Slingsby Sport Vega Glider T65D, BGA 2758

AAIB Bulletin No: 7/2004	Ref: EW/C2002/06/05	Category: 3
Aircraft Type and Registration:	Slingsby Sport Vega Glider T65D, BGA 2758	
Year first registered	1981	
Date & Time (UTC):	23 June 2002 at 1248 hrs	
Location:	Wormingford Airfield, Colchester	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - Serious	Passengers - N/A
Nature of Damage:	Glider destroyed	
Commander's Licence:	BGA Gold C, Diamond Height and Goal badges	
Commander's Age:	22 years	
Commander's Flying Experience:	415 hours	
Information Source:	BGA accident report and further AAIB investigation of restraint issues	

Synopsis

This accident was the subject of an investigation conducted on behalf of the AAIB by the British Gliding Association (BGA). Further investigation, concerning the apparent failure of the pilot's restraint harness, was undertaken by the AAIB.

A practice 'competition finish' was being attempted when the glider descended below tree top level but failed to climb again due to insufficient energy. The aircraft crashed through the upper branches of the trees and came to rest in a field. The pilot was released from his harness during the impacts. He sustained serious injuries and the aircraft was damaged beyond economic repair.

History of Flight (BGA)

Following preparations and inspections the glider was launched by winch for a cross-country flight from Wormingford Airfield. The pilot declared a route prior to the flight, which the GPS showed was flown as intended to Great Ashfield and onwards towards Cambridge, where the pilot abandoned the planned route and returned on a direct route to Wormingford Airfield.

The aircraft was seen to cross the runway at a height of less than 100 feet agl before pulling up and turning towards an approach for Runway 27. The glider did not achieve sufficient speed or height for the turn and it descended below the tree line at the eastern end of the runway. The pilot attempted to climb over the trees but failed and the aircraft crashed through the treetops. The wings separated from the aircraft and the fuselage became inverted and continued into a field of crops, with the wings coming down close to the fuselage. The weather at the time of the flight was good.

Aircraft Description (BGA)

The Slingsby Sport Vega is a modern, high-performance, 15 metre sailplane, constructed using carbon and glass fibre reinforced plastics. The aircraft was maintained in accordance with BGA regulations and was serviceable at the time. Another pilot had lightly lubricated the harness Quick Release Fastener (QRF) on 4 May 2002 and previous pilots had reported no problems with the aircraft.

Aircraft Examination (BGA)

Examination of the wreckage indicated damage consistent with both wings impacting the tree branches causing the wings to be rotated aft with respect to the fuselage. This occurred with sufficient force to separate the wings from the fuselage by tearing the main pin and its handles through both main spars.

The fuselage, once detached from the wings, continued through the trees becoming inverted. There were contradicting reports of the pilot being ejected from the cockpit at this point. The fuselage crashed almost inverted with multiple points of damage to the structure, canopy, tailplane, fin and wings, which landed close to the glider. The fastener holding the battery failed, probably on impact with the ground.

The air brake lever was found to be in the open (rearward) position and the connecting rod was bent where it was not reinforced by the outer cylinder. Because the airspeed was already low, it is unlikely that the pilot deployed the air brake at this point; it is more likely that the lever was moved on impact, when the bending also occurred.

The left hand shoulder and lap straps of the harness were found disconnected from the QRF but they showed no evidence of damage to their fastenings.

The aircraft carried no barograph so there was no record of altitude but the course was recorded on the GPS unit. The course was confirmed as initially following the plan with the turn towards Wormingford occurring to the north of Six Mile Bottom. During the final glide to Wormingford the maximum ground speed was 80 kt but at the point of crossing the runway the speed was 70 kt. A tail wind of approximately 7 kt indicated an airspeed of approximately 63 kt on crossing the runway.

Analysis (BGA)

Analysis of the track log from the GPS receiver of the speeds of the glider indicated an average ground speed of 71 kt in the final glide of the flight and an approach groundspeed of 41 kt. Taking the tailwind into account, the aircraft had a calculated airspeed of about 48 kt on approach.

For a glider like the Sport Vega it is recommended that a practice competition finish be completed at an airspeed approaching V_{NE} which is 135 kt for this aircraft, although a speed greater than 100 kt would have sufficed. A sensible airspeed for the final approach on the day of the crash would have been 55 kt, considerably above the aircraft's actual speed on the approach. The aircraft had required enough energy to climb to at least 200 feet for the turn manoeuvre. However the kinetic and potential energy of the glider on commencement of the turn was inadequate because it was conducted below 100 feet agl with a decreasing airspeed. This lack of energy caused the glider to dip below the tree line and it was then unable to climb.

It is possible that the airbrakes were open at the initial contact with the trees but there were no witnesses to this as the aircraft was hidden from view. It is also possible that the brake lever jolted open during the impact and, as the pilot was unlikely to deploy brakes, this explanation is more likely.

Conclusion (BGA)

The BGA investigation considered that the cause of the accident was the pilot failing to notice that he did not have sufficient energy to perform successfully a practice competition finish on return from a cross-country flight. This may be attributable to the tailwind, which gave an increased ground speed and perhaps a false sense of security. The pilot did not take the safer option of aborting the manoeuvre and making a normal landing further up the airfield but instead, he pulled up to the left to attempt a final turn in the usual position. However, as he climbed away from the runway, the tailwind carried him further from the airfield, downwind of the two lines of trees. This, combined with the low speed and height, made an accident inevitable.

The injuries sustained to the pilot may have been less severe had the harness functioned correctly.

Safety Harness Examination (AAIB)

The examination of the QRF rotary buckle and other items of the restraint harness was conducted in collaboration with the QRF manufacturer's representatives in the UK, an expert metallurgist and, subsequently, by returning the buckle to its manufacturer in the USA.

Description and Operation

The rotary buckle is an all-metal device consisting of a housing with five slotted sockets to accommodate end fittings for two shoulder restraints, two lap belts and one crotch strap. Release of the end fittings is accomplished by rotating the four-vaned handle (see Figure 1) in either direction. The release mechanism for the crotch strap or either of the lap belts can be inactivated so that, with rotation of the handle, the buckle will remain attached to one item of webbing. The two shoulder restraints can also be released separately by pushing forward on the tab located between the shoulder fittings.

Figure 1 - Failed buckle and example buckle

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The construction of the buckle precludes routine internal examination. Moreover, the inspections and checks required for annual inspections and maintenance do not require internal examination.

The rotary buckle manufacturer's representatives found that it was not matched to other parts of the harness. For instance, the webbing, the lap belt plug-in fittings and the webbing adjusters were from at least one other manufacturer. However, the Gliding Club stated that it had owned and operated the glider since 1997. It had been supplied to the Club with the same fittings as it had at the time of the accident and no modifications or replacements had been carried out by the Club during their period of ownership.

Metallurgical Report on Buckle

The rotary buckle is a simple fabricated device in which each belt plug-in fitting is restrained by a restraining dog (retracted by rotation of the four-vane handle), and a combination of the 'mushroom' pins shown in Figure 2 (an example with the pins in place).

Figure 2 - Example buckle with one harness fitting

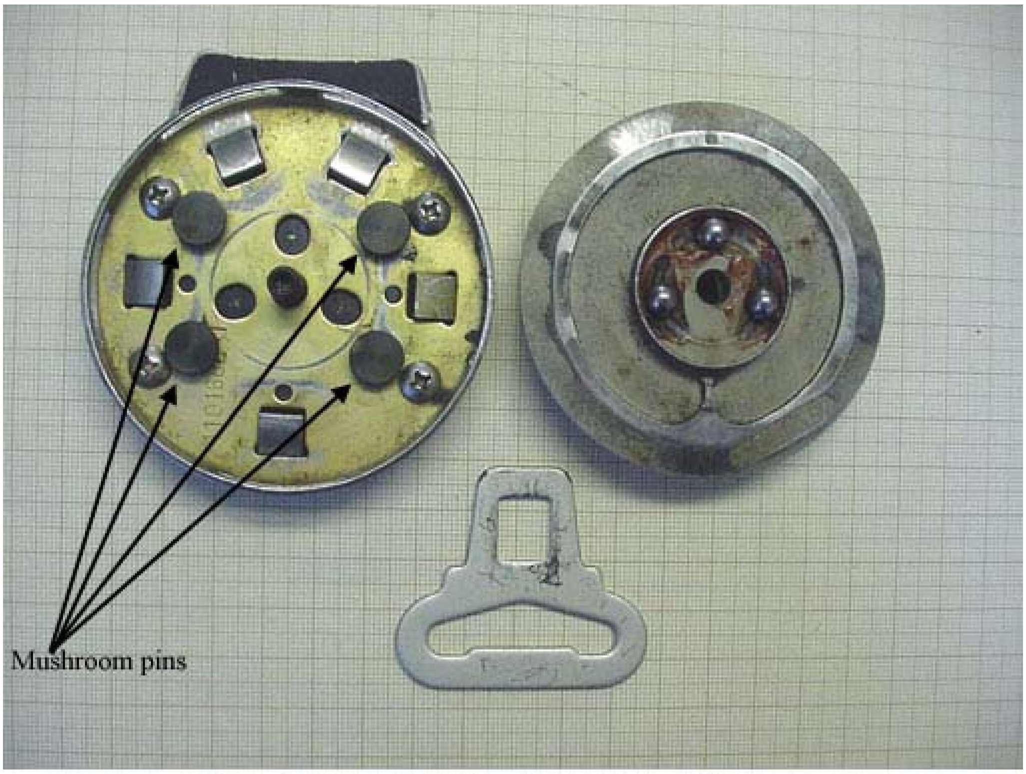

Figure 2 - Example buckle with one harness fitting

The buckle had failed (Figure 3 - failed buckle and end fittings) by the left-hand lap fitting pulling out of the buckle, which created witness marks on the fitting and on the remaining mushroom pin with which it was in contact (Figure 4).

Figure 3 - Failed buckle with harness fittings

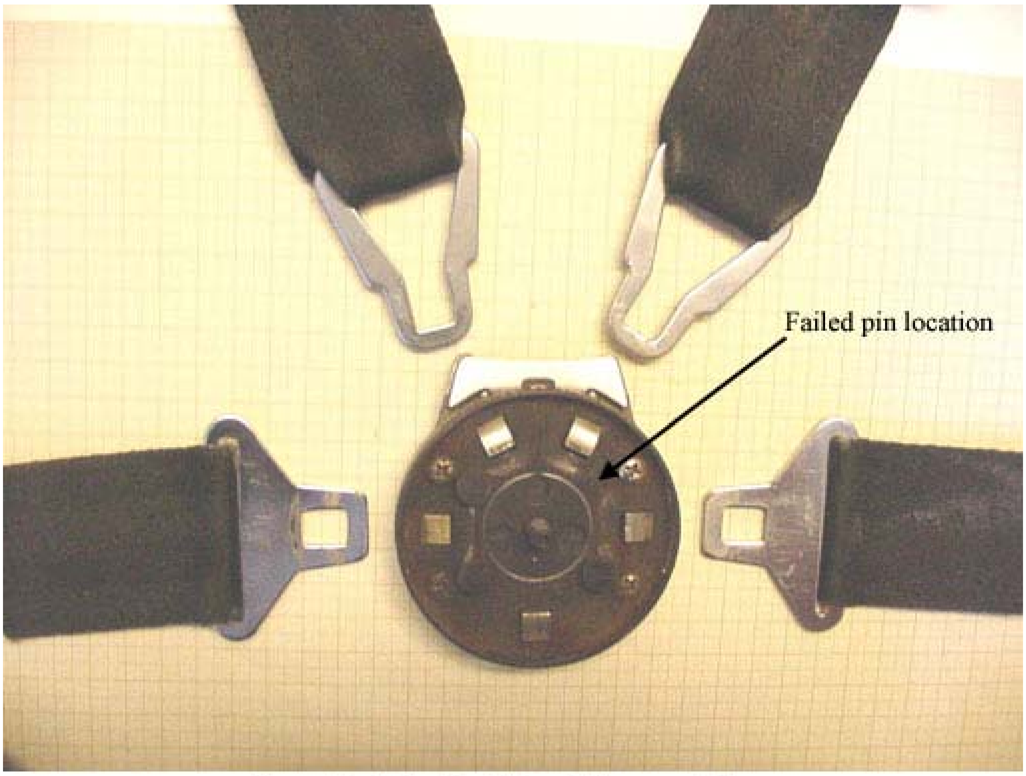

Figure 3 - Failed buckle with harness fittings

Figure 4 - Failed mushroom pin

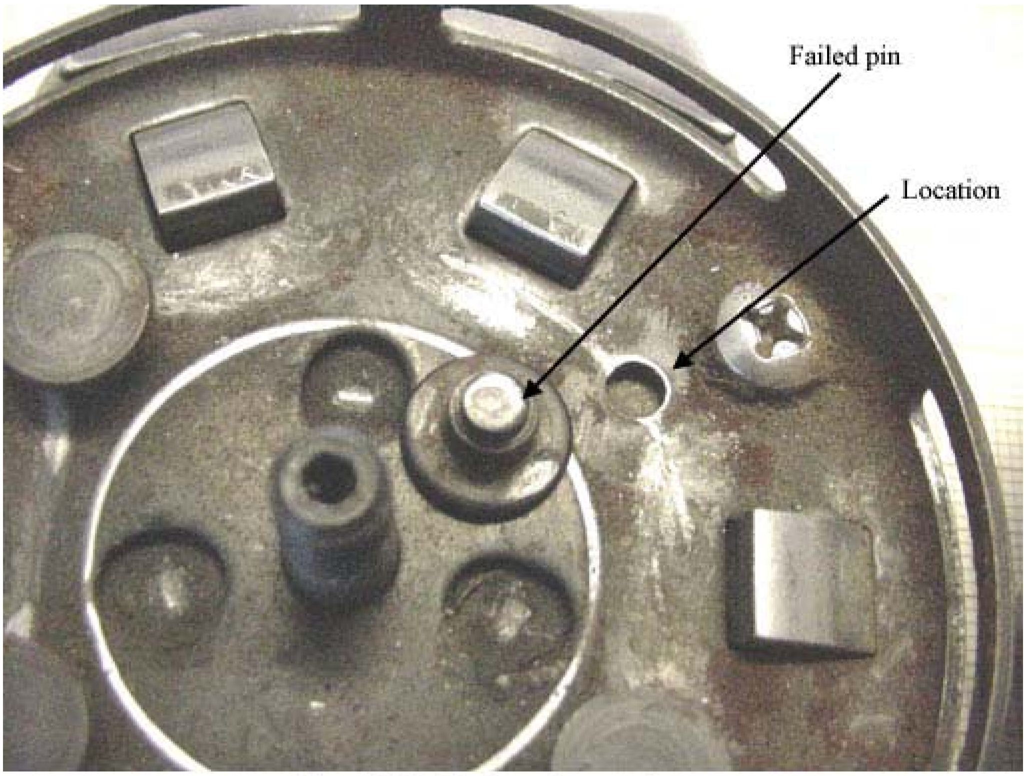

Figure 4 - Failed mushroom pin

In order for this to occur, the detached mushroom pin could not have been in place at the time of failure and the physical evidence indicated that it had been loose for some time. The arcs of scoring (Figure 4) show the rotational movement of the pin when the buckle was operated.

Although the lap fitting from the failed buckle had a different pattern to the example fitting, it could not be determined whether this induced the pin failure. The metallurgist considered that of greater significance was the way in which the mushroom pins had been riveted in the failed buckle, when compared with example buckle (Figure 2) from the same manufacturer. On the example buckle the stems of the mushrooms were drilled before riveting and exhibited a greater spreading and hence a greater resistance to pull-out.

It was noted that the shoulder restraint fittings only have one locating mushroom pin (Figure 2) but are held in place because of the restriction on their movement by the smaller spacing between the restraining dog and the head of the mushroom pin. Under load, the geometry of the harness would make the shoulder fittings more likely to maintain their 'flat' attitude to the buckle, whereas the lap fittings would be liable to tilt away from the body plate because of the direction of the applied force. It is this tilting that would tend to pry the mushroom pins from the body plate and, together with the increased freedom of movement, would allow the fitting to ride over the restraining dog if the mushroom pin became detached.

Examination in the USA

The manufacturer's limited examination of the rotary buckle and other hardware in the USA confirmed that the rotary buckle was of their manufacture but that the other hardware was not. The examination also noted that the buckle was manufactured before December 1980 and thus had a lower rated strength than later buckles. There were additional negative comments on the apparent lack of servicing of the buckle, which had become worn and exceeded the wear limits of the Component

Maintenance Manual, and the method of attaching the webbing to the fuselage structure, with a bolt piercing a double lay of the webbing.

Analysis (AAIB)

The report by the BGA was clear and identified that there was no evidence of any technical defect in the aircraft which would have contributed to the accident and that the causal factors of the accident were operational. The AAIB agrees with this assessment.

It is likely that the severity of the injuries to the pilot, who has since recovered, were increased by the failure of the buckle. This failure highlights the need to ensure compatibility between the different components of a harness plus regular inspection and servicing.

At present, guidance for harnesses in gliders (*'Maintenance of seat harnesses and belts'*) is provided in Leaflet 4-8 of Part 4 of *'BGA Airworthiness and Maintenance Procedures'*. This leaflet is less extensive than the equivalent section of the CAA's *'Civil Aircraft Airworthiness Information and Procedures'* and does not, for example, expressly prohibit the mixing of harness components. Therefore, the following safety recommendation was made to the BGA.

Safety Recommendation 2004-46

The British Gliding Association should review the document *'Maintenance of seat harnesses and belts'* so as to reflect best industry practice and to provide clearer guidance for airworthiness inspection.