



**COMMENT RESPONSE DOCUMENT (CRD)
TO NOTICE of PROPOSED AMENDMENT (NPA) 2007-12**

for amending the Decision No 2003/13/RM of the Executive Director of the European Aviation Safety Agency of 14 November 2003 on certification specifications including airworthiness codes and acceptable means of compliance for sailplanes and powered sailplanes (« CS-22 »)

“Cockpit crashworthiness”

Explanatory Note

I. General

1. The purpose of the Notice of Proposed Amendment (NPA) is to envisage amending Decision 2003/13/RM of the Executive Director of the Agency of 14 November 2003 on certification specifications, including airworthiness codes and acceptable means of compliance for sailplanes and powered sailplanes.

II. Consultation

2. The draft Executive Director Decision amending Decision 2003/13/RM was published on the web site (<http://www.easa.europa.eu>) on 31 August 2007.

By the closing date of 1 December 2007, the European Aviation Safety Agency ("the Agency") had received 33 comments from 15 National Aviation Authorities, professional organisations and private companies.

III. Publication of the CRD

3. All comments received have been acknowledged and incorporated into this Comment Response Document (CRD) with the responses of the Agency.

4. In responding to comments, a standard terminology has been applied to attest the Agency's acceptance of the comment. This terminology is as follows:

- **Accepted** – The comment is agreed by the Agency and any proposed amendment is wholly transferred to the revised text.
- **Partially Accepted** – Either the comment is only agreed in part by the Agency, or the comment is agreed by the Agency but any proposed amendment is partially transferred to the revised text.
- **Noted** – The comment is acknowledged by the Agency but no change to the existing text is considered necessary.
- **Not Accepted** – The comment or proposed amendment is not shared by the Agency

The resulting text highlights the changes as compared to the current rule.

5. The Agency's Decision will be issued at least two months after the publication of this CRD to allow for any possible reactions of stakeholders regarding possible misunderstandings of the comments received and answers provided.

6. Such reactions should be received by the Agency not later than **03 June 2008** and should be submitted using the Comment-Response Tool at <http://hub.easa.europa.eu/crt>.

IV. CRD table of comments, responses and resulting text

(General Comments)		-
comment	3	comment by: <i>Francis Fagegaltier Services</i>
	<p>General</p> <p>The whole concept behind this NPA is, of course, supported.</p> <p>However, it must be noted that the real safety objective is only hidden in the AMC 22.561 and cannot be easily determined from either the new wording of CS-22.561 or the explanation of the NPA.</p> <p>It would appear that this safety objective is similar to what has been done for cars : « the main part of the cockpit ... should constitute a cage strong enough » to protect the passengers. Indeed, this concept has proven its efficiency for saving lives.</p> <p>Why is this requirement not clearly imposed in CS-22.561 and why is it only suggested in the AMC 22.561 ?</p> <p>A suggestion for re-writing of the package is made in another comment.</p>	
response	<p><i>Noted</i></p> <p>The concept of this NPA is introduced within the current principle of CS-22, using the existing requirement based on compliance showing to static loads. The first development in this concept is therefore the change of the load factors of the cockpit that provides a safety cell. The requirement for occupant protection and means to absorb energy in an emergency landing are currently captured in the existing CS 22.561(a). Supporting information to this is provided through new AMC. More specific and explicit AMC is not available at this time, however based on accident data evaluation it is considered necessary to introduce the safety cell requirement and in addition share insight and available data in this AMC.</p>	
comment	9	comment by: <i>CAA CZ</i>
	<p>The CAA CZ generally agrees with the idea of the NPA in question. We would like to use this opportunity to express few following general comments:</p> <p>1) The requirements of the NPA will lead to the improvement of the impact resistance; however, they will probably not lead to more elaborate design solutions such as for example use of controlled destruction methods</p> <p>2) Similar approach should be implemented in other Certification Specifications considering the same type of structures, e.g. CS-VLA</p> <p>3) It is not clear from the proposal whether the requirements set forth by the NPA are applicable also to powered sailplanes</p>	
response	<p><i>Noted</i></p> <p>1) Refer to the response to comment 3.</p> <p>2) If applicable and substantiated, similar crashworthiness requirements for these types of structures used for aeroplanes certified to other airworthiness</p>	

codes will be considered in future rulemaking tasks.

3) CS-22 is applicable to powered sailplanes unless specifically mentioned otherwise. This is also true for the NPA although it was not specifically mentioned.

comment	10	comment by: CAA-NL
	CAA-NL has no comment on this NPA.	
response	Noted	

comment	19	comment by: Allstar PZL Glider
	<p>Idea of increasing safety of soaring, especially in crash-landing conditions, is right and worth to be promoted, but we think that those aims can be realized by other means.</p> <p>Focusing on problem of sharpening regulations only, which forces to design more and more 'armored' cockpits, today's proposals can be found insufficient tomorrow by their Authors. But currently used gliders can be in use next few dozens of years.</p> <p>Increasing load factors we can reach the point, where in unbreakable (safe) cockpit pilot will suffer fatal inner injuries or fatal spinal injuries, caused by deceleration loads.</p> <p>Assuming that, we think the philosophy of 'safe cockpit' should be based on determining of maximum acceptable for pilot load factor, and minimum 'undamaged cockpit volume', necessary for occupants safety. For those parameters cockpit should be designed for absorb energy during its progressively destruction, according to above assumption. By other words - base cockpit design on philosophy of undercarriage shock absorption.</p> <p>Quantity determining for those assumptions will require further research, so applying it in CS 22 rules should concerns only gliders, which are in the first stage of design. Similarly, if decision of changes according to NPA 2007-12 will be taken, we think it should concerns only new projects.</p> <p>In NPA 2007-12 p.IV.9 Authors has mentioned insufficient carbon-reinforced composites properties for carry dynamic loads. Paying attention for that, change of load coefficients could be connected to the material used in foremost part of fuselage.</p> <p>And so:</p> <ol style="list-style-type: none"> 1. For glass-epoxy structures, impact-absorbing and resisting to brittle cracking, leave load factors like they are now defined in CS 22.561(b)(1). 2. Consider excluding carbon-only reinforced composite structures for foremost part of fuselage, and introduce hybrid -glass-carbon or kevlar-carbon structures. 	
response	<p>Noted</p> <p>Current cockpit designs are far away from 'armoured cockpits', which can be clearly seen when looking to accident data that was gathered during the research work of TÜV Rheinland. (Please refer to NPA AMC 22.561 No. 10). The goal of the NPA is to require a 'safety cell' and to prevent collapsing of the cockpit, to improve the pilot's chance to survive a crash landing.</p> <p>Prescription of energy absorption is not a primary goal of this requirement. A stronger cockpit structure is a prerequisite to improve the survivability of crash</p>	

landings.

There is no direct link between the increased structural strength of a safety cell and the injuries of the occupant.

The proposal to differentiate between materials and construction methods used in types of designs is not accepted and too prescriptive.

The change to CS-22 proposed by this NPA will only become applicable for applications for TC from the day it is introduced to the CS-22. (See Part 21A.17) Retroactive implementation is not considered for this NPA.

comment

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comment by: *Austro Control GmbH*

General:

ACG in general highly supports any regulation activity for improvement of crashworthiness on gliders. It is obvious if you look at the picture of glider accidents that the cockpit structure of current designs does not protect the pilot/pax related to the size of impact. Formula One racing car designs have clearly shown, that with moderate impact to the industry (cost and weight) an "Safety Cockpit" can be achieved.

Comments:

The NPA does not contain the technical justification, that the new values can meet the intent. It is more important that the g-loads have been raised by an factor of 2 !

Proposal:

The sailplane development shall also be in future an simple and low end aviation field, without any complex analysis using very simple methods. It was understood by the AMC 22.561 that an dynamic set test is not required, but on the other hands an analysis of the structure may be also an complex task. There is a good chance that an simple test may be more cost and time effective and may give better results than any test. It is cheaper and faster for small companies to builds a test structure than to carry out complex analysis. It is proposed to add an simple test method, that can be achieved with a simple test jig should be adds to the AMC. This test should include one point and direction for measuring a g-load. This minimum g- load must be achieved by the test. If the structure is capable to withstand this, than, 22.561 (b) is completely complied with.

response

Noted

The values contained in the NPA are an outcome of accident investigation, research work and compromise from discussions with stakeholders, regarding realization of increased load factors in the requirements.

Examples for simple static load tests as well as dynamic tests are contained in the research report of TÜV Rheinland. (Please refer to NPA AMC 22.561 No. 10). Nevertheless, the requirement defines only static loads.

To avoid confusion, the first sentence "To show compliance with CS 22.561 (b) no dynamic tests are mandatory." in the AMC is removed. The AMC has been restructured to provide better understanding of the AMC.

comment	33	comment by: <i>Armageddon Associates</i>
	<p>Having read through your document I feel that option 2 is the only acceptable course in view of the number of accidents in this area of general aviation in the last few years.</p> <p>I apologise for my delay in responding due to pressure of other work in aviation matters. Nationally and internationally.</p>	
response	<i>Noted</i>	

A. Explanatory Note - I. General

p. 3

comment	17	comment by: <i>DGAC France</i>																									
	<p>This proposal does not seem consistent with the new EASA approach on non complex aircraft. At a time when EASA is trying to find alternative certification requirements for aircraft up to 2000kg, we do not understand how gliders can be considered more drastically than CS23 aircraft, and than CS25 aircraft.</p> <p>Ultimate Load Factors</p> <table border="1"> <thead> <tr> <th></th> <th>CS22</th> <th>NPA</th> <th>CS23</th> <th>CS25</th> </tr> </thead> <tbody> <tr> <td>Upward</td> <td>4,5</td> <td>7,5</td> <td>3 4,5 (Aerobatics)</td> <td>3</td> </tr> <tr> <td>Forward</td> <td>9</td> <td>15</td> <td>9</td> <td>9</td> </tr> <tr> <td>Sideward</td> <td>3</td> <td>6</td> <td>1,5</td> <td>3</td> </tr> <tr> <td>Downward</td> <td>4,5</td> <td>9</td> <td>6</td> <td>6</td> </tr> </tbody> </table>			CS22	NPA	CS23	CS25	Upward	4,5	7,5	3 4,5 (Aerobatics)	3	Forward	9	15	9	9	Sideward	3	6	1,5	3	Downward	4,5	9	6	6
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response	<p><i>Noted</i></p> <p>The EASA approach on non-complex aircraft is aiming for simplified certification procedures; they do not address changing the airworthiness requirements, like CS-22.</p> <p>Proposed increase of load factors is based on experimental results and human body resistance.</p>																										

A. Explanatory Note - IV. Content of the draft decision

p. 4-5

comment	13	comment by: <i>Walter Gessky</i>
	<p>Generally Austria will support any regulatory activity for improvement of crashworthiness on gliders. It is obvious if you look at the glider accident rate, that the cockpit structure of current designs does not protect the pilot/pax in relation to the kind of impact.</p> <p>Formula One racing car designs have clearly shows, that with a moderate impact with regard to cost and weigh to the industry a "Safer Cockpit" can be achieved.</p>	
response	<i>Noted</i>	

comment	<p>16 comment by: <i>Walter Gessky</i></p> <p>The NPA does not contain a technical justification, that the new values can meet the intent. It is more important that the g-loads have been raised by a factor of 2!</p>
response	<p><i>Noted</i></p> <p>The values contained in the NPA are an outcome of accident investigation, research work and compromise from discussions with stakeholders, regarding realisation of increased load factors in the requirements.</p>
comment	<p>23 comment by: <i>European Sailplane Manufacturers</i></p> <p>The comments from the sailplane manufacturers have been collected and forwarded to EASA centrally. Most European sailplane manufacturers used this discussion period to provide comments and to find wordings acceptable for all manufacturers.</p> <p>Nevertheless some different ideas about answering NPA 2007-12 remained. Therefore it was decided to include all answers acceptable to all manufacturer into the comments – this may include some overlapping answers.</p> <p>The common opinions of all manufacturers were:</p> <ol style="list-style-type: none"> a) Occupant safety is an important topic – no manufacturer wants to risk health or life of pilots as they are also the customers which should buy new sailplanes in the future. b) Cockpit crashworthiness is a very complex business which cannot be handled by the manufacturers alone; research and supporting discussion by several institutions (like the authors and organisations listed in the proposed AMC material) has been fundamentally important in the ongoing development of occupant safety. c) Even without a change of regulation over a long time the safety level has been improved steadily and considerably; this is a result not of regulation but of information offered by these research programs which therefore have to be continued (hopefully now on an European level). d) It makes no sense to simply increase required loads when the resulting economical effort for the single manufacturer makes development of a new design not longer feasible. e) The reasoning for rulemaking activity 22.004 leading to NPA 2007-12 (long time without change in regulation plus increased speeds and masses) is not accepted as sufficient for the proposed change of regulation – neither EASA nor other authorities supplied ample proof that the actual safety level of current products (incorporating the “lessons learned” from the cited research projects) is low or even lower than older designs; quite contrary the manufacturer claim to have indications that the level of safety has been improved and therefore no reason for tighter regulation exists. <p>Further comments by the manufacturers are supplied at the relevant locations within the NPA – if more than one opinion was given separate comments have been edited in the Comment Response Tool of EASA.</p>
response	<p><i>Noted</i></p> <p>The start of the issue of this rulemaking activity was an accident investigation that showed urgency to change the existing situation. The cockpit with the pilot seemed to be the energy absorbing zone of the gliders - due to the fact that</p>

the cockpits collapsed. This fact had to be changed. Aim of this NPA is to improve safety issues, not to prevent a decrease of the level of safety. It is noted that design changes have been made for improvement of crashworthiness.

The NPA addresses the concerns derived from the accident investigations, and enhances a level playing field for all designers for Type Certification.

comment

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comment by: *European Sailplane Manufacturers*

The sailplane manufacturer appreciate the effort by EASA to increase the level of safety of occupants in sailplane cockpits.

It is furthermore appreciated that existing research work conducted by several organisations including the manufacturers is been included into this rulemaking activity.

The inclusion of the OSTIV sailplane development panel into the rulemaking activity leading to NPA 2007-12 has assured that all research work done in this important field until now could be regarded and most of it has been included in the proposed AMC material.

Due to this research documentation literature already published by OSTIV and inclusion of modified wording in the OSTIV airworthiness requirements (OSTIVAS) many sailplane manufacturers were already able to improve their products and thereby increase occupant safety.

Nevertheless it has to be pointed out that the EASA rulemaking process leading to NPA 2007-12 is now different to the approach taken within the OSTIVAS:

The NPA 2007-12 basically increases the loads which will lead towards reinforced cockpit structures which may still fail completely after reaching the (now increased) breaking load. This may also lead to higher deceleration forces upon the occupant(s) if actual loads do not go beyond the specified breaking loads.

(Admittedly experience with modern designs shows that the deceleration levels with designs complying with existing rules are below tolerable g-levels and that the highest injury probability is due to structural failure and not due to exceeding deceleration forces.)

The OSTIVAS approach was to find a wording in the relevant requirements which will insure that failure will at first not be complete but that starting from the nose of the glider. The goal of this approach is to maximise the level of energy absorption until full failure thus minimizing deceleration forces upon the occupant(s).

The NPA 2007-12 approach will increase structural strength and keep the level of effort for showing compliance at a minimum required level.

The OSTIVAS approach is nearer the physics of the crash dynamics which have to be considered but leads toward increased certification effort.

Perhaps the NPA 2007-12 should include clearer wording to not impede more detailed showing of compliance (i.e. by using a more detailed approach like the one proposed by OSTIVAS).

response

Noted

It is the intention of the NPA to avoid a too far deviation from the existing CS-22 wording. Nevertheless, all relevant information, also available from OSTIV

AS, is enclosed. The safety cell philosophy is introduced into CS 22.561 requirements and the energy absorption concept is captured within the AMC material.

comment	<p>25</p> <p style="text-align: right;">comment by: <i>European Sailplane Manufacturers</i></p> <p><i>"The increased loads in the revised CS 22.561 also take into account the introduction of Sailplane Parachute Rescue Systems (SPRS), which after activation brings the sailplane or its damaged body to the ground at a vertical speed of maximum 8 m/s and approximately 45° negative pitch."</i></p> <p>It has to be stated that up to now there are no regulations within CS-22 that define SPRS on board of sailplanes. Since these conditions are not defined, it is not possible to define cockpit standards on the base of assumed SPRS characteristics.</p> <p>Nevertheless several studies concerning possible use and safety impact of SPRS have already been conducted (Röger, Fachhochschule Aachen et.al.) and the results have been published.</p> <p>These documents point more towards a maximum sink speed of 6 m/s which would be acceptable in combination with cockpits fulfilling the existing requirements (i.e. 6g under 45° in 22.561 (b)(2)).</p>
response	<p><i>Noted</i></p> <p>It is accepted that the SPRS are not a part of the NPA. It is only mentioned in the Summary to supply background information.</p>

A. Explanatory Note - V. Regulatory Impact Assessment

p. 5-7

comment	<p>12</p> <p style="text-align: right;">comment by: <i>UK CAA</i></p> <p>Paragraph: A v "Regulatory Impact Assessment"</p> <p>Comment: The RIA does not provide justification for the 15g value that is chosen. The RIA appears to rely upon the technical references identified in the NPA document. A number of these references are identified in the German language only and some of the references cannot be readily accessed by readers of the NPA and/or by users of the proposed AMC material.</p> <p>Justification: The RIA needs to provide all necessary justification for the regulatory change it identifies, providing an analysis of the references that may be used, rather than relying on the reader to review each of the references and come to their own conclusion.</p>
response	<p><i>Noted</i></p> <p>The values contained in the NPA are not an outcome of the information in the references but of accident investigation, research work and compromise from discussions with stakeholders, regarding realization of increased load factors in the requirements.</p> <p>The 15 g requirement is already existing for the retractable engine (CS 22.561</p>

(e)) and the NPA brings the requirements in line by introducing it into CS 22.561 (b)(1) and CS 22.787.

comment

14

comment by: *Walter Gessky*

The RIA does not reflect the retroactivity issue.

To increase the safety of the future fleet retroactive measures should be imposed.

I propose the following measures:

a. the new emergency landing condition requirements has to be applied for all derivatives and significant major changes of the gliders after the new CS becomes effective,

b. all gliders manufactured five years after the new CS becomes effective, has to comply with the new standards for emergency landing conditions.

Justification:

It is obvious from the glider accident rate, that the cockpit structure of current designs does not protect the pilot/pax in relation to the kind of impact. To improve emergency landing conditions in CS-22 will only be effective for new designed products.

Existing products which remain in production, new derivatives to existing models can be designed based on the old emergency landing conditions, because 21A.101 which might require compliance with the requirements effective on the date of application is not effective for gliders.

Since to show compliance with this requirement will create higher costs for the TC holder with regard to design and production, the improvements will not be incorporated in existing type designs.

When no retroactivity measures are in force, no new gliders will be designed.

The new design requirements will only be used on a voluntary basis.

response

Noted

This comment is considered outside of the scope of this NPA. The NPA addresses a change to the Airworthiness Requirements only.

comment

15

comment by: *Walter Gessky*

It is proposed to add a simple test method to the AMC, that can be achieved with a simple test rig. This test should include one point and direction for measuring a g-load. This minimum g- load must be achieved by the test. If the structure is capable to withstand this, than, 22.561 (b) is completely complied with.

Justification:

The sailplane development shall also be in future a simple process for the low end aviation field. Complex analysis should not be required to show compliance with the requirement, very simple methods should be offered in the AMC. As far as we understand the AMC 22.561 a dynamic test is not required, but on the other side a structural analysis may be also a very complex task. The AMC should include the description of a very simple test set up to show compliance with the requirement, which could be easily be performed by the industry.

There is a good chance that this simple test may be more cost and time effective and may give better and more reliable results than a complex analysis. It is cheaper and faster for small companies to builds a test bed, than to carry out complex analysis.

response

Not accepted

Examples for simple static load tests as well as dynamic tests are contained in the research report of TÜV Rheinland. (Please refer to NPA AMC 22.561 No. 10). Nevertheless, the requirement defines only static loads. To avoid confusion, the first sentence "To show compliance with CS 22.561 (b) no dynamic tests are mandatory." in the AMC is removed.

comment 26

comment by: *European Sailplane Manufacturers*

„Option 2 could have only a moderate negative impact. Costs for achieving increased protection of occupants and showing the compliance with new requirements would moderately rise with the necessary design effort. No further research is necessary, published results of accomplished research programmes are sufficient. The new models of sailplanes with improved cockpit design show, that the extra costs are negligible. The results are achieved with the application of standard materials (composites) but with an intelligent structural design, providing the necessary strength in the main part of the cockpit and energy absorption capability in the front part. The weight penalty remains limited. The costs for showing compliance are not increased, thanks to the development of computerised modelling programmes, considered as acceptable means of compliance.“

It is accepted that test cockpit structures have been built showing compliance with the new requirements.

Nevertheless it must be pointed out that

- only single-seater cockpit test fuselages have been built and tested (with double seaters the cockpit is much longer which necessitates probably additional structural reinforcements not yet described)
- the single seater cockpit in the cited tests (which fulfil the new requirements) had in some versions unacceptable high (over 20 kg) weight penalty
- the main financial impact for the manufacturers would be the necessity to modify the mold lines which causes considerable costs due to the needed new tools – it is not clear from the outset if the new requirements will cause such a fundamental modification.

Therefore it cannot be stated that only a "moderate negative (economical) impact" has to be expected. It is simply not yet foreseeable if this impact would be moderate or unacceptable.

The manufacturers do not accept such a "downsizing" of possible impacts on basis of pure speculation.

response *Noted*

The economic impact is only substantiated based on single seater designs that have been used for research. The expectations are however expressed that the negative economic impact is justified when balanced against the increased safety level.

The weight penalty has already been addressed in the research report, showing that additional strength may be achieved by negligible additional weight.

