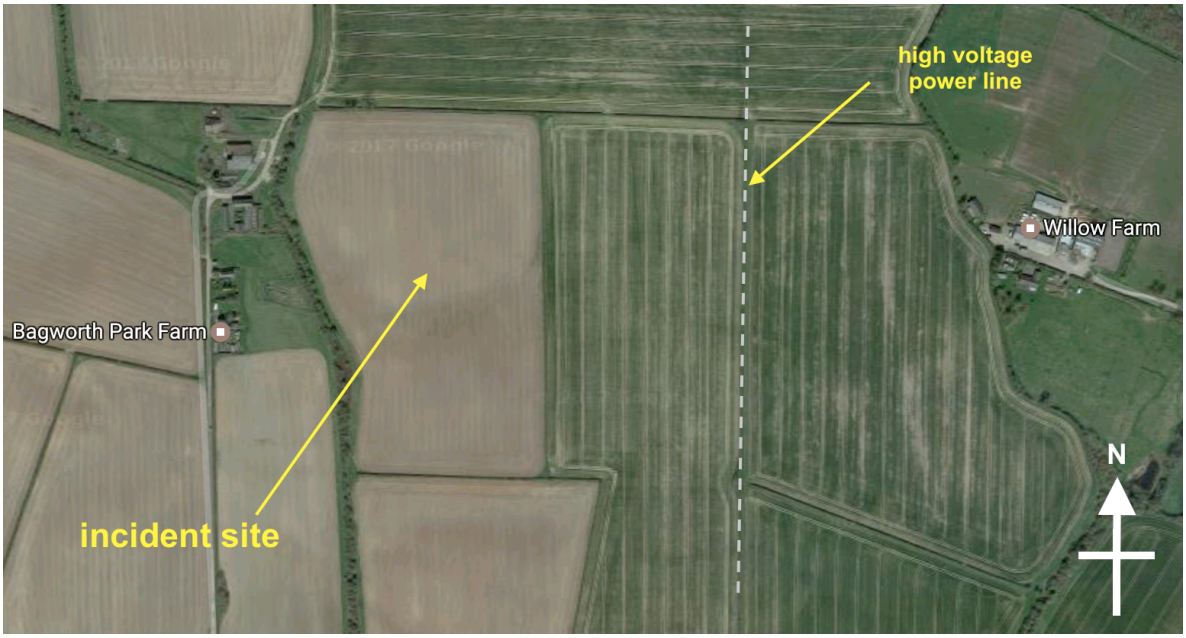

Figure 1

1.8 Aids to navigation.

Pilot A was equipped with a Flytec 4005 electronic variometer that did not record GPS track or detailed barometric data.

1.9 Communications.

Pilot A was not equipped with a radio during the incident flight.

1.10 Wreckage and impact information.

Pilot A's paramotor was recovered with approximately 1/2 tank of fuel. There was no fire.

1.11 Medical and pathological information.

Pilot A's cause of death was listed on the post mortem report as a head injury.

1.12 Survival aspects.

Pilot A was found by Pilot B in an upright sitting position in his harness with his engine stopped. His emergency parachute had not been deployed. He was attended to initially by Pilots B and C, who summoned the emergency services. Witness F (a resident nearby) assisted at the scene. The air ambulance attended the incident.

1.13 Tests, research and evidence.

This report is based on evidence from Pilots B, C, D; Witnesses F and G; the visual inspection of Pilot A's paramotor and the inspection of the Dudek Snake paraglider wing by the Aerofix test centre.

SECTION 2 – ANALYSIS

2.1 Meteorological conditions.

The Investigation considered the meteorological conditions. The conditions were reported by Pilots B and C as being an overcast sky and light winds, with light turbulence up to 200ft above ground level, and smooth air above this height. Witness F noted that the conditions leading up to the incident were calm and appeared still. The Investigation concluded that on the basis of the aftercast from the Met Office and the reports from the witnesses, the conditions were suitable for the activity and were not considered by the Investigation to be a factor in this incident.

2.2 The flying area.

The Investigation considered the local flying area around where the incident occurred. The area consists of gently sloping farmland. There are no obvious topographical features in the immediate vicinity that would give rise to mechanical air turbulence. The Investigation concluded that the flying area was suitable for paramotoring, and not a factor in the incident.

2.3 The incident aircraft.

2.3.1 The Investigation considered the paraglider used by Pilot A. The Snake paraglider wing is designed for use with a paramotor and is described by its manufacturer Dudek on its website as a sport or performance wing, being suitable for experienced pilots with a minimum of 200 hours' total flight, flying at least 80 hours a year. The user's manual states the wing is for the "experienced paramotor pilot" looking for a "fast and agile wing", and is "designed for experienced pilots excelling in slalom tasks".

2.3.2 The Investigation considered the effect of the wing loading on the performance of Pilot A's wing.

Total weight in flight calculation.

Dukek Snake	4.9kg
Paramotor and harness	21.4kg
Apco Mayday 20 Emergency parachute	2.7kg
Other equipment (clothing, helmet, footwear, radio, etc)	5.0kg
Fuel (weight based on approximate tank contents)	4.0kg
Pilot A's body weight	76.0kg

The approximate total flying weight in flight is **114kg**.

The total flying weight of Pilot A and his aircraft is close to the maximum total flying weight recommended by the manufacturer (120kg). Dudek states on its website that for the Snake 18, 120kg is the "maximum allowable take-off weight for very experienced pilots" and draws to the attention of the user:

> *"CAUTION: the paraglider considerably alters its behaviour depending on wing load. Maximum loads require employing highest pilot skills."*

High wing loading is known to increase paragliders' dynamic responses to collapses and other departures from normal flight. The Snake user's manual identifies the following characteristics when in a spiral dive:

"3.8.2 Spiral dive

The Snake is a very agile paraglider, so entering spiral dive happens very quickly and can be surprising for the less experienced pilots.

A spiral dive is characterised by reaching the highest sink rates possible. Significant G-forces, however, make it difficult to sustain for long, as it will place high loads on both pilot and glider to degree of losing consciousness by the latter. Never do this manoeuvre in turbulence or at too high bank angles. Control the dive and do not exceed 16 m/s sink. If the dive is not stopping after releasing the brake, assist the paraglider with the outer one."

The Investigation found that the onset of a spiral dive on a Snake 18 under a high wing load of 114kg would be rapid and would quickly build into a high-energy rotation, the pilot being subjected to high G-force.

2.3.3 At the post-incident inspection of the paraglider, the wing was inspected in the configuration it was set in during the incident flight. The speed trimmers were set for un-accelerated flight and the "power attack" system was not connected. The Investigation found that the trimmer setup of the paraglider was not a contributory factor in the incident.

2.3.4 The wing was then examined by Aerofix test centre. The suspension lines were found to be marginally outside the manufacturer's line length tolerances, but this was not considered to contribute to any departure from normal flight behaviour. The steering (brake) lines were both found to be 90mm shorter than the manufacturer's specified length. It was not possible to ascertain whether this was due to line shrinkage or the lines being manually shortened. Whilst it is possible that equal shrinkage occurred to both control lines (though exposure to environmental factors) it is more plausible given the age of the paraglider that the control lines were manually shortened.

The effect of shortened control lines would be to increase the dynamic response of the wing to control inputs, and is mentioned in the user's manual as a way of a pilot increasing the "aggressive" nature of the wing. The user's manual recommends observing a +/- 50mm adjustment range from the factory standard setting. The Investigation found that control lines shortened to the extent they had been on the incident wing would affect the handling; particularly the speed of onset of a spiral dive, once initiated by the pilot. The Investigation found the shortened control lines to be a contributory factor in the incident.

2.3.5 The Investigation considered the type and condition of Pilot A's paramotor unit. The Octagon 190 is a lightweight paramotor designed for recreational flying, and the manufacturer Techno-Fly states in its user's manual that it is not designed for aerobatics.

Whilst collecting evidence, the Investigation was made aware of a potential issue with Octagon 190 connecting arms (the side bars connecting the harness to the motor and wing) bending under the forces applied by acrobatic manoeuvres. Pilots making spiral dives and other high G-force manoeuvres predominantly in one direction identified that the additional load applied to one side of the Octagon caused the arm on that side to bend so that one riser attachment point was

effectively higher than the other side. It was evident from Pilot B's statement that Pilot A was aware of this issue as he had purchased but not fitted stronger arms.

Pilot A's paramotor was examined and although a bend was detected in the right hand side arm, at 5mm it was not considered to be significant enough to adversely affect the flying characteristics of the powered paraglider.

It could not be ascertained whether the paramotor blades were being turned under power at the point of impact.

2.4 Pilot A: experience and currency.

The Investigation considered Pilot A's powered paraglider experience and currency. Pilot A undertook a paramotor training course with AXB Sports 18 months before the incident. AXB Sports is not a BHPA registered training school. It operates a training course believed to be similar to the BHPA's Club Pilot (Novice) course which includes no practical training in advanced skills such as acrobatic flight manoeuvres or spiral dives. The Investigation knows of no external validation for the course or the standard of instruction. On the basis of evidence from Pilot A's flying colleagues, he had accumulated between 50 and 100 hours' airtime. This is a wide range, and the exact amount is not verifiable without a logbook.

From information supplied principally by Pilot B, and confirmed by other pilots, Pilot A was a regular flyer. He had flown several times that winter including the week leading up to the incident. On this basis, Pilot A would be considered a current pilot.

The Investigation found that Pilot A's experience level was considerably lower than the level recommended by the manufacturer Dudek for the Snake paraglider, and his lack of flight experience was a significant contributory factor in the incident.

2.5 The spiral dive manoeuvre and aerial collision with Pilot B's aircraft.

2.5.1 The Investigation considered the opportunity Pilot A would have had for assessing whether the airspace he was flying into was clear before initiating the spiral dive. Pilots who have received training for extreme flight manoeuvres such as the spiral dive are taught to establish that the airspace around them is clear before undertaking the manoeuvre. In a developed spiral dive, the pilot's body position is orientated towards the ground and the pilot is afforded a view of airspace below him, although many pilots focus on the inner wingtip to counteract the disorientating effects of the rotation.

The Investigation considers that the collision occurred either because Pilot A was unaware of the position of Pilot B before initiating the spiral dive, or because he considered Pilot B far enough away (at approximately 800ft below) not to be a collision risk and decided to embark on the manoeuvre with the intention of exiting it at a height where there was a low risk of conflict with Pilot B.

2.5.2 It is evident from the witness statements that Pilot A's spiral dive developed rapidly, as expected with a highly loaded small wing. The shortened control lines would have contributed to this rapid entry. Witness F stated that the spiral had a high angle of bank (estimated at or above 60° from the vertical axis), and descended very quickly.

Pilot C did not observe any control input by Pilot A whilst he was in the spiral dive prior to the aerial collision. The Investigation considers it highly probable that the Snake with shortened control lines would require active piloting with the outside

control to counter the spiral dive and return to normal flight. This could only be ascertained by flight-testing the wing in its configuration prior to the incident, but this was not available to the Investigation.

2.5.3 The Investigation considered the G force experienced by paraglider pilots performing manoeuvres with a high rotational speed. The effects of G force are widely reported in various types of aviation. Paraglider pilots describe disorientation, tunnel vision, and in some circumstances a loss of consciousness as blood is moved from the brain to the feet at the outer extremity of rotation. National associations including the BHPA strongly recommend that paraglider pilots seek specific training in entering, maintaining and exiting spiral dive manoeuvres. As a general practice, training establishments advise pilots not to undertake spiral dives if any of the above effects present themselves.

Witness G (a pilot colleague of Pilot A) reported having watched him perform acrobatic manoeuvres four months prior to the incident. Pilot A stated to him that he had experienced momentary blackouts in spiral dives on previous occasions.

The Investigation found that when undertaking a spiral dive, the high wing loading, and the shortened control lines were significant factors that contributed to the speed of rotation, the rate of vertical descent of Pilot A's aircraft, and the G force to which Pilot A was exposed. It is both possible and plausible that the exposure to high G force led to Pilot A losing consciousness in the spiral dive, and this was the precipitating factor that led to the aerial collision and ultimately his impact with the ground.

The Investigation considered that Pilot A's level of experience was a significant contributory factor in that he was unable to control the speed of rotation or recognise the onset of the effects of G force, and react appropriately and at the right time to actively pilot the aircraft before being unable to arrest the spiral dive.

2.5.4 The Investigation considered whether Pilot A would have been able to avert the collision by steering away from Pilot B's paraglider. If Pilot A had seen Pilot B's wing when established in the spiral dive, and had identified a risk of collision, he would have needed to counteract the spiral dive by applying opposite control to the direction of turn. The Investigation considered it possible that the aerial collision could have been avoided had Pilot A been aware of the proximity and track of Pilot B, and been able to control the wing out of the spiral dive. The Investigation found that Pilot A either took no avoiding action or was unable to take avoiding action whilst in the spiral dive, because he was subjected to a high G force whilst in the manoeuvre.

2.5.5 The Investigation considered whether Pilot A might have struck part of Pilot B's equipment in the aerial collision, rendering him unconscious or unable to pilot his paraglider. Pilot B could not recall which parts of their aircraft collided. Although damage occurred to Pilot B's wing, there were no signs of impact on his paramotor.

Pilot A's helmet was inspected and there was impact damage to the shell at the front left hand side. This damage was in the form of a vertical line or score approximately 50mm in length, but this did not appear to fully penetrate through the helmet shell to the layer of protective padding. It cannot be ascertained whether this damage occurred during the incident, or a previous occasion. The Investigation concluded that in light of this damage, an impact may have occurred during the incident to Pilot A's face or jaw, or other exposed areas not protected by the helmet.

2.5.6 The Investigation considered the effect and outcome of the aerial collision. Pilot B was not aware of Pilot A until an instant before they collided, when he saw Pilot A flying towards him in a high-banked turn. The collision was evidently insufficient to

arrest the spiral dive, as it was stated by witnesses that Pilot A's wing continued turning at its high angle of bank whilst tangled with Pilot B's wing. After the wings separated, Pilot C did not detect any deviation in course that would suggest Pilot A had made a control input to counter the spiral turn. Pilot D noted that Pilot A's wing remained in the spiral as Pilot A neared the ground. The Investigation found that the aerial collision was not a significant factor in the outcome of the incident.

SECTION 3 – CONCLUSION

The Investigation concluded that the incident occurred as a result of Pilot A undertaking a rapid height loss spiral dive manoeuvre from which he was unable to recover before impacting the ground.

SECTION 4 - SAFETY RECOMMENDATIONS

It is recommended that the Association, through its magazine Skywings,

1) notifies its members of the issues and potential dangers involved in performing spiral dives and acrobatic flight manoeuvres on paragliders with high wing loading;

2) highlights equipment limitations of paramotor units which are repeatedly exposed to high G force in flight manoeuvres outside the paramotor manufacturer's recommended scope of operation;

3) notifies its members about the issues with performing user modifications to control lines which are outside the manufacturers' recommended limits, and how user modifications may affect the certification of the wing, or render the certification invalid.