ACCIDENT

Aircraft Type and Registration:	Standard Cirrus 75, G-DDGX
No & Type of Engines:	No engines
Year of Manufacture:	1975 (Serial no: 619)
Date & Time (UTC):	27 July 2019 at 1130 hrs
Location:	Gwernesney Airfield, Monmouthshire
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:	British Gliding Association (BGA) Certificate with B Badge Endorsement
Commander's Age:	54 years
Commander's Flying Experience:	Total hours not determined 182 flights totalling 41 hours since August 2015 (of which 2 hours and 20 minutes were on type) Last 90 days - 3 hours and 42 minutes Last 28 days - 1 hour and 38 minutes
Information Source:	AAIB Field Investigation

Synopsis

The glider was undertaking an aerotow launch to the west at Gwernesney Airfield which was operated by the resident gliding club. During the early stages of the ground roll the horizontal tailplane (tailplane) detached from G-DDGX and fell to the ground. Club members assisting with the launch signalled for the takeoff to be aborted but the message did not reach the aerotow tug pilot; the accident pilot did not appear to hear or see the stop signals either. The glider became airborne and climbed rapidly, before the tow cable released and the aircraft's nose dropped. The glider descended steeply and struck the ground nose first. It came to rest inverted pointing in an easterly direction. First responders extricated the pilot from the aircraft before he was airlifted to hospital. He died five days later from complications related to injuries sustained in the accident.

The investigation determined that the tailplane had not been correctly attached when the glider was rigged and this condition was not detected prior to the flight. Several possible mis-rigging scenarios were identified during the investigation, but the precise manner in which the tailplane had been mis-rigged could not be determined.

Two Safety Recommendations are made relating to communication for glider launching and detecting incorrect alignment of tailplane locking features. In addition, the gliding club has undertaken several safety actions regarding launch signalling and detection of incorrect tailplane locking on other Standard Cirrus gliders.

History of the flight

A club member reported that, when they arrived at the airfield at 0750 hrs on 27 July 2019, the accident pilot was already on site. By then he had prepared the club's ground equipment and carried out daily inspections (DI) on the club's tractor and the winch used for launching gliders. The pilot was reported to be in good spirits and looking forward to flying. This was to be his fifth flight in G-DDGX.

After helping to prepare the club's own gliders the accident pilot began to rig G-DDGX, which was stored dis-assembled in its trailer at the airfield. Shortly after he had removed the fuselage and wings from the trailer the pilot attended the 0900 hrs morning briefing in the clubhouse. On returning to the glider the pilot sought the assistance of two club members to help attach the wings. He then declined offers of further assistance and completed the rigging process, including fitting the tailplane, on his own. Later that morning a different club member helped the pilot conduct positive control checks on the aircraft. Nothing untoward was noted during the control check process. The aircraft was later moved to the aerotow queue for a westerly launch.

When it was G-DDGX's turn, the aerotow tug pilot positioned the tug aircraft near the glider and radioed for people to assist with connecting the tow cable and to help with the launch. One club member attached the cable to the glider before assuming the role of wingtip holder. Another member took up the position as forward signaller, standing approximately halfway between the tug (G-AVXA) and the clubhouse (Figure 1). The assisting ground personnel directed the tug pilot to take up the cable slack. When the glider pilot was ready, the wingtip holder signalled 'all-out'[1] and this was relayed by the forward signaller.

After the 'all-out' signal had been received, the tug pilot's attention was focused on a safe takeoff. In addition to monitoring engine parameters, the tug pilot needed to keep the aircraft straight and to ensure a safe departure with due consideration for the trees at the far end of the airfield. The forward signaller was very quickly out of their primary visual field.

The wingtip holder was supporting G-DDGX's left wingtip as the glider started to move and noticed that the tailplane had started to "wobble." Coincident with full power propwash from the tug reaching the glider, the leading edge of the glider's tailplane began to lift. The whole tailplane assembly then flipped up and backwards off the fin. The wingtip holder shouted "stop" and let go of the wingtip to send the visual stop signal[2] to the forward signaller. The tug pilot, who was concentrating on the takeoff roll, did not see the relayed signal. The tow cable remained attached to the glider throughout its "shorter than normal" ground roll.

Footnote

1 The executive command for the tug to start the takeoff roll.
2 Both arms raised.

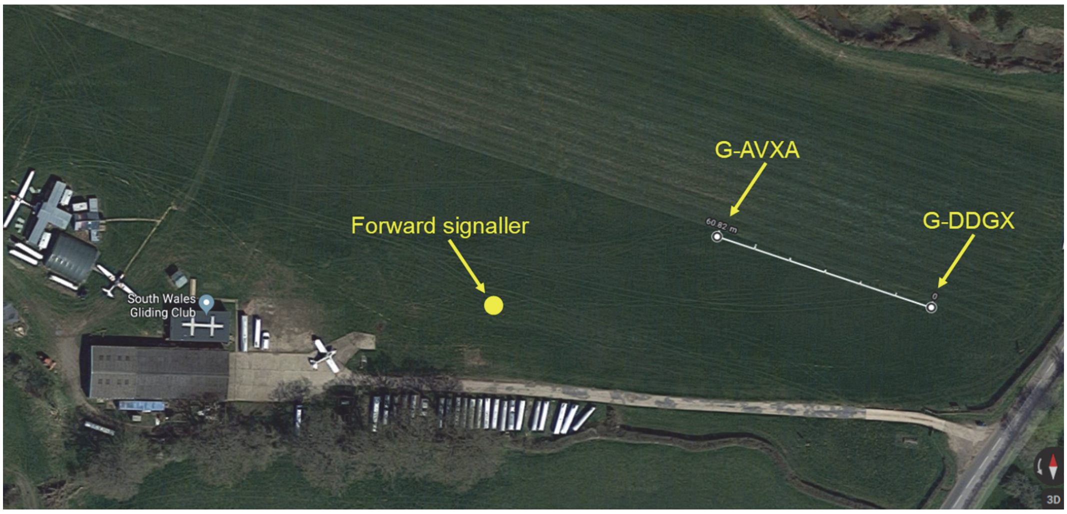

Figure 1

Approximate disposition of G-AVXA, G-DDGX and forward signaller before takeoff

Once airborne the glider climbed rapidly while the tug was still on the ground. The tug pilot felt the tail of the aircraft being pulled upwards and looked in the mirrors. G-DDGX was seen in the mirrors in planform behind the aircraft and significantly higher than would be expected at that stage of the takeoff. The tug pilot immediately aborted the launch and allowed the tug to roll to a halt.

Whether by the glider pilot's actions or by it back-releasing, the tow cable detached from G-DDGX during the climb. Eyewitnesses reported that the glider reached a maximum height of between 30 and 80 ft before its nose dropped and it descended steeply to the ground. After impact, the glider came to rest inverted, pointing in an easterly direction. The canopy had detached, and the pilot was restrained in the cockpit by the harness straps. The first club member on the scene reported that the pilot was initially unconscious but came around a short while later. Emergency Services were on site within 10 minutes of the accident. The pilot was released from the straps and the glider was lifted clear. The pilot was airlifted to hospital in Cardiff. He died five days later from complications arising from his injuries.

Meteorology

At the time of the accident, good weather prevailed and there was a light north-north-westerly breeze.

Airfield information

Gwernesney Airfield is situated on flat ground to the east of the Usk Valley in Monmouthshire. It is aligned broadly east-west and bordered to the north by a tree-lined stream. Due to the presence of trees in the overshoot, aerotow launches to the west often require a left turn after takeoff to make full use of the clear ground track available (Figure 2). The glider site sits within Class G airspace.

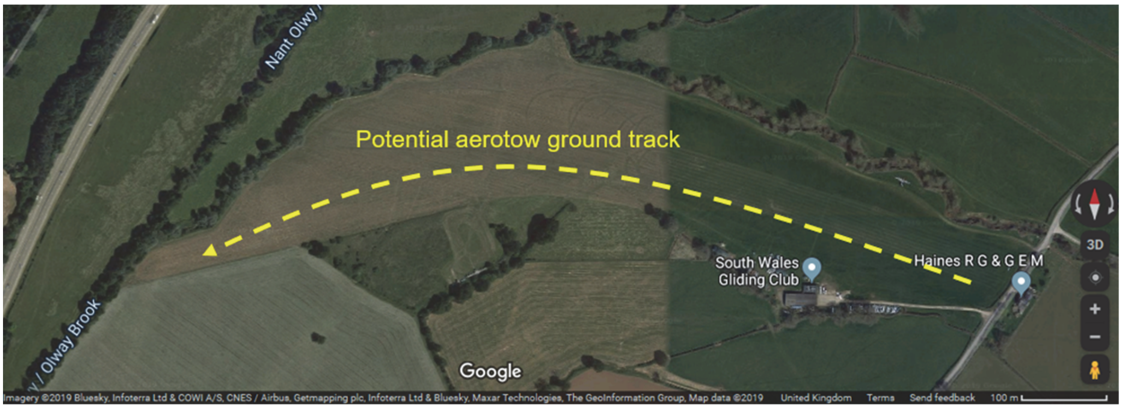

Figure 2

Overview of Gwernesney Airfield

Personnel

The accident pilot had started gliding as a teenager but had not flown for many years before joining the club at Gwernesney in 2015. Fellow club members described him as a cautious and competent pilot. They reported that he was studying for his Bronze Endorsement and was hours-building with a view to eventually becoming a gliding instructor.

Onsite examination

The glider had struck the ground in a steep nose-down attitude abeam the clubhouse. The nose of the glider and cockpit area were severely disrupted. The vertical fin had suffered damage in the impact and remained attached to the fuselage only by the rudder and tailplane pushrods.

The tailplane had come to rest close to the launch point, approximately 237 m from the main wreckage. It was immediately apparent that, although the tailplane safety pin was installed, the tailplane locking lever was forward of, rather than the normal position aft of, the safety pin (Figure 3).

Description of the glider

Ownership

G-DDGX was jointly owned by two syndicate members, one of whom was the primary owner (referred to hereafter as the owner). Two additional pilots had joined the syndicate as '*insurance shares*,'[3] the first began flying the glider in 2018. The second insurance share was the accident pilot who had been a member of the syndicate for two months. G-DDGX was not equipped with a radio.

Footnote

[3] Whereby the individual contributes to the cost of insuring the glider in return for being allowed to fly it.

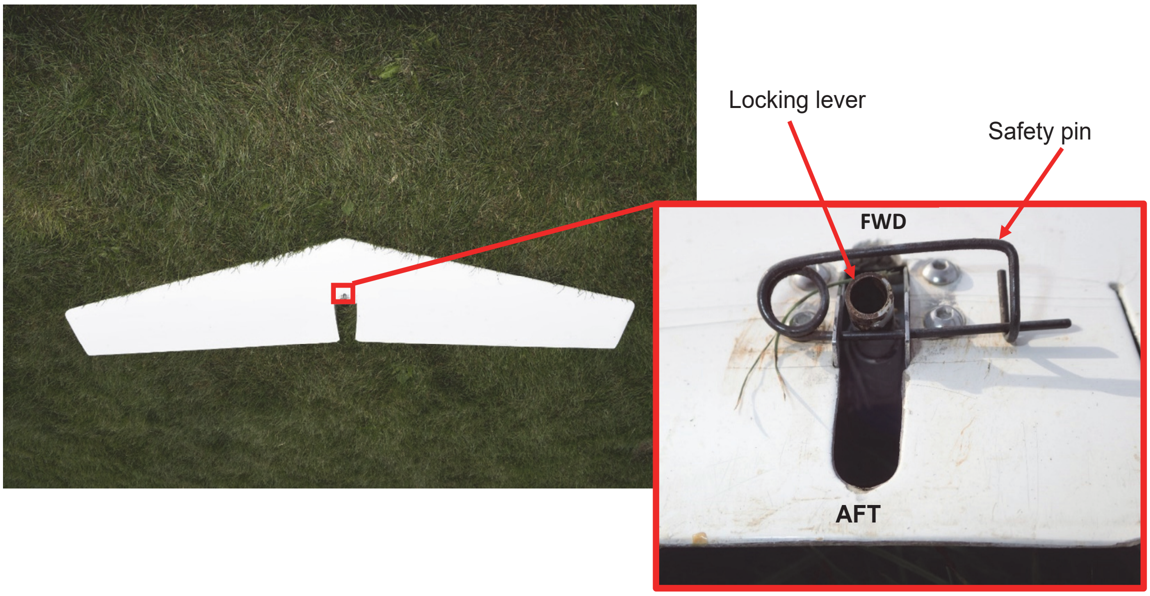

Figure 3

G-DDGX tailplane (as found condition)
with inset showing locking lever forward of safety pin

General

The Standard Cirrus glider is a single-seat standard class glider with a 15 m wing span, which was designed and manufactured by Schempp-Hirth[4] and first flew in 1969. It is of predominantly glass fibre composite construction and is equipped with a retractable mainwheel, a single towing hook and an all-moving tailplane[5] mounted on top of the fin. The flight control systems for the aileron, airbrake, rudder and tailplane are of the pushrod type. The tow hook release and wheel brake control systems are operated by cables.

Several variants of the Standard Cirrus were built. G-DDGX, built in 1975, was a Standard Cirrus 75 which incorporated redesigned wing fairings, a longer nose, larger airbrakes and a modified tailplane attachment fitting.

Tailplane control system

The tailplane (elevator) control system on the Standard Cirrus 75 comprises a horizontal pushrod which runs from the control stick quadrant, through the length of the fuselage to the base of the tail fin, where it is connected via a bellcrank to another pushrod running vertically through the fin. This pushrod is connected to the underside of a fitting mounted at the top of the fin (Figure 4), which pivots around its axle in response to movement of the control stick. At the forward end of the fitting is a tapered bolt, which engages with a lug, known as the 'front fitting,' on the underside of the tailplane.

Footnote

[4] Some Standard Cirrus's were built under licence by other organisations, including Vazduhoplovno Tehnicki Centar (VTC) based in the former Yugoslavia.

[5] The horizontal tailplane on the Standard Cirrus series of gliders is an all-moving tailplane which provides pitch control without the need for a separate elevator control surface. The tailplane attachment mechanism provides structural and control connection.

The corresponding mechanism in the tailplane comprises two locking hooks on a pivoting bar which is mounted on a bracket on the aft face of the tailplane spar (Figure 5).

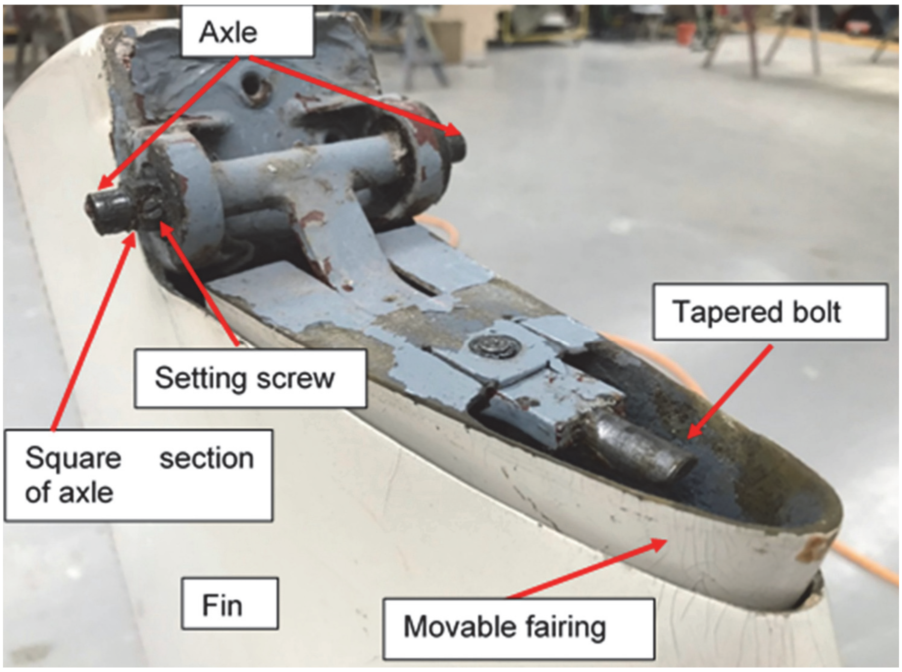

Figure 4

Standard Cirrus 75 Modified tailplane attachment fitting at top of fin

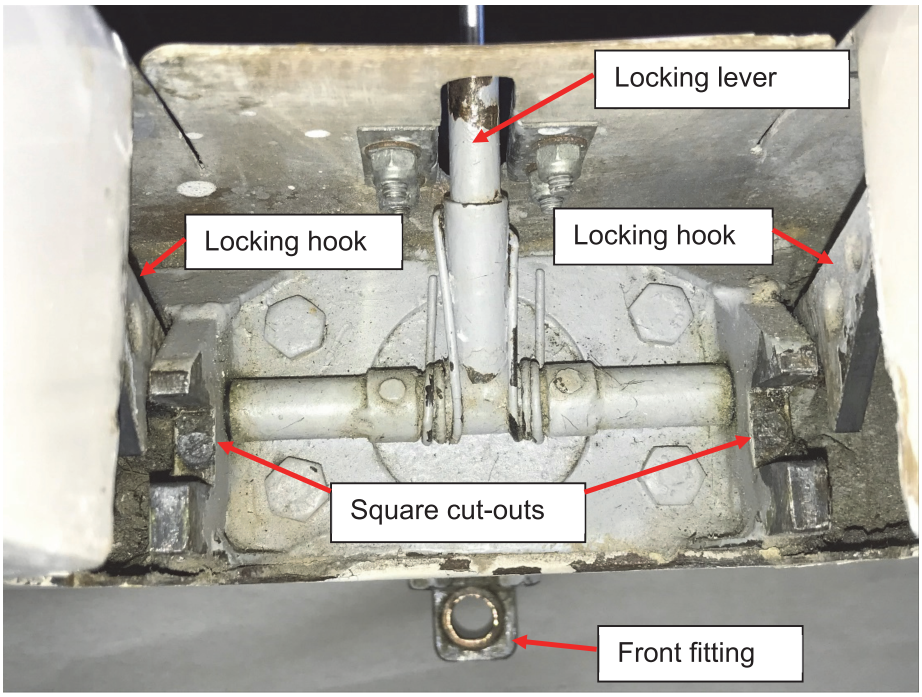

Figure 5

Standard Cirrus 75 Modified tailplane attachment mechanism
(view looking forward)

When the tailplane is placed on top of the fin, square cut-outs in the mounting bracket engage with the square sections of the axle on the fin fitting, to locate the tailplane. Two adjustable setting screws on the square axle sections are used to remove any tangential play in the mechanism. The locking hooks engage with the circular ends of the axle. The hooks are spring-loaded to the closed position and are operated by a locking lever.

When the tailplane is attached, the locking lever protrudes through a slot in the top surface of the tailplane. The locking lever is hollow, and a rigging tool can be inserted for ease of movement. To lock the tailplane in place, the locking lever is moved to the aft end of the slot. A safety pin is then inserted forward of the locking lever to prevent it moving forward towards the unlocked position (Figure 6). To de-rig the tailplane the safety pin is removed, and the locking lever is moved forward to release the locking hooks from the axle.

Figure 6

Locking lever when tailplane attached (left image)
and when locked with safety pin inserted (right image)

Evolution of Standard Cirrus tailplane rigging design

General

Previous models of the Standard Cirrus had a tailplane attachment mechanism known as the 'T-fitting.' In this arrangement, the vertical pushrod in the fin terminated in a hook, which engaged between two bearings in the tailplane.

In 1975, the modified tailplane attachment mechanism was introduced by Technical Notice (TN) 278-15 *'Attachment and control connection of the horizontal tailplane'* (Figure 7). The reason for the modification was described as *'Simplification of the mounting, easy checking of the mounting, adjustable tangential backlash of the elevator control.'* Later models of the Standard Cirrus, including G-DDGX, were manufactured with TN 278-15 already embodied.

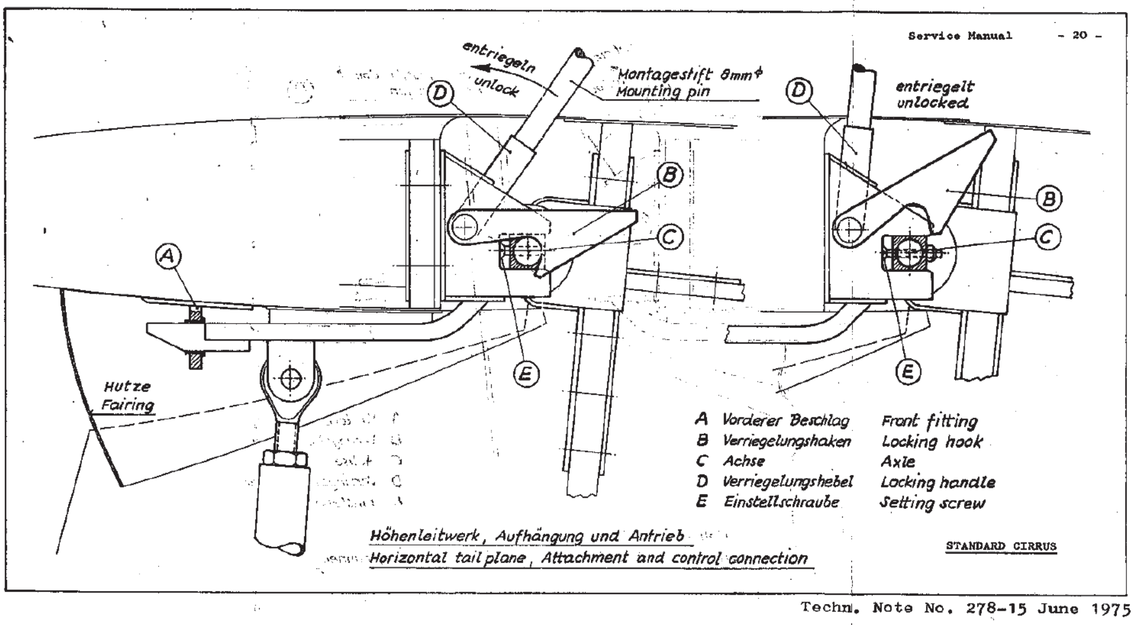

Figure 7

Tailplane attachment and control connection from TN 278-15 and Standard Cirrus flight manual

Rigging instructions

For gliders with TN 278-15 embodied, the Standard Cirrus flight manual provides the following instructions for tailplane assembly. The letters in parenthesis refer to the items labelled in Figure 7.

> *'The tailplane should be mounted by one person only.*
>
> *Put the plane from the front onto the fin so that the front bolt bearing fitting (A) is just dipping into the upper opening of the moveable glass fibred fairing on top of the fin.*
>
> *Push the tailplane slightly down until its lower surface is fully lying on the fairing. Push the tailplane backwards until a clear audible "CLICK" indicates that the locking hooks (B) are engaged onto the axle (C). Move the locking handle (D) using a mounting pin of 8 mm dia in order to lock the hooks (B) tightly up to the rear stop.'*

And disassembly:

> *'When taking off the horizontal tailplane it is advisable to do it from the rear.*
>
> *Unlock the hooks (B) by pushing the locking handle (D) forward using the 8mm dia pin. Push the plane simultaneously forward about some mm [sic] (about one inch) while knocking against the trailing edge until the bolt is disengaged from the bearing fitting (A).'*

Additional safety device

TN 278-36 *'Safety device for the locking lever of the tailplane attachment,'* was introduced on 24 November 1994 and was subsequently mandated by Airworthiness Directive 95-015[6] dated 15 December 1994. It was required to be embodied before 31 March 1995. The reason for the modification was described as: *'Due to the lack of maintenance or because of wear, the locking hook on the tailplane attachment bracket became disengaged in a number of cases, so that the horizontal tailplane was no longer securely attached to the fin.'* The actions required by TN 278-36 included: *'Re-adjustment of the set screws on the tailplane attachment bracket to eliminate any tangential play … Installation of a safety device* [pin] *for the locking lever…Check of the rigged and secured horizontal tailplane for full and free movement up to the stops.'* It did not stipulate any amendments to the existing rigging instructions in the flight manual. An illustration from TN 278-36 is shown in Figure 8.

TN278-36 was also applicable to certain examples of the Nimbus 2, Janus, Mini Nimbus HS7 and Nimbus 2M gliders which have similar tailplane locking mechanisms.

The glider manufacturer was unable to provide details of the incidents referenced in TN 278-36 that had prompted the introduction of the modification.

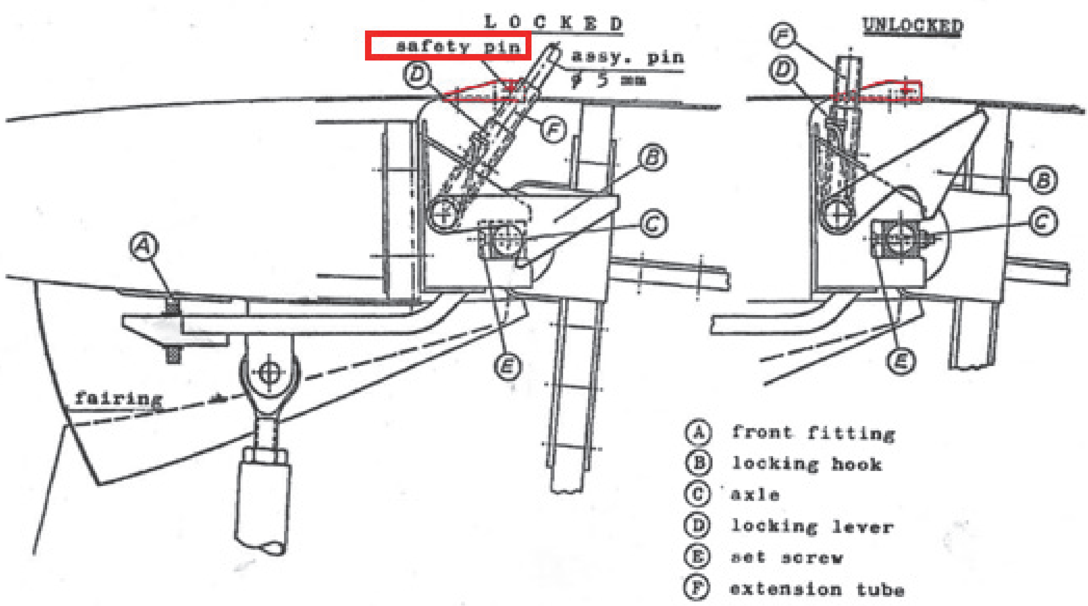

Figure 8

Tailplane attachment and control connection from TN 278-36
showing addition of a metal bracket and safety pin

Footnote

6 Issued by the Luftfahrt Bundesamt (LBA), the German national airworthiness authority.

Flight manual

G-DDGX Flight manual

G-DDGX's flight manual included illustrations showing both the original T-fitting tailplane attachment mechanism and the modified tailplane fitting incorporated on G-DDGX. The tailplane assembly/disassembly instructions were relevant only to the original T-fitting mechanism and were not relevant to the actual tailplane configuration on G-DDGX.

The illustration of the original T-fitting mechanism predated G-DDGX's manufacture and the labelled components were identified in English and German. The illustration of the modified tailplane fitting did not include any reference to TN 278-15, was not dated and the labelled components were identified in Croatian. This suggested that this page may have been from the flight manual of a VTC-manufactured Standard Cirrus. This illustration did not show the safety pin on the locking lever introduced by TN 278-36, however a copy of TN 278-36 was found elsewhere in the G-DDGX's document folder.

The owner indicated that the flight manual was provided when he purchased G-DDGX, and that he relied on the BGA inspector to identify any flight manual updates.

The front cover of G-DDGX's flight manual listed its serial number as 169, rather than 619.

Generic Standard Cirrus flight manual

The other pilot with an insurance share in G-DDGX had downloaded a generic Standard Cirrus flight manual from a popular enthusiasts website, in preparation for flying G-DDGX. This version of the flight manual contained assembly instructions relevant to the modified tailplane mechanism configuration on G-DDGX but although these instructions referenced an illustration of the tailplane mechanism, the manual did not include any such illustration.

Pilot's flight manual

It was not determined what, if any, version of the Standard Cirrus flight manual the accident pilot may have had.

Information from the manufacturer

The glider manufacturer advised that every glider is delivered with the correct flight manual relevant to its production configuration but if, after delivery of the glider, a modification (technical note) is embodied, which results in changes to the flight manual, the relevant pages of the flight manual must be replaced. The manufacturer is not normally informed when a technical note is embodied on each glider and therefore it is the responsibility of the owner to keep the flight manual for their glider up to date. Owners can download technical notes relevant to their glider from a portal on the manufacturer's website.

The glider manufacturer stated that it was not aware of any tailplane rigging accidents involving Standard Cirrus's with the modified tailplane attachment mechanism.

G-DDGX maintenance history

G-DDGX was manufactured in 1975 and was initially operated in the UK by the Army Gliding Association until 1990, when it was purchased by a private owner. The current owners purchased G-DDGX in 2010. Maintenance records show that TN 278-36 was embodied on G-DDGX in May 2000.

G-DDGX underwent its most recent annual inspection and Airworthiness Review Certificate (ARC) renewal on 21 April 2019. A review of glider documents during the ARC renewal indicated that the flight manual had been reviewed in depth, that it was applicable to the aircraft configuration and that it reflected the latest applicable revision status.

Following its annual inspection, G-DDGX flew 16 flights over nine separate days and had accumulated 3,186 hours and 3,176 launches at the time of the accident.

Owner's experience of rigging G-DDGX

G-DDGX was stored in a trailer and was rigged prior to each day's flying. The owner reported that when in the trailer, it was his custom to store the tailplane with the locking lever in the neutral position (sprung closed) and the safety pin inserted in its bracket. The rigging tool, a steel tube with a ball on the end, used to move the locking lever, was stored separately in the trailer.

The owner indicated that he was not overly familiar with the rigging instructions and illustrations in G-DDGX's flight manual and instead relied on the practical demonstration of the rigging that he had received when he first purchased G-DDGX, and his own experience of rigging the glider since then.

He estimated that he had rigged G-DDGX approximately 70 times. He described the tailplane rigging as a straightforward process, during which he had never experienced any difficulties. He normally stood in front of the fin facing aft towards the tail. He would firstly remove the safety pin from its bracket, so that when the tailplane was positioned on the top of the fin, the locking lever was free to move. He reported that the mechanism made an audible "clunk" when the locking hooks engaged on the axle and described the tailplane as being quite securely attached at this point, even before the locking lever was moved aft to the locked position. When moving the lever towards the locked position he described feeling the mechanism tightening up or locking. The safety pin was then inserted forward of the locking lever.

The owner stated that he was always cautious when rigging the tailplane, having been made aware of previous accidents relating to tailplane rigging on the Standard Cirrus. Although, he believed these to be related to gliders with the original tailplane attachment configuration, he adopted a cautious approach. It was his custom to shake the tailplane after rigging, as a secondary check to ensure it was properly attached.

Prior to the accident pilot's first flight in G-DDGX on 25 May 2019, the owner described and demonstrated the rigging of the glider to him. The owner ensured that the pilot carried out all the rigging actions, so that he would become familiar with them. The owner supervised the rigging, checked the connections afterwards and signed the DI book. He communicated his own cautious approach to the pilot. He reported that there was no indication that the pilot had been uncertain about any aspects of the rigging procedure and the owner advised the pilot to call him or to speak with the club technical officer, if he was ever uncertain about the rigging. The owner was not present on the subsequent occasions when the pilot rigged G-DDGX, including the day of the accident.

The other pilot with an insurance share in G-DDGX reported that the owner had demonstrated the rigging to him on two occasions. He recalled the owner emphasising that the locking lever needed to be in the correct position when rigging the tailplane. This pilot reported that on each of the three occasions he had rigged G-DDGX, he had asked the club technical officer to perform a secondary check of the rigging.

Pilot's rigging experience

All the pilot's gliding in G-DDGX took place at the gliding club. Based on records from the gliding club, the pilot had flown G-DDGX four times on four separate days between 25 May 2019 and 13 July 2019. He had signed G-DDGX's DI book four times, including for the accident flight. In addition to rigging G-DDGX with the owner on 25 May 2019, he would have rigged the glider a further three times, with the rigging on the day of the accident being his fifth time. G-DDGX was last flown on 21 July 2019 by the owner.

The club technical officer indicated that he had discussed the intricacies of rigging the glider with the pilot when he first started flying G-DDGX and had offered to perform secondary checks on his rigging of G-DDGX. The pilot had taken him up on this offer on one occasion, but not on the day of the accident.

Detailed aircraft examination

Disruption to the top of the tail fin caused by the impact, meant that the moveable fairing around the tailplane attachment mechanism had separated, but the mechanism was otherwise intact. There was no evidence of grease on the mechanism, but it rotated freely. No tangential play was evident in the mechanism and the setting screws had several threads wound out, indicating that they had previously been adjusted.

Both the vertical tailplane pushrod in the fin and the horizontal pushrod within the fuselage had been bent during the impact and were cut to facilitate recovery of the wreckage and operation of the mechanism. As a result, the mechanism at the top of the fin was no longer connected to the remainder of the control run and was therefore unrestrained. The vertical pushrod was moved up and down to simulate forward and aft movement of the control stick.

The tailplane was undamaged. The locking lever was protruding through the slot in the upper surface of the tailplane and was resting against, and forward of, the safety pin. Upon removal of the safety pin, the locking lever sprang back to its neutral position. The top of the locking lever in the area where it was in contact with the safety pin showed evidence of missing paint and surface corrosion, the extent of which was greater on the rear face of the lever (Figure 9). In normal operation the lever moves freely within the slot and does not come into contact with any other structure.

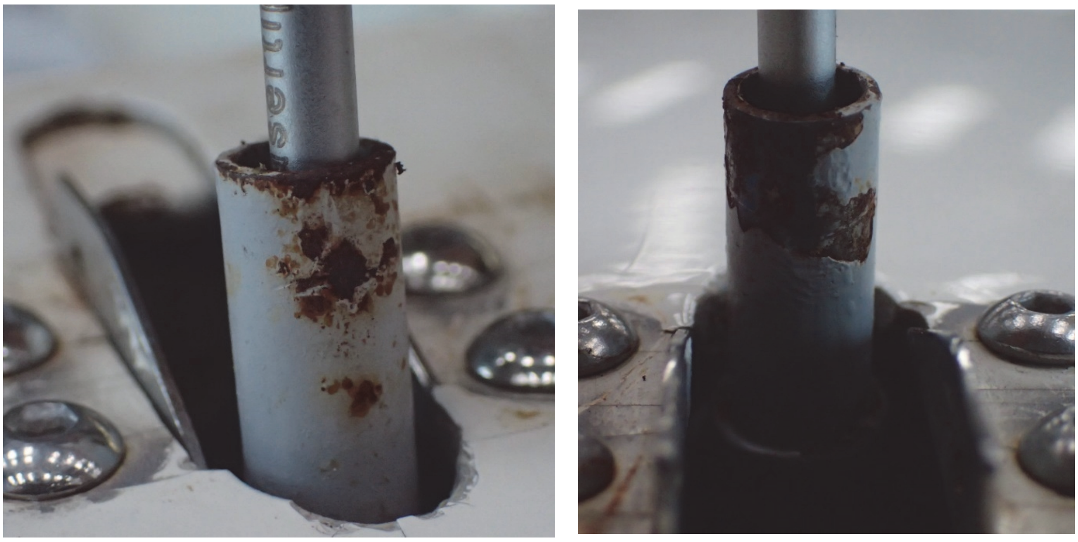

Figure 9

Missing paint and surface corrosion on forward face (left image) and rear face (right image) of the locking lever on G-DDGX

Rigging trials

A number of tailplane rigging trials were conducted on G-DDGX and on another Standard Cirrus 75 with the same tailplane attachment configuration, to assist in understanding potential mis-rigging conditions. An access panel was cut in G-DDGX's tailplane so that the locking hooks of the rear mechanism could be observed.

When the tailplane was attached to the fin, an audible 'clunk' was heard as the mechanism engaged, as described in the flight manual. The locking lever came to rest directly in-line with the attachment hole for the safety pin and the safety pin could not be inserted without first moving the locking lever. To correctly secure the tailplane the locking lever is moved aft to the (fully locked) position (Figure 10).

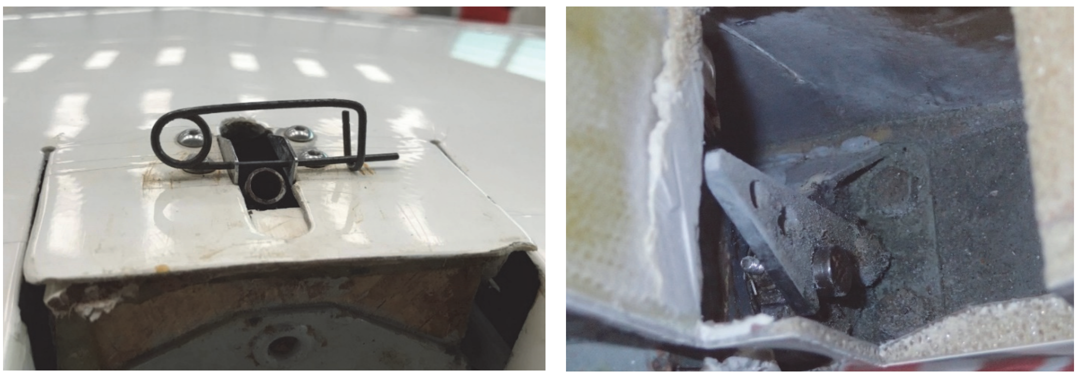

Figure 10

Position of locking lever and locking hooks in fully aft (locked) position. Note: only right hook shown

If the locking lever was moved forward instead of aft, the safety pin could be inserted behind it and the lever would then spring back to rest against the pin when released. The same condition could be achieved by installing the tailplane in the as-found condition, with the locking lever already resting forward of the safety pin. In both cases this resulted in the rear mechanism being engaged but not locked, as the pin prevented the lever from travelling aft to the fully locked position (Figure 11). In this condition the locking hooks were not fully engaged on the axle but the tailplane felt secure and could not be dislodged.

Figure 11

Position of locking lever and locking hooks with lever forward of safety pin.
Note: only right hook shown

It was not possible to attach the tailplane if the safety pin was installed in its bracket and the locking lever was in the neutral position, because the pin prevented the lever moving sufficiently to open the locking hooks.

With the lever forward of the safety pin, it was possible to fold the safety pin forward such that the locking lever rested against the 'free' unrestrained arm of the safety pin (Figure 12). The lever was in a forward position and the locking hooks were not engaged on the axle, with the effect that the rear mechanism was entirely unlocked and the tailplane could easily separate from the fin. In this condition, the position of the unrestrained arm of the pin was somewhat tenuous as the spring force of the lever was acting to push it out of the way. It was demonstrated that movement or light force could cause the unrestrained arm of the pin to be dislodged, such that the lever sprung back against the restrained arm of the pin. Nonetheless a positive control check could be conducted without revealing any anomalies.

Figure 12

Position of locking lever and locking hooks when safety pin folded forward.
Note: only right hook shown

If the tailplane was offered up to the fin in a trailing-edge down orientation, it was possible to achieve full engagement of the locking hooks on the axle and move the lever aft to the fully locked position, while the tapered bolt was not engaged in the lug of the front fitting. If the locking lever was already resting forward of the safety pin when this was done, it was possible to achieve a condition where the rear mechanism was engaged but not locked (as previously described) and the front fitting was entirely disengaged. In both cases a large gap was present between the leading edge of the tailplane and the moveable fairing, where it was visually evident that the tapered bolt was not engaged in the front fitting (Figure 13). These two scenarios were demonstrated on the comparison glider but could not be replicated on G-DDGX.

Figure 13

Rear tailplane mechanism partially engaged, front fitting disengaged

However, it was possible on G-DDGX to achieve a condition where the locking lever was in the fully forward position and the tapered bolt was only partially engaged in the front fitting (Figure 14). In this condition neither the rear mechanism nor the front fitting were properly

Figure 14

Position of locking lever and locking hooks when lever in fully forward position (safety pin not shown) and forward fitting partially engaged.
Note: only right hook shown

In all of the mis-rigging conditions demonstrated, a positive control check did not result in any unusual observations or sensations when resisting the movement of the tailplane.

Aerotow tug aircraft

The club's aerotow tug aircraft was a Piper Pawnee, G-AVXA (Figure 15). It was equipped with a 60 m retractable tow cable. The aircraft was fitted with a radio but, due to noise levels in the cockpit when at full power, this was not used during the launch phase of aerotows.

Figure 15

Piper Pawnee G-AVXA, the club's aerotow tug aircraft

BGA publications

The BGA is the governing body for the sport of gliding in the UK and, among other things, is responsible for managing training standards and ongoing airworthiness of the UK glider fleet. The BGA publishes a Safety Briefing Leaflet *'Is your glider fit for flight?'* which highlights the importance of preparing gliders correctly for flight, offers guidance on how to do so and indicates some of the glider types and mechanisms that are vulnerable to rigging errors. To avoid flying with an 'incompletely prepared' glider, the leaflet indicates that rigging should be directed by a person experienced on the type and in accordance with the flight manual. This should be followed by a Daily Inspection (DI), conducted by a person experienced on the type. Both tasks should be completed without interruption or distraction.

It states:

> *'When you have rigged your glider, ensure that it is checked. This should ideally be done with fresh eyes by another, qualified, person, but at least by someone with a fresh frame of mind: some pilots walk briefly away from the glider so that they approach the checks with a clear new focus.'*

And:

> *'Rigging errors, and other errors and omission in preparing a glider for flight, are frequently caused by interruption, distraction, forgetfulness, and making unwarranted assumptions.'*

Further, it describes the positive control check as follows:

> *'Taking care not to apply excessive force, each control surface should be restrained while an attempt is made to move the control, and the direction of motion checked. It only takes a couple of minutes for a helper to advise the rigger whether movement of the cockpit controls generates the correct responses at the control surface.'*

The leaflet identifies the Standard Cirrus as one of the glider types that are vulnerable to mis-rigging of the tailplane or elevator, but all incidents referenced in the leaflet occurred to gliders fitted with the original tailplane mechanism.

EASA Safety information bulletin

EASA Safety Information Bulletin (SIB) 2019-07 *'Sailplane rigging – procedures, inspections and training'* issued 30 April 2019 references several previous glider accidents that were caused by improper execution of rigging procedures, including some relating to tailplanes/ elevators not being correctly connected.

The SIB indicates that these accidents can be broadly grouped according to the following factors: interruptions or distractions during rigging procedure, leading to omission of important steps; rigging procedure not correctly followed; person conducting rigging not familiar with procedure; mechanical principles of the connection not understood by the person conducting the rigging; connections and/or securing not, or not correctly, inspected; and, absence of positive control check.

The SIB recommends that familiarisation with a new type of glider should include rigging and recommends that even if the flight manual offers detailed instructions on how to perform the rigging, familiarisation should be provided by a person familiar with the type.

Organisational information

The gliding club based at Gwernesney Airfield has the status of a community amateur sports club and is managed by a board of directors. It is affiliated to the BGA and is required to comply with their laws and regulations as well as those of the EASA. The club publishes an Operations Manual (ops manual) which details site-specific information, guidance and direction for gliding operations at the airfield. The club offers winch and aerotow launches to its members and to visiting pilots.

Following the accident, the club conducted a review of its operations with a particular focus on the circumstances surrounding this event. The club timed aerotows to determine how long a 'normal' westerly takeoff ground roll was. It found that from the 'all out' to a glider passing abeam the clubhouse took approximately five seconds. Its review concluded that:

- Due to the voluntary nature of attendance at the club, it was impractical to require all rigging activities at the airfield to be overseen by a third-party qualified to supervise the process.

- The location of the forward signaller should be formalised to ensure they were in the tug pilot's eyeline for longer after the 'all-out' signal. They should also increase their visibility to the tug pilot by using a winch-launch signalling bat rather than relying on hand signals.

- Where it would be beneficial to do so, tell-tale marks should be added to gliders at the club to make it easier to detect incorrect alignment of rigging levers (Figure 16).

- Due to the speed with which the situation unfolded, radios would not have been an effective barrier in this accident sequence. They did not perceive the need to change club radio procedures.

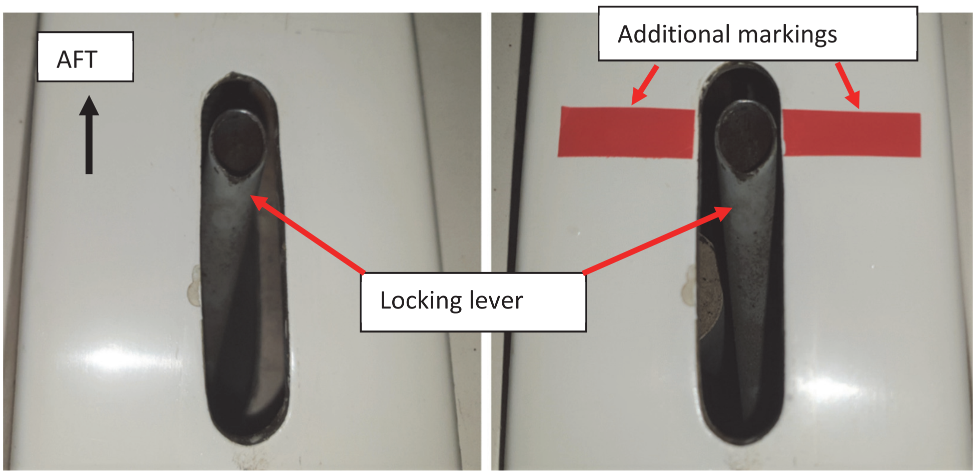

Figure 16

Standard Cirrus tailplane (original T-fitting elevator connection) with and without (left) locally-applied indicator for correct locking lever alignment

Glider launching information

Emergency tow cable release

The ground roll of any launch is a high-risk phase of flight. One of the major risks is that if a glider's wingtip touches the ground it can pivot the aircraft into an uncontrollable cartwheel. It is instilled in glider pilots that, if they cannot keep the wings level during takeoff, they should release the tow cable before a wing touches the ground. To facilitate a swift reaction, they are taught to keep their hand on the cable release control throughout the takeoff roll. The club's ops manual specifically directs that '*the pilot should have his hand on the* [cable] *release mechanism throughout the launch*.'

Glider pilots are also taught to release the tow cable immediately if they climb significantly above the tug aircraft or become un-sighted on it.

Use of radios

Implementing Regulation (EU) No 923/2012[7] and the Standardised European Rules of the Air[8] issued by EASA detail the regulatory requirement for the use of radios in different classes of airspace. Aircraft operating under visual flight rules inside Class G airspace which has not been declared a Radio Mandatory Zone (RMZ) are not required to use a radio. The airspace surrounding Gwernesney is not a designated RMZ.

In the UK, managing the VHF aeronautical communications frequency spectrum is the responsibility of the CAA. They have identified nine frequencies[9] for recreational aviation that are '*pre-assigned*' on a non-protected basis and are shared between users. These frequencies are not guaranteed any protection against mutual signal interference. In agreement with the CAA and Ofcom, the BGA has assigned eight of those frequencies to be used by the UK gliding community. The frequency allocations are detailed in the BGA Managing the Flying Risk publication[10]. Each frequency is assigned for a specific purpose, for example, 129.980 MHz is a '*Common Glider Field Frequency* [to be used] *within 10 nm radius and up to a height of 3,000 ft above certain approved airfields.*'

The BGA provides guidance on the benefits and use of radios[11]. It does not mandate their use and not all gliders are equipped with radios. G-DDGX did not have a radio fitted.

Footnote

7 Commission Implementing Regulation (EU) No 923/2012 adopted 26 September 2012. Available at https://www.easa.europa.eu/document-library/regulations/commission-implementing-regulation-eu-no-9232012 [accessed November 2019].

8 Easy Access Rules for Standardised European rules of the Air (SERA) published December 2018. Available at https://www.easa.europa.eu/document-library/general-publications/easy-access-rules-standardised-european-rules-air-sera [accessed November 2019].

9 Aeronautical Radio Stations, Frequency Assignments. Available at https://www.caa.co.uk/Commercial-industry/Airspace/Communication-navigation-and-surveillance/Aeronautical-radio-stations [accessed November 2019].

10 Managing Flying Risk: Guidance for Pilots and Clubs Version 10 effective 26 April 2019. Available at https://members.gliding.co.uk/library/bga-requirements-guidance/managing-flying-risk-guidance [accessed October 2019].

11 BGA Laws and Rules: Radio Guidance v1.1 effective 3 Jan 18. Available at https://members.gliding.co.uk/library/bga-requirements-guidance/radio-guidance [accessed November 2019].

While not a regulatory requirement, radios are used to support launch operations at some glider sites within the UK. Other clubs routinely use radios for communication between the tug and the glider being towed. At least one other club uses radios for coordinating the launch preparation, but at the 'all-out' call radio responsibility is transferred to the pilots engaged in the aerotow. In the event of a critical failure during a launch, releasing the tow cable would be a glider pilot's highest priority over and above any radio communication.

The gliding club at Gwernesney used radios primarily for passing information on glider type to the winch launch vehicle, but all operational signalling was done by hand, signal bat or lights. Use of the radio is specified as follows in the club's ops manual:

> *'Radio communication between the launch point and the winch using air band transceivers must be made on a frequency of 129.980 MHz. Members must only use the radio for brief and necessary communication between the launch point and the winch and all radio 'chatter' should be avoided.'*

Aerotow launch signallers at the club do not have a radio nor is there a radio-equipped safety observer monitoring takeoffs.

Launch communication

The BGA Operational Regulation 34[12] requires that '*an adequate system of communication must exist between the person in charge of launching and the winch or tow-car driver or tug pilot*.' It does not specify the minimum requirements or operational expectations of an '*adequate system of communication*.'

BGA Operational Regulation 36 requires that, where radios are used, '*a means must exist for making an emergency stop signal which can be received, notwithstanding the noise of the engine*' in the launch traction vehicle. There is no requirement for communication between the person in charge of launching and the pilot of the glider being launched nor is it required to have a dedicated radio-equipped safety observer for launches.

The BGA-published guidance notes for aerotowing[13] includes the following advice regarding radios and the limitations of visual signalling for aerotowing:

> *'Launch signalling is best done by the radio. Not all clubs will have the facility, but it is strongly recommended that it is obtained... Hand signals from behind are difficult to see and it is unlikely that the tug pilot will be able to react quickly to a stop signal. Forward signallers are rarely put far enough forward and are usually in danger of being hit by a glider ground-looping on takeoff.'*

Footnote

[12] BGA Laws and Rules: BGA Operational Regulations Version 1, effective 8 Mar 2015, revised 25 October 2016. Available at https://members.gliding.co.uk/library/bga-requirements-guidance/operational-regulations-of-the-bga [accessed 19 December 2019].

[13] British Gliding Association Aerotowing Guidance Notes, 2nd Edition June 2008. Available at https://members.gliding.co.uk/library/power-flying/aerotowing-guidance-notes [accessed December 2019].

Visual signalling

The type of signalling used by the gliding community has parallels with that used for train departure signalling in the rail industry. To signal to the driver that their train is secure for departure a signaller holds up a white circular bat. Once the driver sees that signal, the focus of their attention shifts to looking ahead to look for track-side signals and to ensure that the rails are clear. If the departure signaller needs to alert the driver to a problem, they lower their bat. Similarly, with a gliding forward signaller one of the main problems associated with this system is that of attracting the driver/pilot's attention when the signal is not in their primary field of view. For glider pilots on aerotow, their visual attention is almost exclusively focused on keeping wings level and maintaining alignment behind the tug, rather than looking for ground-based signals.

While both gliding and rail stop signals involve a dynamic transition to the alert state, they become static thereafter. Static objects in an observer's peripheral vision do not command attention. For such a signal to have the best chance of being detected it needs to be of sufficient size, visually distinct and to be moving rather than stationary.

Experience from the rail industry shows that adding bright LED lights to the signal bat increases the probability that the driver's peripheral vision alerting mechanism will detect it.

BGA aerotow statistics

The BGA held statistics showing that 11.9 million aerotows had been conducted in the UK since 1974. During that time, it had only recorded five previous aerotow incidents involving an unsecured tailplane. Of those incidents, three were not detectable by observers on the ground. One, which involved a Ventus glider, was seen and stop calls were made by an observer with a radio, by which time the pilot had already detected the fault and self-released the tow cable. On the remaining incident, the glider pilot noticed an abnormality with the elevator control and disconnected the tow cable while still on the ground. The accident to G-DDGX was the only event involving a Standard Cirrus 75 in the BGA aerotow statistics.

Analysis

Introduction

The accident pilot held an insurance share in the syndicate that owned and operated the glider and he was qualified to fly it. It was the pilot's fifth flight in G-DDGX. Prior to the day of the accident, he had rigged G-DDGX four times, including once under the supervision of the owner. On one previous occasion he had asked the club technical officer to check his rigging of G-DDGX but did not do so on the day of the accident.

Tailplane rigging on the day of the accident

Other than receiving help fitting the wings, the accident pilot had rigged the glider without assistance. It was therefore not determined precisely how he attached the tailplane to the fin, or whether he encountered any difficulties in doing so.

The BGA Safety Briefing Leaflet *'Is your glider fit for flight?'* and EASA SIB 2019-07 highlight that interruption, distraction, lack of familiarity with the rigging procedure and lack of understanding of the mechanical principles of the connection can be factors in mis-rigging events. It was not determined whether the pilot had encountered any interruptions or distractions while rigging the tailplane, nor to what extent he was familiar with the mechanical principles of the tailplane attachment mechanism. Having only recently started to fly G-DDGX and rigged it four times previously, it is likely that the pilot had not yet developed extensive experience in the rigging process for this glider type.

Opportunities to detect the mis-rig

Other than the locking lever, the tailplane attachment mechanism is not visible once the tailplane has been fitted. Therefore, the only potential opportunities to detect the mis-rig condition after completion of the rigging may have been during the DI or a secondary rigging check, during a positive control check or during a full-and-free check of the controls prior to flight. The pilot signed the DI book prior to the accident flight, which suggests that he undertook the DI himself.

Another club member assisted the pilot to carry out positive control checks, but they did not reveal any rigging anomalies. Although the tailplane was not securely attached to the fin, it must have had the appearance of being so. Additionally, it must have been attached in such a way that it was capable of moving in response to control stick inputs during the positive control check and remaining attached during the tow to the launch point.

It was not established whether the pilot carried out a full-and-free check of the controls before the launch and, as the precise nature of the mis-rigging was not established by the investigation, it was not determined whether it would have been detectable by such a check.

The BGA leaflet states that rigging should be directed, and the DI conducted, by a person experienced on type. It advocates the benefits of a post-rigging inspection being done by another qualified person. Although the pilot had previously requested assistance for a post-rigging check, he did not do so prior to the accident flight. It is possible this was because he felt sufficiently familiar with the rigging process. The gliding club's post-accident review concluded that it was impractical to require all rigging activities at the airfield to be overseen by a qualified third-party, due to the voluntary nature of the club.

Launch signalling

G-DDGX's tailplane was not securely attached and separated from the glider shortly after the aerotow ground roll began. A stop signal was made as soon as the rigging failure was detected by the wing runner. The signal was relayed by the forward signaller, but the tug pilot did not see it. Given his training, ops manual direction and the known takeoff risks, it is considered likely that the glider pilot had one hand on the cable release lever during the takeoff roll. That the tow cable remained attached until after the glider was airborne, strongly suggests that the accident pilot did not hear or see either stop signal. It was not determined whether the tow rope back-released from the glider or if the accident pilot operated the cable release mechanism.

Had the stop signal been received and the cable released from the glider or the launch aborted sooner by the tug pilot, it is possible that the glider would not have got airborne. In any event, an earlier cable release or launch abort could have resulted in reduced height gain and a potentially survivable accident.

It was not club policy to use radios for launch safety signalling. There was no requirement for G-DDGX to be equipped with a radio or for one to be used to coordinate the aerotow or for launch safety calls.

BGA Operational Regulation 34 required an '*adequate signalling system*' for launch control and safety. A stop signal was made but did not reach its intended recipients therefore the signalling system was not effective in this case. The BGA regulations do not specify a minimum standard for an '*adequate*' system.

After the tug began its takeoff roll the forward signaller ceased to have an effective function. They were out of the tug pilot's primary visual field and the noise from the tug's engine drowned out their stop call. Relocating the forward signaller and equipping them with a signalling bat would increase their visibility, but the attention of both pilots would remain primarily forward focused during any launch.

Visual signals can only ever be effective if they are seen by the intended recipient. Experience from the rail industry suggests that a stop signal that involved movement as well as bright lighting would increase the likelihood of it attracting the attention of pilots during a takeoff roll.

The BGA's guidance notes highlight the limitations of hand signals and '*strongly*' recommend that radios are used during aerotows. While pilot-to-pilot communications would not have prevented this accident, intervention by a radio-equipped launch observer, as occurred in the Ventus glider incident, may have influenced the outcome.

Therefore, to provide greater assurance for glider launching safety, the following Safety Recommendation is made:

Safety Recommendation 2020-012

It is recommended that the British Gliding Association specifies in its Operational Regulations the minimum requirements for an 'adequate system of communication' for glider launching.

Accident outcome

After the tailplane had detached, the pilot was unable to control the pitch attitude of the glider, and once airborne, he had no means of effecting a safe landing.

Despite a timely response by the emergency services and air ambulance transfer to hospital, the pilot succumbed to complications arising from the injuries he sustained in the accident.

Nature of the mis-rigging

Those assisting with the launch reported that the tailplane started to wobble as soon as the glider started to move on the takeoff roll, and the leading edge began to lift and detach as the propwash from the tug reached the glider. At this point the tailplane would have been experiencing minimal air loads, therefore it is evident that it was only tenuously attached.

As the tailplane was found with the locking lever forward of the safety pin, the investigation determined that either the tailplane was fitted with the locking lever already positioned forward of the safety pin; or that after fitment of the tailplane, the lever was moved forward rather than aft to insert the safety pin. The owner described that he normally stored the tailplane in G-DDGX's the trailer, with the locking lever in the neutral position and the safety pin installed in its bracket. As he was the last person to fly G-DDGX prior to the accident flight, it is quite possible that the tailplane was stored in this way. As such the safety pin would have needed to be removed before installing the tailplane on the fin.

Missing paint and the presence of surface corrosion on the rear face of the locking lever may have been incidental or may have been indicative of more frequent contact between the lever and the safety pin.

Regardless of how the locking lever came to be forward of the safety pin, in this condition the lever would rest against the safety pin under spring force, such that the locking hooks would be engaged on the axle of the rear mechanism but not fully locked. Nonetheless, in this condition, it was demonstrated that the locking hooks appeared to provide a reasonable degree of attachment and the tailplane could not be dislodged. Although an undesirable condition, with a correctly engaged front fitting, this condition alone may not have accounted for the separation of the tailplane.

It was demonstrated that the locking lever could remain in a forward position, either in isolation or because the safety pin was folded forward. In this condition the locking hooks were not engaged on the axle, and thus the rear mechanism was entirely unlocked.

Rigging trials also demonstrated that it was possible to achieve partial engagement of the rear mechanism (locking lever forward of safety pin), while the tapered bolt was entirely disengaged from the front fitting. Although visually identifiable due to a large gap between the tailplane and moveable fairing, in this condition it is possible the tailplane could pivot upwards, applying spring force to open the locking lever and hooks.

Several mis-rigging scenarios demonstrated on the comparison glider could not be replicated on G-DDGX. This may have been due to differences in the amount of play in the respective mechanisms, or because G-DDGX's tailplane control run was unrestrained, having been cut to facilitate recovery and for detailed inspection of the wreckage.

In summary, the investigation identified and demonstrated several potential mis-rigging conditions, but it was not determined which of these conditions, or combination of conditions, occurred during the rigging of G-DDGX.

Tailplane attachment mechanism

The design of the tailplane attachment mechanism on the Standard Cirrus has undergone several modifications since the type was first introduced. The most recent of these was the safety locking device (safety pin) introduced by TN 278-36 in 1994. This accident has shown that effectiveness of the safety pin is entirely reliant on its correct installation. Additional training or revisions to maintenance documentation have typically been shown to be ineffective in preventing incomplete or improper installation of components. Instances of glider mis-rigging broadly fall within this category of occurrences. In general, such occurrences can only be reliably prevented by design solutions, or an error-tolerant design from the outset.

Following this accident, for gliders with similar tailplane locking features to that of the Standard Cirrus 75, the gliding club introduced tell-tale markings to show the approximate required position of the locking lever and make it easier to detect incorrect alignment. The EASA recommended that such markings indicating the correct position for locking levers should be green in colour. Similar tailplane attachment mechanisms are known to be used on other types of glider and therefore, the following Safety Recommendation is made:

Safety Recommendation 2020-013

It is recommended that the European Union Aviation Safety Agency require a means to detect incorrect alignment of the tailplane locking lever on gliders with locking features similar to the Standard Cirrus 75.

Flight manual

G-DDGX's copy of the flight manual contained rigging instructions which were not relevant to the actual configuration of the tailplane attachment mechanism and illustrations of both the original and modified mechanism. As TN 278-15 was embodied on G-DDGX at the time of manufacture, the original flight manual provided would have included relevant rigging instructions for the modified tailplane mechanism. It is not uncommon for flight manuals to be lost or require replacement over time and it is possible that at some point G-DDGX's flight manual had been replaced with a version that did not accurately reflect its tailplane configuration. The checklist from the recent ARC renewal indicated that the flight manual had been reviewed in depth but neither the discrepancy with the rigging instructions, nor the incorrect serial number were identified.

When TN 278-36 was introduced to add the safety pin, the manufacturer deemed that it did not require any updates to be made to the flight manual. As such, even a correctly updated Standard Cirrus flight manual would not contain any reference, either in the rigging instructions or accompanying illustration, to how the safety pin should be inserted.

G-DDGX's owner demonstrated the practical aspects of the tailplane rigging to the accident pilot. It is not known what, if any, version of the flight manual the pilot had access to, but none of them would have provided guidance on the correct installation of the safety pin.

Conclusion

The glider tailplane was mis-rigged in such a way that it passed positive control checks but was not secure for flight. It detached early in the ground roll and the aircraft became airborne with no pitch control available to pilot. Stop signals were relayed by the forward signaller but they were not effective in alerting either pilot to the failure.

Effective signalling, radio or visual, might have prevented the glider taking off or reduced the severity of the outcome.

Safety Actions/Recommendations

Safety Actions

As a result of this accident the club undertook the following safety actions.

- The forward signaller position was formalised in the club's Operations Manual and their use of a white winch-signalling bat was made mandatory.
- Where appropriate, lever alignment marks were to be added to gliders at the club as additional confirmation that rigging had been completed correctly.

Safety Recommendations

The following Safety Recommendations are made:

Safety Recommendation 2020-012

It is recommended that the British Gliding Association specifies in its Operational Regulations the minimum requirements for an 'adequate system of communication' for glider launching.

Safety Recommendation 2020-013

It is recommended that the European Union Aviation Safety Agency require a means to detect incorrect alignment of the tailplane locking lever on gliders with locking features similar to the Standard Cirrus 75.

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