ACCIDENT

Aircraft Type and Registration:	Schleicher ASW 20L glider, BGA 4354
No & Type of Engines:	None
Year of Manufacture:	1979
Date & Time (UTC):	23 September 2006 at 1032 hrs
Location:	Keevil Airfield, Trowbridge, Wiltshire
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:	BGA glider pilot's certificate
Commander's Age:	67 years
Commander's Flying Experience:	1,116 hours (of which 215 were on type) Last 90 days - 7 hours Last 28 days - 3 hours
Information Source:	AAIB Field Investigation and information provided by the British Gliding Association

Synopsis

The right wingtip of the glider made contact with the ground as it became airborne at the start of a winch launch, causing the glider to yaw and then roll uncontrollably to the right. The winch cable was not released from the glider, which continued to roll, coming to rest inverted. The British Gliding Association (BGA) has reiterated its advice to pilots encountering similar circumstances and emphasised the need to commence the launch with their left hand on the cable release control.

History of the flight

Members of the resident gliding club were conducting winch launch operations from the edge of the asphalt Runway 13 at Keevil, near Trowbridge in Wiltshire. BGA 4354, an ASW 20L single seat glider, was being flown by an experienced glider pilot who had 215 hours experience on the type.

BGA 4354 was launched with the assistance of a wing walker whose main function was to hold the glider wings level until the pilot was able to do so using the aerodynamic controls. Prior to the launch the pilot and wing walker carried out 'release checks' to ensure that the winch cable would release correctly[1], either if pulled backwards off the glider's tow hook or if the

Footnote

[1] Section 2.11 of the gliding club's Flying Order Book entitled *'Release checks'* states *'The glider release hook is to be checked before the first flight of the day to ensure that it releases under tension and that the back release mechanism works in the correct manner'.*

cable release control in the glider cockpit was operated. The wing walker stated that this check was completed satisfactorily.

At the start of the first attempted launch the glider overran the winch cable - a situation which can arise when a glider moves forward faster than the cable due to a momentary winch stall, insufficient winch acceleration or rough ground which then causes the glider to accelerate erratically. This winch launch was aborted to avoid any possibility of the cable becoming entangled with the wheel or another part of the glider. The cable was re-engaged and a second launch attempted from the position to which the glider had rolled following the first attempt – some 50 m ahead of its original start position.

At the start of the subsequent launch the wing walker found that he had to push down on the glider's left wing in order to keep its wings level. He continued to hold the wing, running along the hard runway surface to the left of the glider until he could no longer keep up with it. When he let go of the wingtip the glider became airborne almost immediately but rolled to the right. The right wingtip struck soft ground to the right of the runway causing the glider to yaw and roll rapidly to the right, pitch nose down and somersault inverted. The tail broke off at the base of the vertical stabiliser, causing the top of the cockpit canopy to bear most of the subsequent ground impact. The pilot, who was restrained by a four-point harness, received severe injuries to his unprotected head when the canopy disintegrated.

The winch-driver stated that the glider appeared to drop its right wing as it became airborne. In accordance with his training he maintained power to continue the launch but, when the bank angle of the glider reached 90 degrees and its nose started to drop, he cut the power and applied the winch brake. The winch cable remained attached to the glider throughout the accident sequence.

Members of the club present at the launch site ran to the glider and attempted to return it to its upright position in order to assist the pilot. An air ambulance arrived shortly afterwards. The pilot, who was taken by air to hospital in Bristol, remained unconscious and died of his injuries four days later.

BGA investigation

The investigation was initially conducted by the Safety Member of the Gliding Club but, in accordance with established procedures, was continued by the AAIB following the pilot's death.

Winch information

The winch which towed BGA 4354 performed normally during the accident launch and has been used successfully since the accident without modification. There was no evidence that this winch or its operation had an adverse effect on the accident launch.

Aircraft information

The Schleicher ASW 20 is an FAI[2] 15 m class glider, built from a composite fibreglass structure. It was designed in Germany and first flew in 1977 (see Figure 1). The ASW 20L is a modified version that can be fitted with optional wingtip extensions which extend the total wingspan from 15 m to 16.59 m. BGA 4354 was manufactured in 1979 and was fitted with the wingtip extensions at the time of the accident. The last annual maintenance inspection of the aircraft was completed on 20 March 2006; at this time the aircraft had logged 932 hours.

Footnote

[2] FAI, Fédération Aéronautique Internationale, responsible for ratifying aeronautical records.

The aircraft's flight controls consist of a cable-operated rudder and an elevator, ailerons, and airbrakes, all operated by push-pull rods. The aircraft is also fitted with flaps operated by push-pull rods and an associated cockpit lever with six detent positions. A mechanical mixing unit between the wings enables partial flap movement to augment aileron control when the control stick is moved laterally. All flight control push-pull rods have 'hotelier' connections that enable simple disconnection to permit wing and tailplane removal for transport.

Figure 1

ASW 20 glider without wingtip extensions

Cable release control

The cable release control was located to the left of the aircraft centreline, at the base of the instrument binnacle and ahead of the control column. An adjacent control, used to adjust the rudder pedals, was located just to the right of the aircraft centreline. The two control handles terminated in spherical knobs approximately 30 mm in diameter and were identical except that the cable release control was yellow and the rudder pedal adjustment control was brown (see Figure 2). Both controls were designed to operate when pulled. A more detailed description of these controls is given under the heading 'Additional information'. The Safety Member of the Gliding Club considered that during a winch launch there was no need for a pilot to place his left hand anywhere other than on the cable release control.

Figure 2

Yellow cable release control on BGA 4354

Variable flap setting

There are six flap settings. Starting from the most forward position and progressing aft there are four takeoff positions: 1 (-12º), 2 (-6º), 3 (0º), 4 (+9º) and two landing positions: 5 (+35º) and 'Landing' (+55º). Increasing the positive deflection reduces stall speed but also reduces aileron effectiveness.

The use of a negative flap setting has been found to improve directional control at low speed (below approximately 20 kt), which is useful during aero-tows that produce relatively slow acceleration. The greater acceleration produced by a winch launch usually results in adequate control almost immediately. The flight manual stated that flap position 3 should be used for launch.

Pilot experience

The pilot first flew solo in a glider in 1984. He held a 'full silver badge', indicating that whilst operating gliders he had achieved a gain in height of 1,000 m or more, a flight on a straight course of 50 km or more and a flight of at least 5 hours duration. The BGA recorded him as having made a 'gold badge' distance claim, indicating that he may have carried out a flight of 300 km or more. He was an Assistant category instructor, enabling him to give gliding instruction as specifically authorised by the Chief Flying Instructor of the gliding club.

The pilot was in good practice. Since the beginning of 2006 he had flown 102 hours in the course of 214 flights, 204 of which were winch launches. Of these, 42 flights were conducted in BGA 4354, 36 of which were winch launches.

Meteorological information

Data recorded by the gliding club weather station indicated an average wind from 115º at approximately 10 kt. Lyneham, 12 nm north-north-east of Keevil, was the nearest station providing information to the Met Office. The reported wind there at 1050 hrs was from 110º at 12 kt. The next nearest reporting station was Boscombe Down, 17 nm south-west of Keevil, where the reported wind at 1050 hrs was from 120º at 13 kt.

The ASW 20L flight manual stated that the maximum crosswind component for operation of the glider was 13.5 kt.

Aerodrome information

Keevil is an airfield from the second world war era, located at the northern edge of Salisbury Plain, beneath a series of hills forming a ridge on its south-eastern boundary. The site is operated by the Ministry of Defence for the training of air mobile units. The main runway, Runway 21, is maintained in good condition for occasional use by military transport aircraft. Use of the site as a heavy equipment drop zone has rendered the grass areas unusable for aircraft movements. Consequently, glider operations are restricted to Runway 21/12 and the untended Runway 13/31, which is partially overgrown. The remaining runway is in poor condition and seldom used.

The gliding club maintains several winch vehicles and a coach which serves as a mobile office. On flying days, the coach is positioned beside the launch point for the use of members involved in flight operations. The main club facilities are accommodated in a collection of Nissen huts on the southern edge of the airfield and do not overlook the Runway 13 launch point, where the accident occurred. The control tower, an original structure near the club buildings, is not manned.

Aircraft wreckage examination

An engineering officer of the Gliding Club examined the aircraft at the accident site. Before disassembling the aircraft he confirmed that the wings were secure, the rudder pins were both inserted correctly and that all 'hotelier' control connections were correct and secure. The disassembled aircraft was then recovered to the AAIB for a detailed examination.

The aircraft's right wing had failed due to an overload at a location 2.4 m inboard from the wingtip, measured with the wingtip extension fitted. The right wing airbrake was in the extended position and bent almost 90º aft. The tail section of the aircraft had failed over its entire circumference 0.35 m forward of the lower leading edge of the vertical tail. The aircraft's cockpit canopy had shattered into multiple pieces. There was surface damage to the upper side of the horizontal tail and the

upper rudder hinge pin was bent and had detached. The remainder of the aircraft's structure was relatively intact, apart from damage to the left wing root and compression damage to the upper fuselage skin, aft of the canopy.

All control push-pull rods were examined and could be moved freely except in those locations where impact damage had occurred. There was no evidence of any pre-impact control rod or rudder cable failure. Inside the right wing, close to the outboard failure point, there was an imprint on the upper wing skin from a bolt which forms part of the right aileron bellcrank. This imprint probably occurred during the impact sequence and is consistent with a bellcrank position that would result in an aileron deflection of 15º to 27º trailing edge down (commanding roll to the left). Full aileron deflection was measured at 31º trailing edge down.

After the accident the flap control lever was reported to have been found between positions 4 (+9º) and 5 (+35º); however, it may have moved during the impact sequence.

Cable release hook operation

The cable release hook mechanism was examined and operated normally, moving freely when the control knob was pulled. The force required to pull the control knob to the point of approximate cable release was measured at 18 lb, and a pull to full hook retraction was measured at 22 lb. These measurements were made without a tow cable attached. The force of a tow cable on the hook could increase the pull force required to release it, but it was not feasible to test for this difference. The angle of pull can also increase the pull force, although angles of up to 30 degrees from straight had no noticeable effect on pull force. The current EASA Certification Specifications for gliders state in CS 22.711 and CS 22.143(c) that the force required to release the tow cable must not exceed 20 daN (45 lb) with a cable under load attached.

The EASA requirements do not specify what shape or size the cable release control needs to be but specifies in CS 22.781 that:

> *'The towing cable release control must be so designed to be capable of operation by a gloved hand exerting the force specified in CS 22.143(c).'*

The certification of the ASW 20L predated EASA requirements.

Harness attachment failure

The aircraft was fitted with a four-point shoulder and lap strap safety harness with each of the four ends attached to a fitting that was secured within the fibreglass structure by a pin. The fitting from the left lap strap had separated from the aircraft structure as a result of a failure of the fibreglass skin that retained the pin (see Figure 3). The steel pin had also bent which indicated that the limit load of the pin was exceeded. The aircraft manufacturer was consulted regarding this failure and they stated that the lap strap was designed to withstand a maximum deceleration of -4.015g with a 1.33 fitting factor and assuming a pilot mass of 115 daN (117 kg). The design limit load of each lap strap fitting was thus 307 daN [3]. The manufacturer carried out tests on this fitting type which demonstrated that it could withstand a load of 460 daN without any damage to the pin, fitting or surrounding structure (a safety factor of 460/307 = 1.5). In this accident the pin was deformed so it probably experienced a load in excess of 460 daN during the accident sequence.

Footnote

[3] To satisfy this requirement the lap strap must withstand a load of (115 daN) x (4.015g) x 1.33 = 614 daN. This load is shared between the two lap strap fittings so each lap strap fitting has a design limit load of 307 daN.

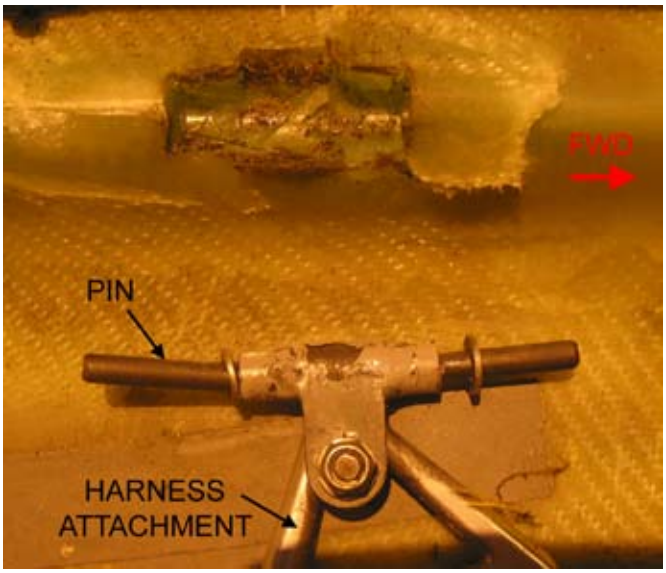

Figure 3

Overload failure of pin from left lap strap attachment

Medical and pathological information

The pilot possessed a *'Declaration of Medical Fitness to Fly'*, signed by his general practitioner, which certified that there was nothing in the pilot's medical history which prevented him from meeting the standard required for flight with passengers or when solo. This document satisfied the requirements relevant to operation of a glider and was valid until 16 September 2007.

An autopsy conducted on behalf of the coroner indicated that the pilot had died of head injuries.

Survivability

The pilot died as a result of severe head injuries caused by the aircraft striking the ground upside down on its canopy. The vertical tail would normally act in a manner similar to a roll-over bar and prevent canopy impact, but in this accident the force and orientation of impact was sufficient to break the tail structure. The remaining loads were absorbed by the upper fuselage skin structure and the canopy leaving the pilot's head unprotected. The canopy and skin structure would not have provided significant energy absorption, and the pilot was not wearing a safety helmet. The left lap strap attachment failure might have reduced the pilot's head clearance but it was not possible to establish if the head injury would have been less severe had the lap strap not failed. It could also not be established how securely the pilot had adjusted his shoulder and lap strap harnesses prior to the launch.

Published guidance

The issue of a wing drop during launch has been the subject of guidance material produced by the BGA and several articles published in UK gliding magazines. The consensus is that even gentle contact of the wingtip with the ground can result in considerable asymmetry, which leads very quickly to a roll that cannot be recovered using aerodynamic controls. Consequently, pilots are taught to release the cable immediately if the wing tip makes any contact whatsoever with the surface during a launch. Any control difficulties that might follow from this action are considered preferable to a developed roll under tow.

BGA Instructors' manual

The BGA Instructors manual, current at the time of the accident, contained the following guidance:

> *'During the ground run the ailerons and rudder need to be used independently of each other. Once the glider has lifted off, independent use of the controls must stop.*
>
> *Release the cable immediately if a wing goes down or anything else goes wrong during the ground run, eg. an overrun. Keep the left hand near to the release knob, or, depending on its position – for example if applying left aileron will make it awkward to reach – actually take hold of it.*

The demonstration might include patter such as the following:

- *As the cable tightens, ensure your left hand is close to, or on the release*
- *As the glider moves forward, keep the wings level using the ailerons. Large deflections may be needed initially*
- *If a wing goes down, release'*

BGA leaflet 'Safe winch launching'

In October 2005, the BGA published a guidance leaflet entitled *'Safe winch launching'*. The leaflet was accompanied by a letter addressed to BGA instructors, chairmen and managers requesting that the guidance contained in the leaflet be circulated, discussed and followed. Table 1, below, shows the guidance offered for the 'Ground Run' stage of the launch:

The issue of safe winch launching and the existence of this guidance were highlighted in the December-January 2006 edition of the bi-monthly *'Sailplane & Gliding'* magazine, produced by the BGA. The February-March 2006 issue of the same magazine included an article entitled *'Time for lateral thinking'* which explored the mechanics of a wing drop during launch. In the cited example there was a crosswind of approximately 10 kt from the right. The launch was being conducted from a frozen worn grass surface which sloped gently upwards to the right. The pilot was an instructor who had briefed the student:

'If a wing goes down despite the application of aileron, you will pull the release and abort the launch'

The instructor conceded in the article that he was "not particularly good at remembering" to place his hand on the release control. As the launch commenced he became aware that the glider was turning right and the right wing had touched the ground. The instructor was able to release the winch cable shortly afterwards and the glider was landed safely, having turned more than 90º to the original direction of launch.

The April-May 2006 issue of *'Sailplane & Gliding'* included an article entitled *'Six eventful seconds'* describing an actual occurrence, accompanied by photographs showing the flight of a glider which experienced a wing drop during a winch launch. The pilot reported that on his first attempt to operate the cable release control his gloved hand slipped off the control and that the pull force required was higher than he expected.

STAGE	HAZARD	AVOIDANCE
Ground Run	Wing touches the ground, glider cartwheels or ground loops violently.	• Start the launch with your hand on the release. • If you cannot keep the wings level, release immediately.

Table 1

Ground Run launch guidance

Additional information

Report by the Safety Member of the Royal Air Force Gliding and Soaring Association

The Safety Member of the Royal Air Force Gliding and Soaring Association (RAFGSA) who attended Keevil shortly after the accident on a previously arranged visit, submitted to the AAIB a comprehensive written discussion of the control ergonomics of the accident aircraft. He had previously conducted three winch launches in BGA 4354 and had over 20 hours flying experience on this type of glider.

During his visit to Keevil he had measured the position of the release knob with respect to the control column on an ASW 19 glider, in which the layout of the control-column and cable release is almost identical to an ASW 20. The release knob was approximately 30 mm left of the cockpit centreline and the control panel was approximately 60 mm forward of the control column. The cable release knob had a diameter of approximately 30 mm. On another similar aircraft the cable release knob had been replaced with a T-shaped grab handle to which a pull force could more readily be applied.

With the left hand resting at the left side of the cockpit, it would be difficult to reach for the cable release in a single uninterrupted movement, as might be necessary to abort the launch. Access to the cable release control would be further restricted by any leftward movement of the stick, which would be the instinctive reaction to a roll to the right. Regardless of the shape of the release control the rapid use of the cable release control could only be achieved if the left hand was already on that control.

Figure 4 shows full left deflection of the control column in the ASW 19 using the right hand. During launch and in flight the right hand would usually be holding the hand-grip of the control column, but in this picture it is shown lower than usual to avoid obstructing the camera view. With the right hand on the hand-grip and with the control column deflected fully left, the pilot's right arm would obstruct his view of the cable release knob.

Figure 4

Full left deflection of control column in similar configuration ASW 19

In Figure 5, the yellow cable release knob is only visible to the right of the control column because the control column is being held by the left hand, which would not usually be the case during the launch or in flight.

Figure 5

Cable release visible with full left control deflection

In order to release the cable in flight, with the control column deflected fully left, the pilot would need to reach around the front of the control column with his left hand and pull the release control at an angle to the control panel. The difficulty of reaching around the control column would require the pilot to apply this force using the strength of his wrist rather than through a direct pull using the strength of his arm. The shorter the length of protruding cable the greater the angle and the greater the problem. Additionally, whereas the pilot should ideally be able to grip the control with his full fist, a short protruding cable might inhibit the pilot from doing so. Cable length is limited to prevent the knob fouling the control column (a problem which is reported to arise on some other glider types) and in the case of BGA 4354 it was approximately 15 mm (visible in Figure 2 and shorter than on the similar configuration ASW 19 shown in Figure 5). The Safety Member of the RAFGSA considered that this combination of factors may have reduced significantly the pilot's ability to operate the cable release control in response to the right wing drop.

It was not possible to establish whether the pilot of BGA 4354 had attempted to release the cable or if his hand had been on the cable release control at any time during the launch.

Operation of cable release control - other pilots

Several glider pilots stated that they preferred not to place their hand on the release control until later in the launch to avoid the possibility of accidentally releasing the cable whilst close to the ground.

The resident Safety Member of the Gliding Club stated that, although it is normal practice for a glider pilot to keep his left hand on the release handle throughout a launch, he noticed that in the course of four consecutive launches he flew on the day after the accident, he forgot to do so on one occasion. He considered that the risks associated with a wing drop during launch outweighed those of accidentally releasing the cable whilst close to the ground.

Analysis

The damage to the aircraft was consistent with the witness descriptions of the aircraft having first struck the ground with the right wing, and then rolling to the right and coming to rest inverted. There was no evidence of any pre-impact structural failure or any pre-impact problem with the flying controls that might have contributed to the right roll. The left lap strap attachment fitting failed because its design load was exceeded but it was not possible to establish what effect this might have had on the survivability of the accident.

No official meteorological information was recorded at Keevil. However, information recorded at Lyneham and Boscombe Down indicated that surface wind at the time of the launch was probably close to the unofficial data recorded by the gliding club at Keevil, which was from 115° at 10 kt. This would have resulted in a crosswind from the left of the glider of no more than 3 kt, which is well below the limiting crosswind component. The benign wind conditions should therefore have posed no problems to this experienced pilot.

During the early stages of the launch the wing walker was holding down the left wing in an attempt to keep the wings level. The most likely reason for this would have been to counter an inadvertent input of right aileron by the pilot. In this case, the aileron input would then have caused the glider to roll to the right when the wing walker released the wing, allowing the wingtip to touch the ground. However, in this instance it was not possible to establish the actual mechanism of the wing drop.

In the article *'Time for lateral thinking'* the author suggested that any ground contact by the wing would initiate a yaw towards that wing, which would then precipitate a roll in the same direction. The investigation did not compare the effect of wingtip contact with the rough grass to the right of the runway to contact with the metalled surface of the runway itself. Consequently, it was not possible to determine what the outcome would have been had the launch been conducted with both wingtips over the runway. Although the effects would probably have been less pronounced, some asymmetry would certainly result from the contact of one wingtip with the ground.

The subject of wing drop during launch and the appropriate remedial action appears to be well understood and publicised in a manner accessible to most glider pilots. It is likely that the pilot of BGA 4354 was aware of the issues and of the recommended recovery technique. Although some pilots prefer not to have their hand on the release cable during launch, it is the belief of the Safety Member who initiated this investigation that this pilot would have been in the practice of doing so.

If it was the pilot's habit to rest his hand near to, rather than on, the release cable, the application of left aileron would probably have made it difficult to reach the release handle and operate it in the very short time available to regain control of the aircraft. Even if the pilot had his hand on the release control it is possible that he was unable to apply sufficient force to it to release the winch cable, especially if he was simultaneously applying full left aileron.

Conclusions

Eyewitnesses reported that the right wingtip of the glider made contact with the ground as the glider became airborne, causing it to yaw and then roll uncontrollably to the right. The winch cable was not released from the glider, which continued to roll, coming to rest inverted. The tail of the glider detached during the impact sequence allowing the cockpit canopy, which would otherwise have remained clear of the ground, to sustain

serious damage. The remaining loads were absorbed by the upper fuselage skin structure and the canopy leaving the pilot unprotected. The pilot received severe head injuries from which he later died.

Safety action

Safety action taken by the BGA

In April 2007 the BGA sent all gliding clubs a revised edition of the guidance leaflet entitled *'Safe winch launching'*. The BGA's view is that it is the pilot who is responsible for his pre-flight actions, which includes initiating the launch with the left hand on the release control. The advice for avoiding problems associated with a wing drop during the ground roll therefore remained unchanged. A memo entitled *'Supplement to BGA Safe winch launching'* leaflet, also promulgated in April 2007, reinforced this advice as follows:

> *'If the wing drops on the ground the glider may rotate about the wing tip and cartwheel. If the wing drops in every hundredth launch, there will be one wing drop accident in 800 wing drop incidents. This is a recipe for complacency and indeed it is experienced pilots who have the majority of wing drop accidents. After the wing has dropped the cartwheel can be so rapid that no recovery by releasing or other means is possible. This hazard must be anticipated and pre-empted by conducting the launch with the left hand on the release, and releasing immediately if it is not possible to keep the wings level.*
>
> *Leaflet advice:*
>
> - *Start the launch with your hand on the release.*
> - *If you cannot keep the wings level, release immediately.'*

A letter to all BGA gliding instructors, also dated April 2007, sought to address the preference of some pilots not to have their hand on the cable release control during the initial part of the launch:

> *'There is inevitably a healthy level of debate on winch launching techniques which should be encouraged to aid better understanding of what is a complex task. One point that really does need to be emphasised however is the need for the pilot to keep his/her left hand firmly on the release during the initial part of the launch.'*

Safety action taken by the Gliding Club

The gliding club at Keevil is conducting a trial in which the person assisting the launch (usually the wing walker) will, after checking that the cable is properly attached, look inside the cockpit to see if the pilot's hand is on the cable release control. If it is not, the assistant will ask "please can I see your hand on the release".