British Hang Gliding and Paragliding Association

BOARD OF INQUIRY

REPORT

Investigation of a tandem powered paragliding accident which occurred near Flagg, Near Buxton, on the 15th May 2004 in which both the pilot and passenger were seriously injured

Introduction

On the 15th May 2004 the British Hang Gliding and Paragliding Association (BHPA) received reports of an air accident near Flagg, which had resulted in serious injuries to the pilot and passenger of a tandem powered paraglider.
The BHPA is required by current European legislation to carry out an investigation and report the findings via the Air Accident Investigation Branch of the Department for Transport. Under its delegated authority it convened a Board of Inquiry under President Mark Dale, with authority 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 04/062

Summary

On the 15th of May 2004 a powered paraglider (ppg) pilot was taking a passenger up for a flight from a field near Flagg. On his previous tandem flight earlier that day a component of the spreader bar system (a 'U' bar which linked the two spreader bars at the front) had been damaged after the landing: the pilot decided that this bar was not essential and prepared for flight without it. After launching the aircraft climbed to about 150 feet. As the passenger and pilot got into their harnesses the pilot was aware of the passenger 'falling' to his right and the entire power unit/pilot/passenger assembly swivelling rapidly under the wing, leaving the paraglider risers crossed in front of his face. The glider had entered a steep descending turn to the left. The pilot switched off the engine and attempted to use the (locked) control lines to recover, but was unsuccessful. The machine completed about three 360's before impacting.
The investigation found that with this particular spreader bar system the missing 'U' bar plays a vital role in mechanically fixing the pilot, passenger and motor suspension points in alignment, and the risers at their correct spacing. With the 'U' bar removed the spreader bars were able to move both laterally and out of alignment fore and aft, with the result that the thrust line was angled off line which drove the entire power unit/pilot/passenger assembly through a rapid 360 (or more) under the wing, twisting the risers and locking the controls.

Date ratified by the BHPA Flying and Safety Committee: 26th October 2004

Contents

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 plus the Appendices:

Section 1 - Factual information

Section 2 - Analysis

Section 3 - Conclusions

Section 4 - Safety Recommendations

Date: 18/11/04 Signed _____

SECTION 1 - FACTUAL INFORMATION

1.1 History of the flight

The pilot had learned to fly paramotors in 2000 using a P130 power unit and an Electron wing. In 2002 his daughter (aged 12) expressed a wish to fly with him so he obtained a set of tandem spreader bars and a small harness from a local paramotor dealer. (These were standard hill tandem pg spreader bars.) He took his daughter up twice using that set-up with his 'solo' power unit and wing, entirely successfully.

Not long after that he purchased a set of Fly Products tandem paramotor spreader bars, but never used them – and as time went by he felt that his daughter had got too heavy to take up using the P130 motor / Electron wing combination.

In early 2004 he decided to purchase some proper tandem flying equipment and bought an Ozone McDaddy tandem wing and a Fly Products 'Gold 130' power unit and a passenger harness. (This would be used with the Fly Products tandem paramotor spreader bars he had bought some time earlier.)

In April he went to a paragliding school in Greece for one week to learn to fly the tandem wing unpowered, under tuition. After returning from Greece he went out to a field at Brassington with a fellow ppg enthusiast friend and spent some hours ground-handling the canopy. He then made two solo flights on the Gold 130 / McDaddy set-up.

Some time in the week leading up to Friday 14th May 2004 he arranged with other ppg enthusiast friends to have a 'flying weekend' based at the flying field at the Bull i'th Thorne public house. He

went up on the Friday evening with both his solo and dual ppg set-ups. He flew his solo equipment on the Friday evening before camping on the field.

It was too windy to fly on Saturday morning so the pilot and another visited two hill flying sites to see if conditions were suitable for hill flying. They were not: Shining Tor (overcast, not enough wind) and Bradwell (blown out for pg). They returned to the ppg field mid-afternoon having heard that conditions there were improving.

When they got back some others had also turned up. During the course of the day perhaps a total of twelve to fourteen pilots and friends/partners came to the field. Some flew in by microlight. It was a good social flying day.

The pilot and others flew their own solo machines during the late afternoon.

There was some general chat about getting the tandem out, and a lady ppg pilot volunteered to be his first passenger. As there was still 5-6mph of wind two other pilots were briefed as launch assisters. The pilot briefed his passenger on the flight. On the first inflation attempt the glider over-shot. He put some trimmer on and tried again. This time was better but not perfect, so was aborted. On the third attempt it was perfect so he put the power on and they took off in two or three steps. After climbing out to about 150 feet his passenger got fully into her seat and then the pilot got into his. During the flight he experimented with the trimmers and general handling. The glider flew perfectly nice and straight 'hands off' and turned easily by weight shift. After fifteen minutes or so they flew back over the field and 360'd down to lose height for landing. He then put some trimmer on, came in and landed. They then turned round and the pilot collapsed the wing. Everything had gone perfectly.

Another inexperienced ppg pilot then wanted a passenger flight, so this was prepared for as before. This time on the first inflation attempt the wing over-shot again, but on the second attempt it was just right. Once they had gained some height and got sorted out the passenger piloted the machine for ten to fifteen minutes. The pilot then took over and, as the passenger wanted to do a spiral dive he did one. They then came in to land. This landing was not quite as good as they were slightly out of wind. They had more or less stopped but the wing went off to one side and pulled them that way. They ran with it and the pilot 'braked' it down. They didn't fall over, but during the 'incident' the nylon fixing at one end of the connecting 'U' bar at the front of the Fly Products tandem spreader bars was broken.

A little later on another lady asked for a tandem flight. Her husband, a ppg pilot was encouraging her – although she wasn't really dressed for flying. There was then some general discussion between the pilot and several of the experienced pilots (at which the lady's husband was present) about the broken 'U' bar: the general consensus echoed the pilot's own opinion that it was not needed. He believed it to be a passenger 'hand rail'. (Some of the pilots involved in this few moments of discussion also had experience at dual flying.) One inexperienced pilot expressed some reservations but was assured that it was ok – based on previous experience flying tandem ppg using 'hill' spreader bars.

By the time the pilot had removed the broken 'U' bar and got everything ready for the proposed flight the lady passenger had run out of time. She was going out that night and had to leave. The pilot therefore prepared to fly his solo equipment. Then the lady passenger came back to the field, having apparently decided that it was too good an opportunity to miss. She had also got her flying suit, helmet etc from home. (She had flying clothing at home as she had flown tandem previously with her husband and was planning to get further involved with the sport.)

They got all set up for the flight. By this time (approx 7pm) the wind had dropped right off and other pilots were having to forward launch with a good committed take-off run. The pilot briefed the passenger's husband to assist the take-off run by pulling on the front of the right hand spreader bar. At the first attempt the canopy came up but went a bit left. The pilot corrected it as they ran, and put the power on – then the passenger fell over which resulted in the pilot falling over. They got sorted out and prepared straightaway for a second attempt. The lady passenger then said that she was nervous so the pilot said that they should leave it. There was some discussion between the lady passenger and her husband and the lady decided that she definitely did want to fly. This time the pilot briefed another ppg pilot to pull on one side and the passenger's husband on the other side. The pilot inflated the canopy, put the power on, and they ran off totally successfully.

They climbed out on full power and gained perhaps 150 feet. The passenger then turned to ask if it was ok for her to get into her seat. The pilot said yes and she did this. He then started to get into his seat. His normal procedure is to put both brakes into his left hand, and use his right (throttle) hand to pull the seat under his buttock on that side, before reversing the procedure with the left side. As he started to get into his seat (holding the throttle still on full power) his passenger suddenly 'fell' to his right and the next thing he knew they had swiveled 360 degrees under the wing, and the paraglider's risers were crossed in front of his face. This all took perhaps one second. The glider had gone into a sharp 360 turn to the left. He had instinctively reduced power to idle and was pulling on the right brake to try to get out of the tight 360. Because the risers were crossed the brake line was locked. He hit the kill switch. The machine completed about three descending 360's at approximately 45 degrees of bank. A witness reports a fleeting impression that the power unit/pilot/passenger 'were not facing forward as normal.' It impacted in a field approximately 400 metres from take off.

Several pilots and a first aider were on the scene within minutes. The emergency services were summoned. The passenger was evacuated by air ambulance and the pilot by conventional ambulance.

1.2 Injuries to persons

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

1.3 Damage to the aircraft

The wing was undamaged. The paramotor unit was severely damaged.

1.4 Other damage

There was no other damage.

1.5 Personnel information

The pilot is aged 38, a BHPA member and holds a PG FLPA rating. He learnt to fly in 2000, completing a PG EP with SkySystems and some CP tasks with Airways, where he bought an Ozone Electron wing. He then taught himself to fly ppg within a ppg group, using a Fly P130 motor that he had purchased. He decided that he should seek BHPA qualification some 2 years later, by which time he had approximately 100 hours. This was achieved by demonstrating competency to a local ppg qualified coach. At the time of the accident he had somewhere between 200 – 250 hours on ppg, all gained on the P130 / Electron outfit (excepting the few on the accident equipment.)
He also has about 12 hours hill flying experience – but no qualification.
He has no qualification for dual flying.

The passenger is aged 29. She was not a pilot but had flown as a tandem paraglider passenger previously with her husband and was planning to get further involved with the sport. (Her husband is not a qualified dual pilot.)

1.6 Aircraft information

The power unit was a Fly Products 'Gold 130'. This has a 206cc Simonini engine producing 80kg of thrust. The standard fuel tank holds 16 litres. The CAA exemption limits flpa capacity to 10 litres. The capacity of the fuel tank on the accident machine was not measured but had an identical appearance to the standard tank.

The wing was an Ozone McDaddy 41. The paraglider type has been tested for paraglider usage by the DHV, and classified as Class 1- 2 Biplace, GH. This testing will have been done with the risers set 45cm (+ or – 3 cms) apart.
The manufacturer has stated that the wing was not designed or tested for tandem paramotor use. (Some of their gliders are – and these are sent to the DULV for certification.)

The tandem spreader bars were produced by 'Fly Products' for tandem paramotoring. The 'U' bar at the front fixes the riser attachment points at approximately 52 cms apart.

1.7 Meteorological information

At the time of the accident (7:20 pm) the wind was light from the North West and there was no turbulence.

1.8 Aids to navigation

Not Applicable

1.9 Communications

No intercom was used.

1.10 Aerodrome and approved facilities

The flight originated from a field at 'The Bull i'th Thorn', on the A515 Ashbourne to Buxton Road.

1.11 Flight recorders

A Magellan Map 330 GPS was in use. This had stored details of the flight, but due to the recording interval and the short duration of the flight only four points were recorded. These support the narrative account of the flight.

1.12 Wreckage and impact information

The wing was undamaged. Photos taken at the site within a few minutes of the accident show that the lines are crossed for a distance of two to three metres from the riser attachment points. When subsequently examined at the Police storage facility the risers and lines were very untidily wrapped in the canopy. The main lines were twisted around each other three and a half times (as though the pilot/passenger/power unit combination had rotated clockwise through 1260 degrees) - but the canopy had been disconnected from the paramotor at the accident site so it is possible that this twisting had been introduced after the accident.

Both trimmers were set at the nearly fully on (slowest) position.

The power unit frame and cage was badly damaged. A considerable amount of damage appears to have occurred after impact when the passenger has fallen behind the propeller, disrupting the cage on the right hand side. The front harness had mud staining on the lower right side. Both seat boards were broken. General indications are that the initial impact was with the power unit virtually erect.

Photos taken at the accident scene show that the fuel tank was nearly half full at impact.

1.13 Medical and pathological information

The pilot and passengers injuries were predominately to the right side of their bodies.

1.14 Fire

Not Applicable

1.15 Survival aspects

The passenger sustained 'brain bruising' injuries, indicating a severe head impact. She was wearing a 'Charly' open-face air sports helmet. A full recovery is expected but this will take some months.

The pilot was not wearing a helmet. Fortunately he did not sustain any head injury.

The pilot was not carrying an emergency parachute.

1.16 Tests and research

Not Applicable

1.17 Organisational and management information

Not Applicable

1.18 Additional information

During this investigation unconfirmed rumours were heard that other accidents / incidents have occurred where paramotorists have rotated relative to the wing.

1.19 Useful or effective investigation techniques

Not Applicable

SECTION 2 – ANALYSIS

2.1 The previous flights that day using the tandem equipment had been successful, and the obvious difference between them and the accident flight was the removal of the front 'U' bar. The

investigation focussed on the role of the 'U' bar and the mechanisms which could be involved in the pilot/passenger/power unit swivelling under the wing.

Photo 1: Fly Products publicity material showing the tandem paramotoring equipment general arrangement and the spreader bar / 'U' bar assembly.

The manufacturer was contacted and has stated that the 'U' bar is a 'passenger hand grip' and its removal would have no adverse effect in flight.

There are three principal effects that would seem likely to have played a part in the 'swivelling' event: the stability changes arising from altering the lateral separation of the main risers, the differential loading of the main risers arising from weigh-shift effects and lastly, the thrust line misalignment effects arising from the lack of rigidity in the passenger/pilot/motor combination. The last effect is considered to have been the most important but the others may each have played a part. Each effect is looked at in turn.

The pilot/passenger/motor unit assembly is suspended from the two main canopy risers. The only force holding the pilot/passenger/motor unit assembly in alignment with the wing is that generated by these two suspension points being laterally separated. With the risers closer together the resistance to swivelling is reduced: with the risers wider apart the resistance to swivelling is increased. It seems likely that with the 'U' bar removed the risers would tend to position themselves more widely spaced than normal, so there would be more resistance to swivelling. However, after the first 180 degrees of swivel the risers would be pulled together and there would be little resistance to further swivelling.

Differential loading of the main risers arising from weight-shift effects: the lateral separation of the main risers has an enormous effect on the way weigh-shift is transmitted to the wing. The wider apart the risers, the more 'weight-shifty' the wing. In effect, when the pilot moves this weight to one side he is differentially loading the canopy risers, and with the risers widely spaced this can be very pronounced. It is possible that in this accident the unrestrained risers were widely separated and during the wriggling to get into the harness the pilot's and passenger's weight went mainly on to one riser. In that case the thrust line would be acting offset to the (single) suspension point which would tend to produce a swivel.

Thrust line misalignment effects arising from the lack of rigidity in the passenger/pilot/motor combination: removing the damaged 'U' bar removed the only rigid fixing of the two spreader rails in fore and aft alignment with each other. With the 'U' bar removed the motor/pilot/passenger combination was able to move out of alignment with each other, thus offsetting the thrust line.

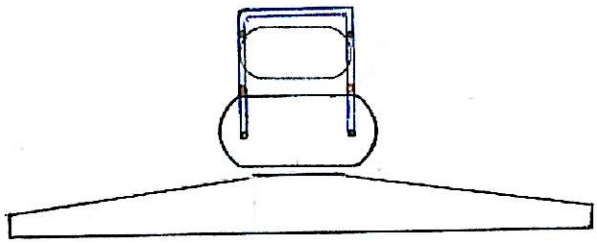

Diagram 1: 'U' bar installed – motor, pilot and passenger held in alignment.

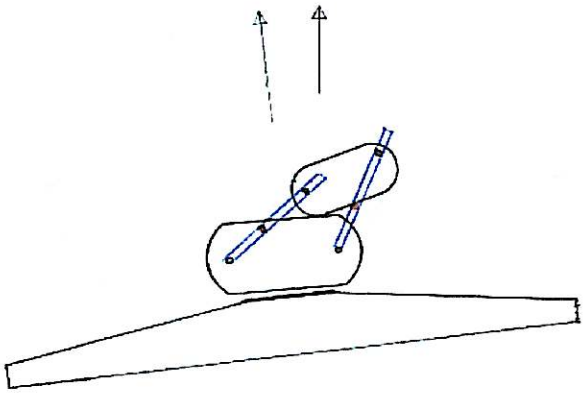

Diagram 2: 'U' bar removed – motor, pilot and passenger out of alignment. Thrust line offset to direction of flight.

It should be noted that the spreader bars are the only rigid members in the motor/pilot/passenger assembly, and that those three components are suspended from the spreader bars on webbing straps. The possible range of movement is quite large – diagram 2 is only indicative. The amount of misalignment could have been greater.

Photo 2: Degree of independent spreader bar movement available without the 'U' bar assembly in place.

To sum up: the probable chain of events was that as the pilot was wriggling into his harness some weight shift and fore and aft motions were applied to his suspension points. The spreader bars slid out of fore and aft alignment and, with the powerful motor in use, the misaligned thrust was able to instantaneously drive the suspended load round in a 360 degree swivel under the wing. (It is quite possible that this swivelling was anything up to three and a half full rotations.)

2.2 Power on whilst getting in to the seat.
An experienced tandem paramotor pilot has stated that his normal procedure is always to throttle back (once at a safe height) before getting his passenger and himself fully into the seats. In this accident it seems inescapable that the motor drove the 'swivel': if the motor had not been producing thrust at the time the 'swivel' could not have happened. That said, an asymmetric collapse or other similar event under power could have produced a very similar accident.

2.3 Paraglider tandem spreader bars.
A major influence in the pilot's (and other's) thinking about the unimportance of the damaged 'U' bar was previous experience and knowledge of tandem paramotoring using paraglider spreader bars. It would seem likely that the primary reason that a similar accident had not ensued in these instances was that they were using significantly less powerful motors (32 kg thrust as against 80 kg thrust.) Another factor may also be that with paraglider spreader bars there is no moment arm offset to counter-balance the weight of the power unit. This results in the spreader bars usually being inclined significantly upward, especially if flying with a light passenger. Compared to the purpose-built tandem ppg spreader bars the thrust is produced less far behind the main risers (so any thrust misalignment effect has a reduced moment arm) and the effect of any fore and aft misalignment of the spreader bars would be to tilt the motor to one side or the other (which would

have no negative effect) as much as to alter the thrust line alignment. Good fortune may also have played a significant part.

2.4 The Helmet.
The passenger sustained 'brain shake' type injuries, indicating a severe head impact. She was wearing a 'Charly' open-face helmet.

2.5 Emergency Parachute.
The pilot was not carrying an emergency parachute. There was probably time enough for the pilot to have deployed one if it had been available, and given the descending circling flight path there may have been enough time/height for it to deploy. That said, it is not clear that there is a properly engineered emergency parachute system available for tandem paramotor usage, and adding further weight to the already substantial mass that has to be supported on the ground may be impractical.

2.6 The Design.
The 'U' bar was removed before the accident flight as its attachment at one end had been broken during the landing/post-flight stages of the previous flight. The 'U' bar attaches to the spreader bars by bolting through a simple nylon spigot joiner. Given the amount of movement available at the rear ends of the spreader bars (limited only by the webbing harness and motor attachment straps) it would seem inevitable that substantial bending loads will be applied to the nylon spigot joiner during the ground handling stages. Breakage of the spigot joiner would seem to have been something that was bound to happen sooner or later.

Photo 3: 'U' bar assembly. Broken attachment furthest from camera.

Photo 4: Broken nylon spigot joiner.

2.7 Rules, regulations and qualifications.

No qualification or training is legally required to fly a paramotor or a tandem paramotor.

The BHPA and the BMAA both have training schemes for pilots learning to fly paramotors.

The BHPA does not support tandem paramotoring as it has yet to be convinced that the activity is reasonably safe. All BHPA paramotoring qualifications are for solo flight only.

The BMAA do support tandem paramotoring. The training is for solo flight, but pilots would not be in breach of any BMAA rule if they fly with passengers. BMAA Instructors do use tandem machines as an instructional tool. The BMAA is considering introducing a separate dual qualification.

During the investigation it became evident that some of the paramotor pilots involved in the weekend at Flagg did not confine their activities to those that their Association qualifications permitted.

2.8 Information.
This investigation was unable to obtain any published information on the topic of tandem paramotor flying.

The manufacturer of the tandem paramotor flying equipment involved in this accident does not produce any manuals or written advice on tandem ppg flying.

The BMAA apparently has some written information on the subject which is made available to their instructors. It was not made available to this investigation.

SECTION 3 - CONCLUSIONS

The tandem paramotor swivelled through 360 degrees (or more) under the wing, crossing the risers and locking the controls. With the height available and no emergency parachute a crash was inevitable.

The removal of the damaged 'U' bar had significantly reduced the stability of the suspended pilot/passenger/motor unit in fore and aft alignment with the wing and had also allowed the motor/pilot/passenger combination to move out of alignment with each other, thus offsetting the thrust line.

The probable chain of events was that as the pilot was wriggling into his harness some weight shift and fore and aft motions were applied to his suspension points. The spreader bars slid out of alignment and, with the powerful motor in use, the misaligned thrust was able to instantaneously drive the suspended load round in a 360 degree swivel under the wing.

The lack of a need for qualification to fly tandem paramotors was considered to be a factor in the lack of knowledge that led to this accident.

The lack of airworthiness standards for tandem paramotor equipment was also considered to be a factor.

SECTION 4 - SAFETY RECOMMENDATIONS

When paramotoring began growing in popularity in the UK the CAA decided to deregulate the activity. This decision was partly based on the fact that the similar airsports of hang gliding and paragliding were deregulated and had been successfully 'managed' by an airsports association (the BHPA). The CAA also had long experience of gliding being deregulated and managed successfully by the BGA. So the evidence was that airsports flourish safely and cause no problems when deregulated. Unfortunately there are worrying indications that this success has not been achieved with paramotoring. This seems to be largely linked to perceptions: a person wanting to take up gliding, hang gliding or paragliding would almost certainly not realise that these were deregulated activities. He would invariably join a club and obtain tuition and become part of the sport as managed by the relevant Governing Body. With paramotoring almost the first thing anyone finds out about the activity is that it is deregulated. So a significant proportion of newcomers undertake little or no formal training and operate outside or on the fringes of the Governing Body's influence. Whilst generally this tends to result in nothing worse than nuisance and pilot injury, it is considerably more worrying when innocent passengers may also be involved. For this reason the Board makes the following recommendation:

The Board recommends that the BHPA brings the Board's concerns over the current status of tandem paramotoring to the attention of the responsible authority (i.e. the CAA) and to the attention of the BMAA.