European Union Aviation Safety Agency

COMMENT RESPONSE DOCUMENT

EASA PAD No. 21-100

[Published on 13 July 2021 and officially closed for comments on 10 August 2021]

Commenter 1: Company name – N/A – Stefan Krahn – 15/07/2021 and 16/07/2021

Comment # 1

Deviating from the procedure of the PAD and the TM of the manufacturer, I suggest the following repair measure:

Why?:

The measures of the above-mentioned documents involve the risk of an annually repeated "destructive test", since the covering has to be torn off the plywood each time, with the result that the cover fibers of the planking are torn out.

Proposed solution:

It would be better if, as a one-off measure, the first planking field between ribs 1 and 2 is renewed by removing it and sanding off the old Kaurit glue from the ribs and then renewing the planking, preferably one size thicker. In this way, a permanent solution would have been found that could also make repetitive tests superfluous.

Comment # 2

I would like two more items to my proposed repair method:

1. The replaced planking shall be mandatory be made with Aerodux.

2. Rip 1, which holds the metal fittings shall be also replaced by a rip with an increased thickness to increase the bonding area betwin rip and planking. The bolts fixing the fittings to the rip have to be renewed then as well, which also makes sense after that long time of operation.

EASA response: disagreed

#1: The proposed inspection of the elevator rib is a non-destructive test. The risk of damaging the plywood depends on the method used ; however is not considered as destructive test.

#2: Alternative methods are not handled by the PAD process. In order to establish alternative means to address the unsafe condition in question the process is as follows:

1. ***Development of a modification***

2. *Application to EASA for getting the modification approved as Supplemental Type Certificate (STC)*
3. *Application for Alternative Methods of Compliance (AMOC) with the respective AD by means of that STC approval*
4. *Step 2 and 3 can be combined, if the wish to use the STC as an AMOC to a given AD is indicated upon application*

No changes have been made to the Final AD in response to this comment.

Commenter 2: Luftsport-Verband Bayern e.V. – Harald Goerres – 01/08/2021

Comment # 3

We appreciate to get the opportunity for commenting this AD. Thanks a lot.

I'm the quality manager of the CAO DE.CAO.0034 of the Luftsport-Verband Bavaria. We are doing the Airworthiness Review of about 1200 gliders and 300 powered gliders per year among which are also about 200 K-types. All our ARS (about 60) are Certifying Staff too. I have asked my colleagues about their experience with the former LBA LTA 72-7/3 and have got two feed back with positive findings in the last 30 years. So, in principle we appreciate the approach of EASA to make this national LTA an EASA-AD and we promote the increase of inspections for annual/500 cycles.

Nevertheless, we would propose some improvements to make these inspections easier to handle.

1. To do the inspection the fabric cover of the gluing of rib 1 has to be removed. If it's properly fixed to the plywood, removing this fabric has a high potential to damage the plywood. This again would create a need for repair which is a great effort in this small area and creates another gluing with potential weakness.

2. Removal and recovering the area with the fabric is a lot of work (the two elevator actuating lever have to be removed and reassembled as well, to apply the cover). Nobody of my colleagues has seen this fabric cover as necessary; especially if the area is now under inspection every year/500 cycles. It should be sufficient to check that the area is properly painted, and the paint is without any cracks. From the inside of the D-box the glue can be easily inspected with mirror or endoscope.

So, the inspection without fabric cover can be done in about 2 hours; with the fabric cover is more than a day required; if a repair is required (see point 1) it's even more!

3. Please change the compliance time "A" in Table 1 from 30 days after effectivity date to 60 days after effectivity date. This brings the inspection safely into the wintertime (out of the flying season) and also the following repetitive inspections.

These improvements are only valid if the area is glued with Aerodux. If Kaurit has been used, the rib 1 should be repaired with Aerodux or a suitable epoxy resin in case there is any doubt that the gluing will be good.

EASA response: disagreed

The fabric cover is part of the type design. In cannot be ensured that strength and weather resistance of the affected region remains unchanged with removed fabric cover.

Compliance time of 30 days is appropriate for the inspection of such an important part of the aircraft. The inspection can be also done during flying season within one day.

No changes have been made to the Final AD in response to this comment.

Commenter 3: Company name – N/A – Eric Munk – 01/08/2021

Comment # 4

The technical defects highlighted in PAD 21-100 are without exception due to the deteriotation of the Kaurit glue used by the manufacturer. A small percentage of the types covered in the PAD was delivered new with a different glue on the request of customers, for instance Aerodux or Aerolite. These do not display the technical issues mentioned. It would be beneficial to leave the inspection interval at three years for these more robust glues, or even remove the need for periodic inspections of the elevator drive altogether.

EASA response: disagreed

Since 1972 several defects on elevator ribs were found during inspection according the LBA LTA 72-7/3. It cannot be excluded that defects were found on elevators build with Aerodux or Aerolite, too. To be on the safe side the inspection is mandatory for all aircrafts independent from the kind of glue used.

No changes have been made to the Final AD in response to this comment.

Commenter 4: Company name – N/A – Gerhard Scholten – 04/08/2021

Comment # 5

I would like to comment on the PAD 21-100 and propose an alternative method of inspection and correction compared to the Technical Notes of Alexander Schleicher Segelflugzeugbau.

On page 12 of the Hungarian incidence report 2018-734-4 (www.kbsz.hu/j25/dokumentumok/2018-734-4.pdf) mentioned in Schleicher's Technical Notes, I found a picture of the damaged rip 1: The former bonded surfaces do not show any residue of glue or wooden counterpart, moreover this piece of solid wood shows explicit impact of moisture. There is no residue of the fabric strip too. Based on these observations, I presume that the tasks corresponding to Technical Note 18 have not been performed. On the basis of such a single case it is not justifiable to release an AD.

The failure of the rip 1 and of the bonded joint between rip 1 and the plywood shell of the D-box, is caused by impact of wet conditions. The preventive action of covering the bonded joint with a fabric strip is not suitable to prevent the impact of moisture effectively. In some cases the inspection interval of three years could therefore be too long to assure a safe status of the rip. The coverage of the vulnerability with fabric impeded its detection at an early stage.

Based on this observation, I propose to remove all covers (fabric, varnish etc.) from the surface of rip 1 after the removal of the lever and to impregnate the outer surface, the bore and the holes of rip 1 and the pine flange with epoxy resin. Especially the end grain surfaces in the bore should be impregnated thoroughly. After curing the lever has to be remounted. The outer surface should not be varnished again. That way the condition of the rip and of the bonded joint can be inspected any time non-destructively and the solid wooden structure is well protected.

In case of detected defects, rip 1 should be renewed and completely impregnated with epoxy resin. It should be glued with epoxy resin such as Rütapox L 20, too.

EASA response: disagreed

According to the investigation results of the Hungarian national authority the Technical Note 18 was performed on the aircraft having the accident.

Regarding the function of the fabric strip, see comment #3.

No changes have been made to the Final AD in response to this comment.

Commenter 5: British Gliding Association – Gordon MacDonald – 10/08/2021

Comment #6

Please see the attached British Gliding Association response to the Proposed elevator PAD No.: 21-100 Issued: 13 July 2021 and 4 additional attachments. This is an area where the BGA have been a subject matter expert on these exact issues for 17 years now. We have lots of images and data of problems found during that time. We are very confidant the BGA glue inspections, captures all the issues of concern and address them.

It is a lot of information and requires some study, if it is to be fully understood.

It makes sense to expand the PAD beyond just the elevator, otherwise we will be revisiting other parts of wooden Schleicher airframe in the future with similar issues. That will also deal with the limitations issues.

In the attachments we have also included the generic glue inspection for all wooden sailplanes which is aimed more at the EASA Sib system. This glue inspection includes the non EASA wooden sailplanes as well as all the Polish, English and a few Italian and French types.

BGA experience with Sailplane wooden Glue joints

The BGA have been overseeing sailplane airworthiness in the UK since the 1930s to now. We have a robust reporting system. This way airworthiness problems and unusual defects are reported resulting to the BGA identifying trends. Currently we have 2400 sailplanes in the BGA CAO.

Problems with some glue joints in Schleicher sailplanes were known about by the 1970 and often found in Vintage types. This often started as waving trailing edges and the trailing edge rib gussets coming unbonded. This would be all fixed/replaced during a wing recover.

Problems like this were referred to BGA technical committee The technical committee consists of experienced aircraft designers and very experienced sailplane engineers.

Through this system in 2004, the BGA identified the need for a formal glue inspection and engineer training to ensure expertise in inspection of wooden sailplanes. A formal fleet check (over 400 wooden Schleicher sailplanes at that time) found enough problems to indicate that doing nothing was not an option.

We now have 17 years of experience carrying out formal glue joint inspections and over 1500 formal glue joint inspections have been performed to the BGA wooden fleet of sailplanes.

What causes the elevator to degrade with age and high humidity storage?

The consensus of the engineers doing these inspections, is that the plywood of the inside of the elevator D box was not correctly prepared prior to bonding, rather than actual glue failure. With so little glue saturation into the wood, due to either the protective dope applied to plywood not making it porous enough, or the mould release agent from plywood manufacturer having not been sufficiently removed with sandpaper. This gave a weak surface tension of glue that over time lets go.

Is this just an elevator rib problem?

No, from the experience gained using the BGA glue inspection since 2004, the issues highlighted by the proposed AD and TN20 are and do not go far enough to find and then fix the problem. This specific inspection should equally apply to the rudder and all fabric covered ailerons. Non EASA sailplanes like the K2. K3 and K4 are also affected. There are very few Schleicher fabric covered control surfaces that have not had to have some rectification work after inspection. Majority of them ended being recovered by the time all the defects had been fixed.

Why did the BGA develop a Glue inspection program on top of normal inspections in 2004?

After a fatal accident in 2004, GLIDER ACCIDENT REPORT BGA NO: 36/04 (gliding.co.uk) it was suspected glue failure played a part. The BGA as a result instigated a formal glue inspection regime, that required extensive inspections of glue joints. This went a lot further than the normal annual inspections required at annual maintenance or even a recover.

Sadly in 2013, another K7 lost a wing in the USA where glue failure was a factor. In the original NTSB report (not available online anymore) it clearly stated that if the BGA inspection had been carried out, this K7 would have never had this accident. See links below:

Schleicher Alexander crash in Texas (N12053) | PlaneCrashMap.com

NTSB Docket - Docket Management System

The BGA glue inspection has been revised many times since (now on issue 6). Each time adding more lessons learned. An important factor is to make the repeat inspections as non-destructive and as few man hours as possible. Modern cheap inspection cameras have made this job massively easier in recent years.

If you have not read it, take your time at least 30 or more minutes to fully understand it and watch the videos in the links in the documents. Link here 042-07-2004-issue-6-16th-March-2017-r3.pdf (gliding.co.uk).

Interestingly, extensively repaired gliders had far less glue problems, as they had less Kaurit in them.

The only critical part we cannot non-destructively inspect at all is the spar Cap. To address this Is, in issue 6 we required that scrapped gliders would have samples of main spars removed and destructively tested by trying to separated the spar cap laminations with a chisel and mallet. This has shown no evidence of degradation at all in airworthy glider (spars had better wood preparation perhaps).

This is reassuring since the sailplanes that had their spars tested, had extensive glue failure already, that rendered them uneconomic to repair.

All gliders were surveyed for what glues are used in various parts of the glider. Critical joints (like the elevator root rib) would ideally be replaced with Aerodux glue and all Kaurit glue joints subject to more intense/frequent inspection while under load.

Results of the inspections

Since 2004, approximately 30% of the wooden fleet have been found to have defects (mostly glue problems) putting them beyond economic repair. All K2 and K4 have been scrapped (although one of them is now having an extensive restoration). In 2008 we had 17 serviceable K7 and now we only have 4. All these 4 sailplanes required extensive glue joint replacement and overhaul to keep them airworthy.

The inspection program is now 17 years old and very mature. Owners' expectations are now managed to know that finding incipient glue problems during the inspection is not unusual. At which point the glider is either repaired or scrapped.

Most of the Schleicher wooden sailplanes have had to have some remedial work to keep them airworthy. Repaired Aerodux joints are at least as good as or better than the original joints.

All bolted on fins when removed were found (we mandated that in 2015) to have problems, glue joints of the base rib poor, some rotten wood where the lower fin spar it sits in the U shape metal bracket, corroded retaining bolts, corrosion in the fuselage metal tubes around the fin and in the lower keel member, This is now a 3 yearly, fin off inspection. The first ever fin off inspections found defects on most fins and/or their metal work.

Like the fabric covered control surface inspection, with the use of wooden plywood fabric supports around the

unsupported Fabric next to the fin, has enabled the use of high quality exterior Fablon to be used instead of Fabric. This means no fabric or paintwork work is required for the 3 yearly inspections.

Understanding Glue joints. All the gliders that have undergone inspection, have glue joints that are far better understood, and their integrity is assured (every year for the elevator rib) and 3 years for the rest of the airframe. After heavy landings or accidents, some critical joints are inspected again regardless of whether they are due. For instance, for a K6E, in the fuselage above the tailskid, seats supports and above the mainwheel wheel.

Except for some Dutch gliders that found the same problems the UK ones had, after the BGA inspection had been performed, we are not aware of any of the European sailplanes having undergone such a rigorous inspection and repair process. Perhaps because EASA and Schleicher have not developed an EASA/Schleicher approved program yet. The BGA have been engaged with EASA on this program for a few years now.

Should limitations be restricted?

Although the BGA glue inspection was never an EASA or Schleicher required inspection (the opinion from them at the time being that this was a unique UK problem caused by the UKs climate). The BGA mandated this inspection on all wooden sailplanes in its system (that became a CAMO when we joined EASA). There are currently 2400 sailplanes in our CAO currently. In effect all wooden sailplanes in the UK sailplanes in the BGA glue inspection system since 2004.

The BGA sees zero reason to change the flight limitations to sailplanes in this inspect and repair glue inspection system.

The BGA propose EASA/Schleicher adopts the BGA glue inspection for elevator as follows:

1. The pull test as specified annually. Plus apply a significant torsional load to the elevator drive arm. This is best performed with both elevators still attached to the tailplane, by applying opposing loads of the trailing edge of the elevators.

While this load is being applied, the engineer should be looking and listening for glue cracking sounds and excessive movement. This noise could be either or both the spar shear web failing or the elevator D box ribs delaminating due to weak glue joints.

2. If the glue joint is Kaurit. Extract the rib and remake it with Aerodux. This removes all ambiguity of this critical glue joint.

3. Put a camera up the centre of the elevator D box looking at the all the ribs for the plywood delaminating. If defects found the entire elevator D box must be removed for a full inspection.

4. Using an appropriately shaped long stick. Insert it up the elevator D box and apply a load on each rib, to check the D box ribs are attached.

5. The Elevator D Plywood box and Spar shear web that the root rib bonds to, has often been found to be poorly bonded to the spar and the spar web. It's pointless having the rib bonded to a spar that might have defective glue joints. This requires a 75mm hole in the lower surface fabric. Then apply pressure to the spar shear web to see if it still properly bonded. Then see if a knife blade or thin 'feeler' gauge can be inserted between the plywood and elevator spar cap. Often we have found that only the aerodux D box to rib gussets (glues with Aerodux) and the fabric itself, are all that is holding the elevator together. (See video links below).

For the lower surface fabric hole, do not repair it with fabric. Insert an inspection ring to reinforce the fabric hole and cover with either Fablon (at least 50 mm overlap) or an inspection cover. This is essential, so future repeat inspections are low workload and non-destructive. See links below:

INSPECTION RINGS | Aircraft Spruce

D & E AIRCRAFT NON-SLIP INSPECTION COVERS | Aircraft Spruce

See YouTube videos below on common problems found

https://www.youtube.com/watch?v=JPCj_yY58WU&feature=youtu.be

Another short video showing elevator glue failure of the spar and D box https://youtu.be/i5AZFrGSe5k

6. If space allows, drill a hole in the outer elevator hinge and attach a washer and split pin. This way, in the event of the elevator rib becoming unbonded. The elevator cannot move sideways and become detached. See link to BGA inspection requiring this 043-07-2004-issue-2.pdf

7. Remove the requirement to wrap the rib in fabric. Protect it with a clear varnish to weatherproof it. The joint should always be accessible to inspect non-destructively with minimal workload.

8. 17 years of experience have shown that this is an age issue, not a fatigue issue. The 500 launch inspection requirement is not required. Annual inspections are sufficient to find all problems. Root rib inspection should be annually and the internal inspection through the hole in the fabric at least every 3 years.

9. Do not assume all qualified inspectors/engineers are experts at finding glue failure. Educational material (photos and videos) is an essential part of this AD to educate the engineers on what to look for.

10. Carry out the entire BGA glue inspection on the airframe. That way all joints are checked and there is no requirement to have additional limitations on the airframes such as no spins. See link 042-07-2004-issue-6-16thMarch-2017-r3.pdf (gliding.co.uk)

EASA response: partially agreed

1. A load test on the rigged aircraft with applying opposing loads to the trailing edge is prescribed in the AFM supplement which comes mandatory within this PAD / TN.

2. With repetitive inspections also original bonding's are able to be airworthy.

3.-5. It`s obviously that the structural integrity of all parts have to be checked during annual inspection. However, the present PAD addresses especially the rib no. 1 of the elevator for the inspection due to the occurencies reported.

6. This modification is not part of the type design. In addition, the modification does not prevent the elevator from a failure of the rib no. 1 bonding.

7. See comment #3.

8. The investigation of the Hungarian national authority concludes that the launch criteria for the inspection is required.

9. The BGA publications are referenced in the respective Technical Notes of the manufacturer.

10. Operational limitations are not addressed by this PAD.

No changes have been made to the Final AD in response to this comment.

Commenter 6: Company name – N/A – Swen Lehner – 10/08/2021

Comment # 7

I) Comments:

a) Changed operating limitations for gliders:

Taking into account the age and the unknown storage conditions of the affected aircraft this across-the-board reduction of the operation limitations might be a simple action to handle this item. On the other hand these gliders are subject to more or less frequent profound overhaul actions due to the materials used for surface protection. These maintenance provides the opportunity for a closer inspection of the structure.

The proposed modification of the operation limitations intends to reduce some rare but eventually strong loads from operation. This limitations affects the operations in service only to a limited amount. Nevertheless this action has an impact on the serviceability of the affected aircraft and so far is an unusual action on this type of aircraft which should be as well-founded as possible. In case similar actions should be taken into account in future it should be considered if there are alternative actions available, too.

b) Implemented maintenance actions:

• Repetitive accomplishment of the established inspection also encloses the risk of damage to the structure. This assumption is already indicated in action 1 from Appendix 01-2021, Operations manual, “3 Inspection of the elevator”. The potential risk from maintenance should be minimized.

• Unfortunately the report from the Hungarian Ministry of Innovation and Technology is difficult to translate and to interpret. At least from the pictures it becomes not clear if the fabric strip required in the actions from LTA-72-7/3 had been installed. It can be assumed that this strip helps both to protect the gluing joint from moisture and additionally to delay the spanwise separation of the elevator after failure of the gluing joint of rib 1.

• The risk for additional loads from inertia forces on the elevator during ground run in winch launching is more likely on gliders where the main wheel is behind the flight c/g-position (like K 7, K 8, ASK 13). It should be less likely on gliders like Ka 6, ASK 18. If the impact of this load case seems to be important the different designs should be considered.

• The correct and complete accomplishment of a structural repair like the actions from LTA 72-7/3 should be taken into account. If a repair has been accomplished according to the certified instructions from the DO/TC holder there should be a certain operation time when the maintenance action should guarantee normal operation. The incident from Hungary might create doubt in the efficiency of the actions from LTA-72-7/3. If so, there might be other actions, which allow a more continuous observation to detect a degradation in time.

II) Proposals:

a) Enter an adapted version of action 1 from Appendix 01-2021, Operations manual, “3 Inspection of the elevator” to the daily preflight inspection procedure in the Flight Manual of the affected gliders. This could probably result in a simple but continuous monitoring of the affected gluing joint within the annual/500 landings period and possibly could help to make incidences as reported from the K 7 registered in Hungary more unlikely.

b) Take into account when a complete structural repair similar/according to LTA-72-7/3 including its improved protection against moisture already has been accomplished.

(i) If no structural repair according to LTA-72-7/3 has been accomplished the repetitive inspection (annually / every 500 landings) according to Appendix 01-2021, Operations manual, “3 Inspection of the elevator” will be introduced.

(ii) In case the structural repair from LTA-72-7/3 has been already carried out completely the frequency of the actions could be adapted to LTA-72-7/3:

- Annually/every 500 landings proceed according to action 1 (and 2) from Appendix 01-2021, Operations Manual, “3 Inspection of the elevator”.

- If there are no doubts about the structural integrity the repetitive deep inspection from Appendix 01-2021 according to actions 3, 4 and 5 including the removal of the fabric strip must be accomplished only every three years / reasonable number of landings, whichever comes first after the date/number of landings the structural repair according to LTA 72-3 has been executed.

This procedure can be repeated two times (i.e. nine years or three times the reasonable amount of landings) have passed. Then the inspection procedure returns to the annual frequency from Appendix 01-2021, Operations manual, “3 Inspection of the elevator”. Every repetition of the structural repair from LTA-72-7/3 will reset the inspection interval to the repeated three years term.

EASA response: disagreed

Operation limitations are not subject to this PAD. The referenced Technical Notes addressed the inspection of the elevator only.

A special daily preflight inspection procedure of the elevator is not required as a check of the control system is part of the daily inspection already. During this control check (with one person the the elevator and one on the control stick) a significant damage to the elevator`s rib bonding can be determined.

Similar to comment #4 we do not agreed with the proposed changing he inspection intervals. From the occurrence reports since the 70`s it cannot be derived with 100% guarantee that a structural repair is sufficient that the elevator needs no deep inspection or larger intervals can be applied.

No changes have been made to the Final AD in response to this comment.

Commenter 7: Company name – Deutscher Aero Club – Alexander Willberg – 11/08/2021

Comment # 8

The Federal History and Technology Committee of the German Aeroclub e.V. comments as follows:

The problem with the elevators of the affected aircraft types is simplified to the safety of gluing the elevators. However, the problem has so far only occurred with gliders whose elevators are glued with Kaurit. To our knowledge, there is no known incident involving elevators glued with Aerodux.

We therefore suggest that the restrictions in flight operations (no aerobatics, no spinning) apply exclusively to elevators glued with Kaurit. Furthermore, the Schleicher company should publish a list for all affected types, which glue was used. This should also include the types built under licence.

We propose that the glue used for the affected types be listed in a form in the life cycle file.

We propose that the intervals of the elevator must be done annually as part of the annual inspection. A shorter period is not practical, as gliders used in training operations, for example, perform more than 1000 take-offs per year.

The Federal History and Technology Committee of the German Aeroclub e.V. is happy to provide assistance with questions of air and operational safety at any time.

EASA response: disagreed

Regarding the type of glue see comment #4.

The restrictions on flight operation are not subject to this PAD.

It`s not possible to publish production details for such old aircrafts, partly over 50 years old. Also, licence build aircrafts are not build under the scope of the manufacturer. In addition, such information are not reliable due to overhaus or repairs performed on the aircrafts.

See comment #6 for the statement on the take-off interval.

No changes have been made to the Final AD in response to this comment.