

INCIDENT REPORT

VH- [REDACTED] PROPELLOR FAILURE

Issue 2

OVERVIEW

The sailplane fuselage was secured in an outside engine run up area for engine testing. The fuselage was not fitted with a canopy or cockpit seat pan. The senior engineer was kneeling outside of the cockpit to the left hand side of the sailplane where they could operate the engine throttle and observe engine instruments. A safety observer was standing away some distance from the fuselage. The engine revs were progressively increased from idle to 4500 rpm by the senior engineer when the propellor departed from the propellor pylon.

The propellor struck the upper fuselage between the pylon and the rear edge of the cockpit. The propellor then travelled forward and to the left and struck the senior engineer on the left hand rear of their head. The propellor continued for a further 30 meters, passing close to the safety observer before impacting two sailplane trailers.



Photo 1 – Recreation of Senior Engineer Position With VH- [REDACTED] Post Incident. Sailplane Has Been Moved into a Workshop. Propellor Strike on Upper Fuselage. Propellor Pylon Visible at Bottom Right

The senior engineer operator remained conscious and shut down the engine. The safety observer called for medical assistance. The senior engineer was transported by ambulance to hospital and treated for a gash to the scalp. The senior engineer required 15 staples and was released from emergency before 10pm the same day.

LIMITATION OF FINDINGS

It is not the purpose of the aircraft incident investigation to apportion blame or liability. The sole objective of the investigation and the report is the prevention of accidents and incidents.

INCIDENT DETAILS

Time: 1530 Hrs 14 Feb 2022

Location:

Aircraft Manufacturer:

Aircraft Type:

Propellor Manufacturer:

Defect Report No:

Aircraft Owner:

Aircraft Owner's Assistant:

Senior Engineer:

Junior Engineer:

Safety Observer:

Investigator:

Assistant Investigator:

Assistant Investigator:

INVESTIGATION

Visual inspection of the sailplane fuselage showed the propellor and pulley assembly had separated from the spigot post (referred to as the hub in the sailplane maintenance manual). The propellor and pulley assembly contains bearings which are press fitted onto the spigot post and secured in place with a M10 bolt and large washers. The M10 bolt was missing.

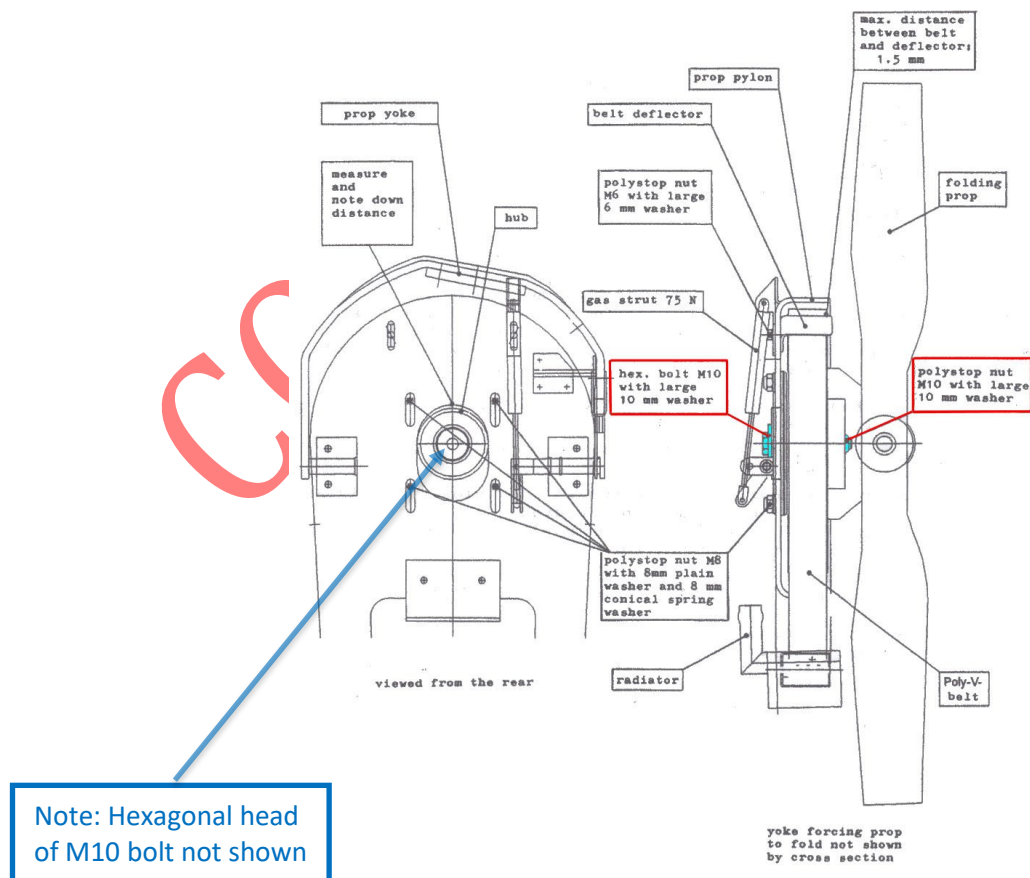


Photo 2 –Propellor and Pylon Assembly Diagram from Maintenance Manual. Missing Bolt is Highlighted.



Photo 3 – Recreation of Prop and Pulley Assembly Fitted to Spigot Post (Hub). Missing Bolt is Fitted from Left to Right in Centre Hole.

Sequence of Events

After discussion with maintenance staff and the sailplane owner the following sequence of events occurred:

Prior to May 2021 it was noticed that the propellor had received damage from the propellor yoke (used to fold propellor during retraction). Sailplane being operated as unpowered sailplane with engine bay taped closed and minor defect entered in maintenance release.

May 2021: Propellor and pulley assembly and hub is removed from sailplane by owner assisted by another sailplane owner. Propellor and pulley assembly, and hub is shipped as one unit by sailplane owner to the propellor manufacturer for overhaul and repair.

July 2021: Sailplane owner identified pylon system was missing parts and prop yoke gas strut was defective.

Sept 2021: Sailplane delivered to maintenance venue for annual inspection and installation of propellor and pulley assembly and hub. Sailplane owner requested the sailplane being ready by 24 September.

During inspection of sailplane, further pylon system parts found to be defective. Missing and defective parts ordered from the sailplane manufacturer. Propellor and pulley assembly and hub fitted by senior engineer at maintenance venue. Independent inspection not carried out as

engine was not able to be used and propellor and pulley assembly would need to be removed to fit new parts.

23 Sep 2021: Sailplane released for service as unpowered sailplane with engine bay taped closed and minor defect entered in maintenance release.

Feb 2022: Sailplane returned to maintenance venue to have replacement pylon parts installed. Sailplane owner requested the sailplane being ready by 12 Feb.

Propellor and pulley assembly removed, new parts fitted and propellor and pulley assembly refitted by junior engineer. Independent inspections carried out.

11 Feb 2022: First attempt at engine run. Engine failed to start.

14 Feb 2022: Minor engine maintenance carried out. Second attempt at engine run. Incident occurred.

Event Analysis

Propellor Removal: The sailplane owner had previously e-mailed the maintenance venue requesting the propellor be removed but had not received a reply. The propellor and pulley assembly and hub were removed by the sailplane owner with an assistant, with reference to the sailplane maintenance manual. Neither the owner or assistant has appropriate airworthiness authorisations. This is in breach of Gliding Federation of Australia MOSP 3 Section 10.

The sailplane maintenance manual states to remove M10 mounting bolt and attempt to remove propellor and pulley assembly from hub. If the propellor and pulley assembly is unable to be removed from hub, measurement of the hub position relative to the pylon is carried out, then the four M8 nuts are removed from the rear of the pylon and the hub removed from pylon. The maintenance manual then states to separate the hub from the pulley by lightly tapping it with a plastic tip hammer.

Whilst it initially appears that the maintenance manual instructions were followed, measurements of the hub position relative to the pylon were not provided to the maintenance venue and it is **assumed** that they were not measured. Furthermore, the hub was not separated from the pulley and propellor as per the maintenance manual and the entire assembly was shipped to the propellor manufacturer minus the M10 mounting bolt. The wording of the maintenance manual refers to the spindle or axle that the pulley rotates on as the 'hub'. However, the common use of hub refers to the assembly which attaches the blades. This is probably due to translation of the manual from German to English. The propellor manufacturer requested the propellor pulley and hub to not be separated when sent for overhaul. This refers to the pulley and blade attachment assembly not being separated. The use of the word 'hub' to describe the spindle in the maintenance manual lead to confusion with the sailplane owner over what as to be separated before overhaul.

The M10 mounting bolt was placed in a zip lock bag and then in a large plastic lunch box with an assortment of other components in similar zip lock bags. The sailplane owner claims that the components were labelled (as per e-mail dated 27 Aug 2021).

The maintenance venue received the plastic lunch box of assorted components but claim the components were unlabelled when they were delivered with the sailplane paperwork making it not immediately obvious where the M10 bolt in the zip lock bag belonged.

For a critical component, it would be considered best practice to replace the M10 mounting bolt into the hub assembly. The alternative would be to place the M10 mounting bolt in a separate zip lock bag and secure the bag to the hub assembly.



Photo 4 – M10 Mounting Bolt (centre left) and Assorted Fasteners After The Incident at The Maintenance Venue in Zip Lock Bags (bottom left).

Propellor and Pulley Assembly Overhaul: The propellor and pulley assembly and hub (but without the M10 mounting bolt) was repaired and overhauled by the propellor manufacturer as one unit. It was returned as one unit without the M10 mounting bolt fitted, with an EASA Form 1 Certificate [Attachment 1](#). This created the assumption at the maintenance venue that the entire assembly as returned was complete, serviceable and able to be installed as one item without additional parts.

Propellor and Pulley Assembly Installation: The workshop procedures at the maintenance venue are for the junior engineer(s) to prepare sailplanes for inspection by removing all miscellaneous components eg seat cushions, canopy, seat pans, etc. The senior engineer would meanwhile establish work sheets detailing all work to be done by referring to the sailplane maintenance manual, including Minor Defects to be rectified and prior requests by the owner. The maintenance venue has detailed worksheets including detail of who is assigned the work, who checked the work and a final sign off for every task required on an aircraft. There is a check system in place where any work that is unfinished or requires further inspection is tagged with orange tape.

During the annual inspection in September 2021, it was found the pylon pivot bearings were also defective. These were ordered from the sailplane manufacturer.

The propellor and pulley assembly and hub were fitted as one item by the senior engineer. The senior engineer was not completely familiar with this particular system but had worked

on the sailplane previously and had experience on other similar propellor and pylon systems. By observation, it appeared that the propellor and pulley assembly and hub was simply installed using the four M8 studs on the back of the hub mounting plate. The missing M10 mounting bolt was not immediately apparent.

An independent inspection was not carried out as the engine was not able to be used and the propellor and pulley assembly and hub were going to be removed again when the new parts arrived from the sailplane manufacturer.

The sailplane owner had requested the sailplane being ready by 24 September and the sailplane was released as an unpowered sailplane on 23 September with the engine bay doors taped closed and a minor defect entered into the maintenance release.

The sailplane was returned to the maintenance venue in early February 2022 when the parts arrived from Germany after 4 months. The propeller and pylon assemblies were dismantled, the new parts fitted and the propeller and pylon reassembled by the junior engineer. The junior engineer was not completely familiar with this particular system but had worked on the sailplane previously and had experience on other similar propellor and pylon systems.

The senior and junior engineers stated they referred to the schematic of the propeller and pylon assemblies. Other pylon systems have the pylon arresting wire attached to a bolt in the center of the spigot attaching the propeller to the pylon. This model sailplane has two arresting wires, one to each side of the pylon. It would be expected that the hub center would be hollow and not necessarily have a center mounting bolt. The independent safety check on the refitting of the propeller failed to identify the M10 securing bolt was missing. The maintenance manual does not list critical checks to be carried out after each installation procedure. It was noted the forward view on the left hand side of the installation drawing (Photo 2) in the maintenance manual does not show a hexagonal bolt head. The bolt is only shown on the side view on the right hand side.

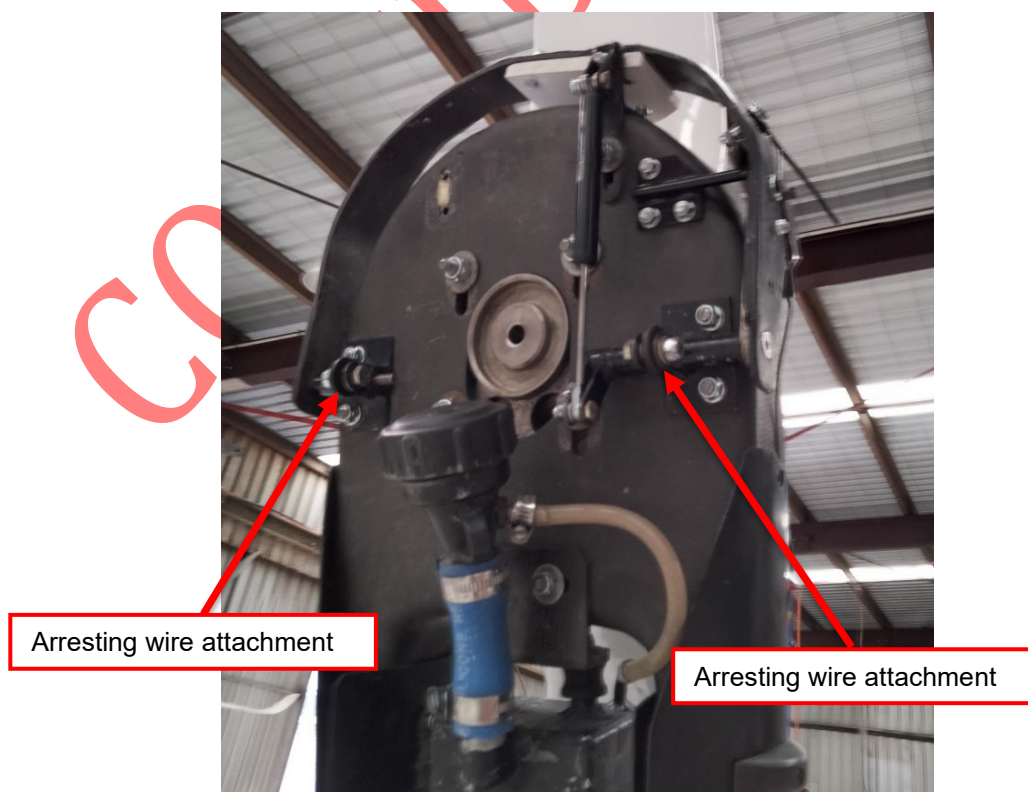


Photo 5 – Rear of [REDACTED] Pylon Prior to Engine Run Showing Open Centre Bolt Hole with M10 Bolt Missing. The Position of the Two Arresting Wires are Indicated.



Photo 6 – Rear of [REDACTED] Pylon Showing Centre Bolt Hole in Hub Where Pylon Arresting Wire Attaches.

A check for left over components was not carried out at the completion of the work. The bag of assorted components was with the sailplane paperwork. The bag was located by the maintenance venue after the event. The M10 mounting bolt is quite substantial compared to other bolts used throughout the sailplane (typically M6 and M8 in size). The substantial size implies that it performs a function that requires high strength and would be safety critical.

Engine Running: The sailplane owner had requested the sailplane being ready by 12 February. Engine runs were planned for Friday 11 February. The engine was unable to be started. The sailplane remained in the maintenance venue over the weekend. On 14 February minor engine maintenance to remove coolant from the front cylinder and the engine run planned for the afternoon.

The seat pan had not been refitted to the sailplane. The senior engineer was kneeling outside of the cockpit to the left hand side of the sailplane where they could operate the engine throttle and observe engine instruments. A safety observer was standing to the front left of the cockpit some distance away. The propellor passed 5m from the safety observer after it struck the senior engineer.

Civil Aviation Safety Regulation (CASR) 103.050 allows for the engine to be operated by an approved person and the aircraft is secured from moving. In this instance, the wings were not fitted to the sailplane and the fuselage was tethered.

Human Factors

Communication. There was some communication between the people who removed the propellor and pulley assembly and the people fitting the propellor and pulley assembly as to how the propellor and pulley assembly was removed. There was at least one e-mail on 27 Aug 21 from the owner to the senior engineer mentioning the location of the M10 mounting bolt. Communication between the owner and the maintenance venue has been contested.

Parts Control. The M10 mounting bolt was allegedly not identified and was presented to the maintenance venue by the sailplane owner, mixed in with an assortment of other parts not directly connected to the propellor. The zip lock bags of assorted parts were provided

with the sailplane paperwork to the maintenance venue. The maintenance venue used new nuts and washers in the installation of the hub and did not relate the zip lock bag contents with the propellor installation.

Delay in Completing Work. There was a 4 month gap between the original fitment of the propellor and pulley installation and the final completion of the work. This clouded the recollection of communications and what maintenance processes had or had not been completed. This is similar to experiencing an interruption or distraction whilst carrying out a process.

Checking Procedure. It is common practice at the completion of aircraft maintenance work to check that there were not any parts left over that should be fitted. This was not carried out. Adding to this, the maintenance manual does not list critical checks to be carried out after each installation procedure. This absence is typical of sailplane maintenance manuals.

Time Pressure. The sailplane owner set deadlines for work and requested that they were met. This created pressure in the maintenance venue to meet these deadlines. It was perhaps a self applied time pressure that resulted in the sailplane owner removing the propellor in order to "get it done".

Complacency. Modern sailplanes have increasingly complex systems. Many of these systems are not standardized. Familiarity with other similar systems lead to complacency with the removal and installation of the propellor and pulley assembly. The maintenance manual was available for the annual inspection in September 2021. The propellor assembly was temporarily fitted at this time. The maintenance manual appears to have not been used comprehensively for this installation. The maintenance venue claims the maintenance manual was not made available for the work performed in February 2022. It is the Registered Operators responsibility to ensure the maintenance manual is up to date and is provided to the maintenance venue when work is performed on the sailplane.

Confirmation Bias. Confirmation bias can result in a maintainer seeing what they expect or want to see, rather than the reality, which may include an error or omission. Cognitive filtering may cause people to see the desired result, or a general picture rather than the detail. In this incident there are several instances where the absence of the M10 bolt was not perceived. An assembly received from overhaul was believed to be complete and ready for installation and use. Once installed, the pylon and propellor were incorrectly confirmed as complete.

Assumptions. The propellor and pulley assembly along with the hub was returned from the propellor manufacturer with an EASA Form 1 Certificate as one item. This resulted in the not unreasonable assumption that the assembly as it was presented was serviceable and able to be fitted to the sailplane. Technically, the assembly as presented was not serviceable with the M10 mounting bolt missing.

Normalised Behaviour. The operation of the engine from outside of the sailplane did not directly contribute to the propellor departing the sailplane. However, it exposed the operator to greater risk. It is likely that this practice is commonplace and is an example of normalized behavior.

CONCLUSION

A series of errors lead to what could have been a potential fatality.

The M10 mounting bolt was omitted. Whilst there were many interrelated contributing factors, there were several opportunities where the missing bolt could and should have been detected and refitted.

There are aspects of this report that are contested by both the sailplane owner and the maintenance venue.

RECOMMENDATIONS

The investigation recommends the following (not in order of importance):

1. The maintenance venue, with the assistance of the RTOA, to undertake a thorough assessment of their workshop procedures including:
 - i. Use of authorized data and maintenance manuals when carrying out activities,
 - ii. Independent checks after critical work is completed,
 - iii. Work task hand over / take over procedures,
 - iv. Final check for omitted parts after maintenance,
 - v. Managing customer time pressure, and
 - vi. Engine running procedure.
2. GFA Airworthiness Department to periodically audit the maintenance venue at the conclusion of Recommendation 1 above.
3. GFA Operations and Airworthiness Department review guidance risk mitigation for engine running and guidance on bystanders being outside of region where a thrown propellor blade or departing propellor assembly could end up.
4. GFA Airworthiness Department to mount a campaign to improve awareness of the increased hazards arising from unauthorised people performing maintenance or repair of sailplanes. The limits of allowed pilot maintenance should be reinforced by education. Owner participation in maintenance must only be undertaken under qualified supervision.
5. GFA Airworthiness Department to inform propellor manufacturer of failure and discuss the provision of a release certificate for an assembly which was technically incomplete and therefore unserviceable.
6. GFA Airworthiness Department to inform sailplane manufacturer and recommend changing use of the word hub and inclusion of a list of critical checks to be performed at the end of each installation procedure in the maintenance manual.
7. GFA Airworthiness Department to recommend the sailplane manufacturer correct the omission of the bolt head in the rear view of the drawing.



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