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1	*Morten Arnesen*	3.1	15	In the second last paragraph it is stated Quote "Documentation on all repairs should be added to the maintenance records..." There is no references to already performed repairs. Should they be assessed and recorded ? Or are the grandfathered ?	There should be an advice how to either record or grandfather already performed repairs which are within the scope of this Policy paper.	Suggestion	Substantive	Partially accepted	This CM does not attempt to address repairs retrospectively. These may be addressed in developing ageing aircraft processes, for which complete repair records will be very beneficial. 'Implementation' text added to 'purpose and scope' in order to clarify applicability of the CM for repair applications after the issue date of the CM.
2	*Dassault Aviation*	1.3		OEM should mean Equipment Original Manufacturer instead of ~~Operational~~ Equipment Manufacturer	Rectify	Yes		Accepted	Rectified – OEM removed from CM, replaced by TCH (or appropriately approved TCH original component subcontractors).
3	*UTC Aerospace Systems - Aerostructures*			As a representative of Rohr Aero Services Limited, holding EASA Part 21 approval EASA.21J.023 and EASA Part 145 approval UK.145.00553, we have identified a number of areas where we believe the proposed Certification Memorandum will have a negative impact both directly upon our organisation and also on our customers. For your convenience I have included our comments as an attachment to this letter. The comments provided are intended only to represent our organisation noted above, and are not intended to represent the larger UTC Aerospace Systems group which has a number of global divisions. I would be obliged if you can confirm receipt of these comments at your convenience.				Noted	
4	*UTC Aerospace Systems - Aerostructures*			**<u>Subject : Application to nacelle structures</u>** The memorandum stipulates that it is applicable to "critical structures" as defined in AMC 20-29, which in turn stipulates "PSE are critical structures for Large Aeroplanes." Recently there has been a substantial variation between the major airframe manufacturers in their approach to classification of nacelle structures with respect to their being PSE. To briefly summarise, Boeing have never considered any nacelle structure as PSE, Airbus historically classified nacelle structures in the same manner, but recently re-classified sub-assemblies or major assemblies of the nacelle structure as PSE. This causes disparity where a common engine type is fitted to both Airbus and Boeing aircraft such as the PW4000 and CF6-80C2 engines which are fitted to Airbus A300, A310 and Boeing B747 & B767 aircraft types. As the nacelle structures on these older aircraft types were deemed to be secondary non-PSE structures at the time of original certification they were designed to be lightweight and were therefore not designed with the multiple load path redundancy which would now be necessary to satisfy the criteria in the certification memo (i.e. bonded repair size limit no larger than a size which allows limit load strength...	**<u>Suggested action:</u>** Please revise the criteria in certification memorandum to exclude nacelle structures or change the language to reflect the situation whereby a component which was originally designed to be lightweight retains an acceptable level of repairability.			Partially accepted	The CM is not intended to change existing or previous TCH structure classifications or retrospectively address differences between classifications (e.g. as described with the engine example in the comment) because this would be outside the scope of the CM. 'Critical structure', as defined in the CM, primarily addresses 571/573 structures. However, a TCH may also wish to classify structures as being critical for reasons other than for fatigue, e.g. static strength, stiffness considerations. This CM does not change this or the means of compliance expected for such baseline structures. However, if such a structure relies upon a bonded repair to maintain airworthiness, then adequate F&DT evidence would be expected to show that the repair is durable in addition to satisfying the usual Strength, Deformation, Proof of Structure requirements etc. Note: the term 'TCH (or appropriately approved TCH original component subcontractors)' has been added to the text to allow scope for typical manufacturers of 'light weight' sub-assemblies to easily substantiate its repair actions by virtue of reference to its original equipment baseline data etc. Purpose and Scope' text slightly amended to add *'(as classified by the TCH)'*. The definition of 'critical structure' has been slightly amended to include FCS. 'Implementation' text added to 'purpose and scope' in order to clarify applicability of the CM for repair applications after the issue date of the CM and that previous established agreed means of compliance

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				…with the repair failed). ***Comment*** *By applying the requirement holistically to "critical" structure (i.e. PSE including nacelle parts which were originally deemed to be non-PSE secondary structure), many nacelle components on Airbus aircraft will in effect become unrepairable.* *For example the A300 / A310 PW4000 translating sleeve is now defined by Airbus as PSE. The original structure was not designed to satisfy limit load capability with significant areas of structure missing, and therefore applying this requirement retrospectively will in effect prevent any medium or large area repairs from being accomplished. It should also be noted that these components are out-of-production, and therefore a replacement "new" part cannot be purchased when the part is deemed unrepairable as a result of this new requirement.* *Furthermore, there is no stipulation that this new requirement be applied to existing repairs, and therefore in the above noted situation (unrepairable component which is out of production) an operator may be forced to purchase a replacement "used" serviceable item which has existing repairs far beyond the scope of the repair on their own component, which could be considered as fit for flight with no further action. We do not believe this situation is in the interests of the aircraft industry either from a safety or commercial perspective.*					may be used. Regarding out of production items, please note the developing SAE CACRC activities intended to help support safe continued use of such structures. Note: Existing bonded repairs may be addressed in developing ageing aircraft processes, but are not addressed in this CM.
5	*UTC Aerospace Systems - Aerostructures*			**Subject : Application to MRO facilities affiliated with the OEM** Our organisation is part of the UTC Aerostructures group and consequently around 95% of the components we repair were manufactured by our parent organisation. On these components we have access to the original manufacturing drawings, specifications, certification and test reports for the parts being repaired. This permits us to in effect return parts (through repair) to an as-new condition, ensuring that full certification load capability (i.e. ultimate load) is restored in the repaired configuration. Furthermore, by utilising the same equipment, tooling, processes and procedures as those used in the original OEM environment, we are able to produce a bonded repair which has equivalent strength, quality and durability to the properties of a new part. ***Comment*** *Whilst we appreciate that the purpose of the certification memorandum is to ensure that repairs developed and incorporated by maintenance / repair organisations with limited capabilities and facilities*	**Suggested action:** Please revise the certification memorandum to permit an OEM's repair facility to be excluded from the criteria for a failed repair to sustain limit load, or alternatively change the scope of the certification memorandum in that it only applies to Part 145 organisations which are not affiliated to the OEM.			Partially accepted	See response to comment 4 above and text added to the end of the policy which could allow credit for such activities, i.e. '*Note: To accommodate special cases and advances in bond repair technology, alternate methods of repair substantiation may be acceptable when established in coordination with the Agency.'* This CM policy is not intended to address in-production repairs or non-standard in service repairs which are directly supported by the TCH (or appropriately approved TCH original component subcontractors) on a case by case basis. Similarly, it does not include TCH (or appropriately approved TCH original component subcontractors) repair facilities when it can be demonstrated to the regulator that capability is at a level which justifies deviation beyond the stated limits of this CM, i.e. this is considered to include appropriate TCH support when the subcontractor is repairing within the scope of that support.

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				are inherently safe, the manner in which this is being implemented is in effect limiting the OEM's own repair organisations from developing and incorporating repairs which introduce a level of safety, durability and airworthiness equivalent to the standards of part being produced by the OEM.					
6	*UTC Aerospace Systems - Aerostructures*			**<u>Subject : Variation between EASA and FAA requirements</u>** In conjunction with the EASA certification memorandum, the FAA has issued a draft policy statement on bonded repair size limits. The content of this document is largely similar to the EASA CM, however there is a significant difference brought about by the final sentence in paragraph A. of the FAA document: "This policy is not intended for minor repairs" ***<u>Comment</u>*** *There has been much debate over the classification of repairs as Minor and Major, and the FAA and EASA have fundamentally different approaches to how they treat Minor repairs, namely EASA require all Minor repairs to be approved and the FAA do not (i.e. only to be performed in accordance with data acceptable to the FAA).* *Whilst the classification of repairs as Minor and Major is to a large degree subjective, the variation between the EASA and FAA documents in this respect is problematic. In essence an organisation such as ours, based in the EU wishing to perform a Minor repair to a nacelle structure may be forbidden from doing so, due to the limit load criteria mentioned above. An equivalent organisation based in the USA may find the same repair to be Minor and can therefore accomplish the repair without further recourse. Furthermore due to the bilateral agreement between the EU and the USA, the organisation based in the US can then certify the repaired part on an FAA 8130-3 / EASA Form 1 dual release, whereas the EU based organisation would be faced with scrapping the component.* *We do not believe this is in the best interests of the airlines and repair organisations based in Europe. Furthermore, in these instances where the repair is Minor it would be possible for an organisation based in the EU to contract the work to an organisation in the USA to circumvent this requirement.*	**<u>Suggested action:</u>** Please revise the certification memorandum to stipulate that it only applies to Major repairs, or is not intended for Minor repair common with the FAA Policy Statement.			Partially accepted	EASA is familiar with the broader points made in the comment. This CM does not attempt to address the broader 'major/minor' and 'bi-lateral agreement' issues described in the comment, which is outside the scope of a CM. However, it attempts to identify some of the contributory elements in the repair process which may require limitations. EASA agrees that some subjectivity is necessary in the determination of the classification, i.e. 'engineering judgement' forms part of the repair classification process. Note: Recognising that part of the classification determination process requires consideration of the amount of work necessary to substantiate a repair, ref. GM 21.A.435(a), EASA is also using this CM to help support the repair classification definition process by highlighting the issues which need to be addressed which might drive a repair to 'Major' classification. The following text to the 'Purpose and Scope'. *'The content of this CM may be used to assist in the determination of repair classification and the policy, section 3.1, is not intended for repairs finally determined to be minor repairs.'* See also responses to comments 4 and 5.

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7	*Boeing Commercial Airplanes*	1.4, Definitions	5	**The proposed text states**: Definition table **Justification**: More than one repair done on a structure, at the same time and under the same processes, should be considered as a single repair to satisfy regulatory residual strength.	**Requested Change**: Add the following **new** definition: ***Repair**: **One or more repairs performed, at the same time and under similar processes, on a structural part.***		Y	Partially Accepted	Intent added to background discussion.
8	*Boeing Commercial Airplanes*	1.4, Definitions	6	Definition for ***"Bonded Repair"*** **The proposed text states**: *"A repair means elimination of damage and/or restoration to an airworthy condition following initial release into service by the manufacturer."* **Justification**: Requirements are provided for production-bonded repairs or rework and for bonded repairs after release into service. However, the guidance is not strictly made applicable to bonded repairs or rework conducted prior to delivery, after the part has been taken from the original production facility and installed on an aircraft. Since many of the same issues associated with in-service repairs apply (e.g., process control, surface preparation), we consider it logical to apply the same guidance in such cases.	**Requested Change**: We recommend additional guidance be provided for bonded repairs or rework conducted after initial part fabrication, but prior to release into service (i.e., repairs conducted during assembly and prior to delivery).		Y	Noted	EASA does not wish to expand the CM further to address the in-production repairs, particularly noting that the TCH is best placed to address its own product in-production.
9	*Boeing Commercial Airplanes*	1.4, Definitions	6	Definition for **"*Co-cured Structure*"** **The proposed text states**: *"Uncured components cured together. Bonded repairs of co-cured structure are covered by this policy."* **Justification:** This proposed CM is intended to be applicable to all bonded structural repairs: co-cured, co-bonded, secondarily bonded, and metal bond. This could be added in an opening sentence. Our suggested struck-out text should be removed from the definition section.	**Requested Change**: *"Uncured components cured together. ~~Bonded repairs of co-cured structure are covered by this policy.~~"*	Y		Accepted	

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10	*Boeing Commercial Airplanes*	1.4, Definitions	7	Definition for Principal ***"Structural Element"*** ***The proposed text states:*** *"Principal structural elements are those which contribute significantly to carrying flight, ground, and pressurisation loads, and whose failure could result in catastrophic failure of the aeroplane. (AMC 25.571 para.2)"* **Justification:** Our suggested change in the definition in the proposed CM will make it consistent with the text in the parallel FAA policy.	**Requested Change:** *"Principal structural elements are those which contribute significantly to carrying flight, ground, and pressurisation loads, and whose failure could result in catastrophic failure of the aeroplane.* ***Principal structural elements include all structure susceptible to fatigue cracking, which could contribute to a catastrophic failure*** *(AMC 25.571 para.2)"*		Y	Accepted	
11	*Boeing Commercial Airplanes*	1.4, Definitions	7	Definition for ***"Secondary Bond"*** **The proposed text states:** *"The joining together, by the process of adhesive bonding of two or more already-cured composite parts or metal parts, during which the only chemical or thermal reaction occurring is the curing of the adhesive itself."* **Justification:** Technically, when applying heat to conduct a repair, the elevated temperature will promote additional cross-linking of the resin within a previously-cured thermoset composite part. The chemical reaction is relatively minor compared with that occurring within the adhesive, but still exists. This is one reason there are cure cycle/duration limitations on composite structure (excessive cross-linking can lead to embrittlement).	**Requested Change:** *"The joining together, by the process of adhesive bonding of two or more ~~already~~* ***previously*** *cured composite parts or metal parts, during which the ~~only~~* ***principal*** *chemical or thermal reaction occurring is the curing of the adhesive itself."*	Y		Accepted	
12	*Boeing Commercial Airplanes*	1.4, Definitions	7	Definition for ***"Weak Bond"*** **The proposed text states:** *"A bond line with mechanical properties lower than expected, but without any possibility to detection using non-destructive inspection (NDI) procedures currently applied by industry."* **Justification:** If technology is developed that can detect weak bonds, this policy should not change until the reliability of the detection technology has been demonstrated.	**Requested Change:** *"A bond line with mechanical properties lower than expected, ~~but without any possibility to detection~~* ***which cannot be detected reliably*** *using non-destructive inspection (NDI) procedures currently applied by industry."*	Y		Accepted	

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13	*Boeing Commercial Airplanes*	2, Background	9; 3rd paragraph	**The proposed text states:** *"… For example, bonded repair to critical structure, which includes low safety margins and failure modes that are strongly affected by bonded repair failures, should be avoided."* **Justification:** The proposed is stating that repairs are not allowed to critical structure with low margins. It should be made clear that the repair is not allowed if the failure of the repair drops the residual strength below limit load. Deleting the text will make this issue clearer.	**Requested Change:** We recommend removing this text.		Y	Accepted	
14	*Boeing Commercial Airplanes*	2, Background	9; 4th paragraph	**The proposed text states:** *"… If 'Weak Bond' damage exists in a bonded repair and remains undetected, the structure could be exposed to significantly less than Ultimate Load capability for long periods of time, which is unacceptable from a safety viewpoint."* **Justification:** The proposed statement is confusing. "Weak Bond" cannot be detected - per definition. Does *"significantly less that Ultimate Load"* mean "less than limit load capability"? If so, then it does not matter whether it is a long period or a short period; the repair is unacceptable. If not, then as long as the repaired structure (after an inspection interval of fatigue) meets limit load with the repair failed, it is still acceptable. If this statement were changed to *"if a delamination exists in a bonded repair …"* it would be less confusing.	**Requested Change:** We recommend removing or revising this text to make it clearer.	Y		Accepted	
15	*Boeing Commercial Airplanes*	2, Background;	10; 2nd paragraph	**The proposed text states:** *"In-service bonded repairs are typically performed less frequently than production bonding activities and often occur in less stabilized service environments. …"* **Justification:** Requirements are provided for production-bonded repairs and for bonded repairs or rework after release into service. However, the guidance is not strictly made applicable to bonded repairs conducted prior to delivery, after the part has been taken from the original production facility and installed on an aircraft. Since many of the same issues associated with in-service repairs apply (e.g., process control, surface preparation), it would be logical to apply the same guidance in such cases.	**Requested Change:** We request that guidance be provided for bonded repairs or rework conducted after initial part fabrication, but prior to release into service (i.e., repairs conducted during assembly and prior to delivery).		Y	Noted	EASA does not wish to expand the CM further to address the in-production repairs, particularly noting that the TCH is best placed to address its own product in-production.

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16	*Boeing Commercial Airplanes*	2, Background	10; 7th paragraph	**The proposed text states**: *"… Unless receiving assistance from the OEM, it is unlikely that this can be accomplished without further substantiating data development."* **Justification**: The intent of the statement should be clarified and should provide positive guidance. The proposed text also does not provide a reason as to why a remanufactured process is unlikely to be accomplished without OEM assistance.	**Requested change:** We recommend that the statement be re-written to indicate that OEM assistance will be required to develop substantiating data to process repairs or remanufacture outside the OEM specified processes. We suggest adding a statement similar to the following: ***"The OEM will have data that characterize and control the manufacturing process for a specific component to address non-end item inspectable items, e.g., wrinkles, voids, etc. Thereby, OEM assistance will be required …"***		Y	Partially accepted	Intent captured in revised background text.
17	*Boeing Commercial Airplanes*	2, Background	11; 1st paragraph	**The proposed text states**: *"Some recent research results with cured composite materials show reduced repair bond strength, which may be linked to irreversible environmental and mechanical load history."* **Justification**: This statement should not be addressed here until this effect is quantified and understood. The specific research is not referenced in the policy statement and, consequently, there is no positive guidance to the industry on how to provide sufficient data to address this concern.	**Requested Change**: We recommend removing this text.		Y	Accepted	
18	*Boeing Commercial Airplanes*	2, Background	11; 2nd paragraph 3rd bullet	**The proposed text states**: *"• for structural repairs subject to cabin pressurization loads where partial or complete failure of the repair could lead to pressure loss, rapid decompression should be considered within the structural evaluations."* **Justification**: "Compartment" is terminology consistent with current 2x.365 regulations. This proposed CM should clarify whether repair size for pressurized compartments should be limited by the effects of rapid pressurization of normally un-pressurized compartments (e.g., failure of an aft pressure bulkhead repair pressurizing Section 48). Additionally, clarify whether repairs to normally unpressurized compartments should be limited in size to those that can withstand structural loadings associated with rapid decompression of a pressurized compartment (e.g., Section 48 repairs must withstand aft pressure bulkhead decompression).	**Requested Change**: Change the term *"cabin"* to ***"compartment"*** and revise the text to more completely address 2x.365(e) requirements.		Y	Partially accepted	EASA agrees that the points discussed in the comment need to be considered when addressing CS 25.365. However, the purpose of the text in this background discussion was to simply identify the issue, not describe it. The implicit understanding is that repair sizing should ensure that the basic design concept and baseline structure capability is maintained relative to CS 25.365.

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19	*Boeing Commercial Airplanes*	2, Background	11; 3rd paragraph	**The proposed text states**: *"Additional considerations may also need to be applied to structures not typically considered PSE or Primary Structure, but for which repair failure could result in a significant reduction in safety.* *● bonded repairs to composite and metal engine structures should consider whether the failed repair can be ingested and damage engine parts.* *● repairs to large fairings, which may depart the aircraft, if failed, and impact downstream critical structure require other consideration.* *Such evaluations will require engineering judgment. The EASA should be consulted early in the process whenever additional substantiation data is needed to extend existing repair size limits."* **Justification**: Parts departing the airplane are typically addressed under a continued operational safety program. The noted text adds confusion as to which structure this proposed CM applies. We recommend that the affected structure be kept to a documented list, such as PSE structure for part 25 airplanes or critical structure lists used by OEMs.	**Requested Change**: We recommend removing this text.		Y	Partially accepted	The CM is not intended to change TCH structure classifications. It is simply identifying in the 'backgound' additional considerations which may, or may not, have contributed to a TCH size limit and which may be a consideration for any non-TCH considering deviation from TCH guidelines. 'Purpose and Scope' text slightly amended to add '(as classified by the TCH)' The text has also be strengthened elsewhere to indicate that critical structures are currently the priority, e.g. as per the slightly amended 'critical structure' definition, such that PSEs etc are the emphasis of current concern, and within the revised Policy text.
20	*Boeing Commercial Airplanes*	2.1.6	12; Last paragraph	**The proposed text states**: ***"2.1.6. AMC 145.A.42(c) Acceptance of Components …"*** *This CM is focused on Primary Structures and PSEs. However, it also recognises that some structures not typically considered to satisfy the definitions of Primary Structures and PSEs could reduce the level of safety should a repair fail, e.g. large fairings which could separate and impact other structure or be ingested by engines. These may require further consideration. … etc."* **Justification**: This paragraph continues the focus on parts departing the airplane as a concern. As addressed in our Comment #13, parts departing airplane are typically addressed under a continued operational safety program. The text in this paragraph will add confusion as to which structure this proposed CM applies. As previously stated, we suggest that the affected structure be kept to a documented list, such as PSE structure for part 25 airplanes or critical structure lists used by various OEMs.	**Requested Change**: We recommend removing this paragraph.		Y	Not accepted	The CM text is simply providing background information which identifies some potential issues which could require consideration and which help to define criticality, and therefore size limits, for a bonded repair. This could be appropriate to the TCH for initial sizing. However, it can also be of relevance to the non-TCH when assessing the potential consequences if deviating from TCH data without TCH support.

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21	*Boeing Commercial Airplanes*	3.1, EASA Policy	13; Item 2. 4th bullet	**The proposed text states**: *"2. … The bonded repair must be shown to be capable of withstanding ultimate static loads and be shown to retain the required residual strength, as defined in the applicable CSs, which include, but are not limited to:* *…* *• A requirement for statistical material design values (CS 2x.613)* *…"* **Justification**: There are many instances when the bondline design values used in stress analysis of a repair are not strictly developed for the particular bonding system utilized, but that are developed from use of another adhesive or resin and then conservatively applied. For example, we developed statistical bondline shear design values using a Boeing standard wet layup system, and then applied those values conservatively to the analysis of adhesive-bonded repairs by conducting representative repair tests and demonstrating that use of the Boeing engineering design values was acceptable and conservative. This is an acceptable approach to complying with §2x.613. We are concerned that the proposed text could be interpreted as meaning that unique statistical design values are required for all bonded repair materials, which is not the case.	**Requested Change**: There is no specific change requested, but we wish to bring up a potential concern.		Y	Partially accepted	EASA understands and agrees with this point. 'A requirement for' has been deleted from the text to reduce the emphasis on CS 25.613, i.e. standard interpretation of the requirement is implied, which includes the possibility of using obviously conservative data etc. Furthermore, the need for 'engineering judgement' is repeated throughout the document. This can be considered to apply to appropriate rational use of data and cases when acceptance might be obvious by comparison.
22	*Boeing Commercial Airplanes*	3.1, EASA Policy	13; Item 3.	**The proposed text states**: *"3. … Inspection thresholds and intervals should be set that consider criticality of the structure and the magnitude of the residual strength of the failed repair (i.e., a failed repair which could result in a residual strength near Limit Load is recommended to be inspected with increased frequency)."* **Justification:** Components such as flaps experience relatively high fatigue loading each flight and are also subject to load exceedences outside of the certification envelope. Inspection intervals should account for a more severe loading environment and exposure to possible overload conditions.	**Requested change:** *"3. … Inspection thresholds and intervals should be set that consider **the fatigue loading environment, likelihood of load excursions,** criticality of the structure and the magnitude of the residual strength of the failed repair (i.e., a failed repair which could result in a residual strength near Limit Load is recommended to be inspected with increased frequency)."*		Y	Accepted	Slightly amended text used.

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23	*Boeing Commercial Airplanes*	3.1, EASA Policy	14; 1st paragraph	**The proposed text states:** *"As noted in item 2 from above, bonded repairs must be designed to be damage tolerant in order to preclude catastrophic failure due to fatigue, corrosion, manufacturing defects or accidental damage throughout the operational life of the aircraft. …"* **Justification:** Non-critical (non-PSE) structure does not have to be designed to be damage tolerant. Our suggested change clarifies this. Additionally, the phrase *"manufacturing defects"* in the proposed sentence is not consistent with the other items mentioned, which comprise the airplane operating environment. The concerns with manufacturing defects are sufficiently captured in the sentences following this sentence.	**Requested Change:** *"~~As noted in item 2 from above, b~~**B**onded repairs **on critical structure** must be designed to be damage tolerant in order to preclude catastrophic failure due to fatigue, corrosion, ~~manufacturing defects~~ or accidental damage throughout the operational life of the aircraft. …"*	Y		Accepted	
24	*Boeing Commercial Airplanes*	3.1, EASA Policy	Page 14; 1st paragraph 2nd bullet	**The proposed text states:** *"• When complying with CS 25.571, 27.573 and 29.573, all CS-25 PSE and CS-27 and CS-29 critical structures have a minimum required residual strength of limit load (as defined in the regulations for each type of aircraft) for all assumed detectable damage types. …"* **Justification:** The discussion is regarding the quality of the bonded repair. Any found damage must be addressed from a residual strength perspective. The concern is damage that may be undetectable, but permissible by process. In these cases, the structure must still be able to satisfy regulatory residual strength.	**Requested Change:** *"• When complying with CS 25.571, 27.573 and 29.573, all CS-25 PSE and CS-27 and CS-29 critical structures have a minimum required residual strength of limit load (as defined in the regulations for each type of aircraft) for all ~~assumed detectable damage types~~ **defects acceptable by process, but will not or may not be found by inspection**. …"*		Y	Partially accepted	Text proposed for deletion has been deleted.
25	*Boeing Commercial Airplanes*	3.1, EASA Policy	14; 4th paragraph	**The proposed text states:** *"Documentation on all repairs should be added to the maintenance records for the specific part number. …"* **Justification:** Repairs performed as part of the MRB process use the major/minor process to determine need for reporting and documenting to the airlines. Repairs performed in service are subject to different requirements that may or may not document bonded repairs sufficiently for this proposed CM.	**Requested Change:** *"Documentation on all repairs **performed in service** should be added to the maintenance records for the specific part number. …"*	Y		Accepted	

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26	*Boeing Commercial Airplanes*	3.1, EASA Policy	14; 4th paragraph	**The proposed text states**: *"Documentation on all repairs should be added to the maintenance records for the specific part number. …"* **Justification**: The subsequent sentence in the policy document indicates that the retained documentation is to be "*… available to those evaluating airworthiness….*" As bond strength is process-dependent, the ability to conduct an evaluation will rely upon having documentation that the processing and materials used are within the process limits for which substantiating data exist. Retention of such data will also be useful should the bond in a repair prove to be unreliable after time in-service and a root-cause analysis needs to be conducted. Such documentation requirements are also consistent with the FAA regulatory philosophy of System Safety, which requires collection and evaluation of data to incorporate lessons learned back to the industry.	**Requested change**: We recommend appending the following text: ***"As bondline strength is only ensured by abiding to the substantiated processes and materials, documentation should include relevant material and process parameters which are controlled by the repair document."***		Y	Accepted	Similar text added.
27	*Diamond Aircraft Industries GmbH*	all	all	It should be clarified that scarf repairs, which are standard repairs for small airplanes, are not in the scope of the CM. We disagree with the basic assumption that limit load must be supported with a completely failed repair. This would make some types of repair impossible which have been conducted successfully many times in the past, e.g. replacement of complete wing skin panels. More general, the replacement of a part that is bonded to the structure per type design is a repair to full compliance when proper materials and processes are used. The CM as well as the referenced pages in the FAA Policy Statement do not reference a specific case (accident or incident) that prompts the introduction of such a strict policy. We are inclined to agree with the FAA Policy Statement where it says "Most bond failures and problems in service have been traced to invalid qualifications or insufficient quality control of production processes." However, this cannot be fully solved in design. Where appropriate, current repair designs account for conditions which are different from a fully controlled manufacturing environment by assuming lower design values, requiring larger bond areas, etc. Nevertheless, the minimum qualification of repair personnel must be assured by the repair organizations. The system will not be practicable otherwise.	Include statement in front matter. For cases in which the strength of a bonded repair is ensured to a high level of confidence (in particular: repairs to full compliance), remove the limit load requirement for a completely failed repair.	yes	yes	Partially accepted	EASA agrees and believes that the amended text to 'purpose and scope' and at the end of the policy will address the comment. Please see the response to comment 5.

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28	*Airbus*	1.1 Purpose and scope	4	The concern is with failure of bonded repairs leading to impact on airworthiness. Classification of repairs follow the 21A.91 criteria that state that a minor change/repair is one that has no appreciable effect on the airworthiness of the product. By definition, the scope of this CM should cover only major repairs The FAA draft policy states in chapter A: **This policy is not intended for minor repairs.** The EASA CM does not refer to minor repair. For clarification of the purpose of this CM and harmonisation with the FAA draft policy, the scope should be identical	Propose to add at the end of the chapter 1.1: **This certification memo is not intended for minor repairs.**		y	Accepted	Slightly different text to that proposed has been added to 'Purpose and Scope' *'The content of this CM may be used to assist in the determination of repair classification and the policy, section 3.1, is not intended for repairs finally determined to be minor repairs.'*
29	*Airbus*	2 Background	9	The following paragraph is not in the FAA Policy: *The potential for older critical structure to include bonded repairs (particularly those not meeting the intent of this policy), which may have deteriorated due to environmental aging, should be considered within fleet leader and fleet sampling programs.* For clarification of the purpose of this CM and harmonisation with the FAA draft policy, this paragraph should be deleted	Propose to delete this sentence: ~~*The potential for older critical structure to include bonded repairs (particularly those not meeting the intent of this policy), which may have deteriorated due to environmental aging, should be considered within fleet leader and fleet sampling programs.*~~		y	Accepted	Ageing composite structure, including repairs, are likely to be addressed in future regulatory/industry activities.
30	*Airbus*	2 Background	11	The following paragraph is not in the FAA Policy: *The effects of exposure to in-service loads and environmental aging should also be considered in the substantiation of repairs. Some recent research results with cured composite materials show reduced repair bond strength, which may be linked to irreversible environmental and mechanical load history.* For clarification of the purpose of this CM and harmonisation with the FAA draft policy, this paragraph should be deleted	Propose to delete this sentence: ~~*The effects of exposure to in-service loads and environmental aging should also be considered in the substantiation of repairs. Some recent research results with cured composite materials show reduced repair bond strength, which may be linked to irreversible environmental and mechanical load history.*~~		y	Partially accepted	The intent of the first sentence has been retained to remind applicants that the repair, as is the case for the baseline structure, should consider environment, ageing etc.

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31	*Airbus*	2 Background	11	The following paragraph is not in the FAA Policy: *Additional considerations may also need to be applied to structures not typically considered PSE or Primary Structure, but for which repair failure could result in a significant reduction in safety.* ● *bonded repairs to composite and metal engine structures should consider whether the failed repair can be ingested and damage engine parts.* ● *repairs to large fairings, which may depart the aircraft, if failed, and impact downstream critical structure require other consideration.* *Such evaluations will require engineering judgment. The EASA should be consulted early in the process whenever additional substantiation data is needed to extend existing repair size limits.* For clarification of the purpose of this CM and harmonisation with the FAA draft policy, this paragraph should be deleted	Propose to delete this sentence: ~~*Additional considerations may also need to be applied to structures not typically considered PSE or Primary Structure, but for which repair failure could result in a significant reduction in safety.*~~ ~~*● bonded repairs to composite and metal engine structures should consider whether the failed repair can be ingested and damage engine parts.*~~ ~~*● repairs to large fairings, which may depart the aircraft, if failed, and impact downstream critical structure require other consideration.*~~ ~~*Such evaluations will require engineering judgment. The EASA should be consulted early in the process whenever additional substantiation data is needed to extend existing repair size limits.*~~		y	Not accepted	The CM text is simply providing 'background' information which identifies some potential issues which could require consideration and help to define criticality, and therefore size limits, for a bonded repair. This could be appropriate to the TCH for initial sizing. However, it can also be of relevance to the non-TCH when assessing the potential consequences if deviating from TCH data without TCH support. As discussed in the 'purpose and scope' , this CM also provides some reference for the Part 145 + non-TCH DOA communities.
32	*Airbus*	3.1 EASA Policy	13	The paragraphs 3.1.2 & 3.1.3 seem to be quite generic and do not really drill to sufficient detail for distinguishing between metal and composite F&DT. At least it should explicitly state that the "LL/fail safe rule" and "BVID/VID on composite repairs" must be considered, if that is what is intended (otherwise there will be big differences "world-wide", such that the policy fails to achieve its intended benefit)	The CM to be modified to consider the following points: • lack of clear split of F&DT policy for metal vs composite (consistent with 2x.571 vs 2x.573/AC 20-107B) • should highlight fatigue and corrosion for metal and impact for composite • no mention of Fatigue Critical Structure • the LL rule is a "fail safe rule" coming from 23.573 – clearly "F&DT"		y	Partially accepted	EASA agrees with the majority of the technical comments made. However, for the purposes of maintaining a manageable document, it is not practical to expand the discussion here without more extensive explanation and provision of further context. However, the intent of the comment has been added to the 'background' text. Furthermore, the paragraphs running over page 13/14 do reference 'fatigue, corrosion, and accidental damage' (slightly amended for this revised version) and the following bullet points reference CS 23.573, CS 25.571, CS 27.573, and CS 29.573 which should drive the applicant to follow the supporting guidance, e.g. AMC 20-29 etc. Note: Reference to FCS added to PSE definition text.
33	*Airbus*	3.1 EASA Policy	13	In paragraph 3.1.2, the use of wording *Dynamic strength* is not usual wording to represent the criteria to be analysed.	Delete: ~~and Dynamic strength~~		y	Accepted	
34	*Airbus*	3.1 EASA Policy	13	The policy in 3.1.2 refers to • *Flutter protection, and (CS 2x.629)* A repair does not need to include by definition a flutter justification, only for the cases where there is an impact foreseen (example weigh and balance distribution control surface) this aspects need to be justified. Deletion of this reference is in line with the following paragraph, page 14: *If significant changes in structural stiffness and/or geometry result from the failed repair, analysis for flutter and other aeroelastic instabilities should be performed to ensure the failed repair does not lead to other flight safety issues.*	Propose to delete ~~• *Flutter protection, and (CS 2x.629)*~~		y	Not Accepted	EASA agrees that the page 14 discussion addresses the important points regarding flutter. However, inclusion of CS 25.629 in the listing is considered to be beneficial to encourage thought regarding this subject. Some non-TCH applicants have been known to forget this point.

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35	*Airbus*	3.1 EASA Policy	14	The policy states: *As noted in item 2 from above, bonded repairs must be designed to be damage tolerant in order to preclude catastrophic failure due to fatigue, corrosion, manufacturing defects or accidental damage throughout the operational life of the aircraft.* The sentence is confusing and has no added value in the context of the explanation in §E.3 which is focusing on LL capability of failed repairs due to manufacturing defects or weak bonds.	Propose to delete this sentence: ~~As noted in item 2 from above, bonded repairs must be designed to be damage tolerant in order to preclude catastrophic failure due to fatigue, corrosion, manufacturing defects or accidental damage throughout the operational life of the aircraft.~~		y	Accepted	
36	*Bombardier Aerospace*			Bombardier Aerospace supports the proposed Certification Memoranda CM-S-005, Bonded Repair Size Limits in accordance with CS 2x.603 and AMC 20-29, and offers the following comments to ask for clarification of some issues. Similar comments will be submitted to the FAA on their proposed Bonded Repair Size Limits policy as well.				Noted	
37	*Bombardier Aerospace*	3.1.2	13	It is understood that in demonstrating compliance with 25.571 for growth and residual strength of boded repair, there will have to be simulation of the "weak" bond considered defect. It would be appropriate to conclude that the simulated defect would reduce residual strength somewhere between Ultimate and Limit load. The size of the simulated defect and related "drop" in residual strength would therefore be subject of interpretation likely relative to the size of the repair. It would be helpful to offer some discussion on the subject that can ultimately lead to some level of harmonization of the approach. BA does not consider necessary to strictly define the required factor commonly defined as "K", but would rather suggest that some guidance is provided as of what would be in general acceptable means of compliance such that the compliance plans can be somewhat better defined. Further guidance would certainly reduce risk of undesirable rejections of compliance plans on the basis of the size of the simulated defects.				Noted	EASA agrees with the intent of the comment. However, the subject is currently evolving regarding expectations and EASA considers current discussion to be too detailed and product specific to develop manageable discussion in the CM. Reference to CMH-17 has also been added to the CM because discussion regarding this subject should be developing in that forum.

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38	*Bombardier Aerospace*	3.1.3	13	It is stated: *"The data supporting the bonded repair should include inspections that are capable of detecting complete or partial failure (within arresting design features) of the bond line. Inspection thresholds and intervals should be set that consider criticality of the structure and the magnitude of the residual strength of the failed repair (i.e., a failed repair which could result in a residual strength near Limit Load is recommended to be inspected with increased frequency)."* It would be helpful if some guidance could be given regarding an acceptable method of determining such threshold and repetitive inspection intervals.				Noted	EASA agrees with the intent of the comment. However, the subject is currently evolving regarding expectations and EASA considers current discussion to be too detailed and product specific to develop manageable discussion in the CM. Section 3 'Policy' has been amended to direct the applicant to the DT principles of AMC 20-29 (and evolving substantiation content in CMH-17). Reference to CMH-17 has also been added to the CM because discussion regarding this subject should be developing in that forum.
39	*Grob Aircraft AG*			Grob Aircraft disagrees with the basic assumption, that limit load must be supported with a completely failed repair. Grob policy is, that with a proper composite repair the original structural integrity will be restored to comply with all airworthiness requirements. Standard repairs which can be executed by a MO are defined in the corresponding 'Maintenance Manuals'. All other repairs are subject to a specific repair design approval according to DO-procedures. For each individual case it will be decided, if the repair can be performed in an authorized MO or if we require the repair should be done locally at the maintenance shop of Grob Aircraft AG. Grob policy is, before discussing about detailed wording in the proposed CM-S-005, to clarify the requirement *"All critical structure will have a repair size limit no larger than a size that allows Limit Load strength to be achieved with the repair failed or failed within constraints of the arresting design features"* (see Ref./1/page 13). Grob Aircraft AG as member of the AFF participates also in the discussion for a common Comment Response Document of the AFF with respect to CM-S-005 Issue 01. Grob Aircraft AG as member of the AFF agrees in principle to the Comment Response Document of the AFF (see Ref./2/) as well as to the Comment Response Document of Dornier Seawings.				Partially accepted	EASA believes that the amended texts to 'purpose and scope' and at the end of the policy will address the comment. Please see the response to comment 5.

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40	*Airbus Helicopters*	/	/	General comment We have the information that this document has been created by authorities with consultation of fixed wing OEMs like Airbus, Boeing… Rotorcraft OEMs were not part of this consultation. As a matter of fact, it appears that some main principles in this document do not account for specificities of rotorcraft design and experience of the rotorcraft industry, as shown in some of the subsequent comments.	Suggestion is to: - Limit the scope of this CM to fixed wing aircraft, - Create a new or enlarged working group including representatives of rotorcraft OEMs.		yes	Noted	The need for the document was driven by the recent expansion of composite use in the CS-25 community. Therefore, for reasons of practicality, this draft was developed within a limited initial group of regulators and organisations knowing that this formal comment period is also available to allow inclusion of all interests. The CM is a living document and can be revised now or in future. EASA believes that the high level principles of the CM remain applicable to rotorcraft and that the impact upon the industry should be limited. The intent is to extend the working group activity to include rotorcraft activity in the future. EASA acknowledges the established experience with some critical bonded repair activities and has also amended the 'background' text accordingly. EASA believes that the amended texts to 'purpose and scope' and at the end of the policy will address the comment. Please see the response to comment 5.
41	*Airbus Helicopters*	2	9	"*In the past, bonded repairs have generally been limited to less critical structure. These repairs have not always been successful.*" Return of experience on non-critical structures cannot be considered as relevant for critical ones, unless it is proven that process and quality controls were at the same level as for critical parts. For critical parts, critical characteristics are identified (e.g. surface preparation) and controlled in order to ensure reliability of manufacturing or repair.	The rationale for development of this policy should not be based on past experience of repairs failures on non-critical parts, but only on documented cases of failure observed on properly managed critical parts. For example, large and positive experience of sandwich repairs performed since 30 years on composite blades (critical parts) should be taken in consideration.		yes	Partially accepted	The rationale is that the broader combined industry bonded structure experience includes issues associated with design, production, and continued airworthiness. This includes PSEs, Primary Structures etc. Therefore, it is appropriate to reference lessons learned, some which may be relevant and transferable between rotorcraft and fixed wing. EASA is well aware of the fact that there are some notable established successes, particularly relating to rotorcraft, such as identified in the comment. Text amended in the CM accordingly.

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42	*Airbus Helicopters*	3.1	13	"*All critical structure will have a repair size limit no larger than a size that allows Limit Load strength to be achieved with the repair failed*" This policy leads to the following observations: - The only characteristic focused on by the proposed CM is the size of a bonding. So there is no differentiation between high and very low stressed bonding interfaces, whereas the failure probability for very low stressed areas is lower because a small area without weak bond is sufficient to transfer the load. Also, one could argue that the larger the bonding is, the lesser is the chance to have weak bond on the entire surface. - There is no option left for developing an inspection plan or methods which would be able to detect bonding failures early enough to guarantee the required level of safety. Especially, blades are external components, easily monitored by routine inspections and GVI. The strict application of this policy suggests almost instantaneous failure of the complete bonded surface, which is obviously unrealistic. - There is no room given for potential future improvements of NDT methods to guarantee sufficient failure probability of bonding. There is also no option left for the industry - after long time experience with bonding - to generate a quality program to guarantee sufficient reliability of bonding. This policy would introduce tremendous changes as compared to the status quo of helicopter design, manufacturing and repair, especially for blades and for typical very thin-walled airframe structures (especially sandwich structures).	This policy should be completely reworked, at least in the context of helicopters, to consider: - Differentiation between high and low stress areas, - The ability of early detection of bonded repair failures by inspection plans or even due to the visibility of structures (e.g. rotor blades), - Technological advances in the manufacturing and/or NDT processes. NOTE: One shall also consider that the proposed policy is not consistent with current rotorcraft certification guidance and that the cited statement appears as a new prescriptive requirement, which is not in line with the principles of Certification Memoranda as reminded on page 1. As per AC29-2C MG8 (and AC 29.573), it is recognized that components using secondary bonding and providing satisfying service experience can be acceptable, at least for rotor blades. Cf. MG8 § g.6.ii.C.3 : "*Critical bonded joints that have high static margins of safety (e.g. some rotor blades) may be acceptable, provided there is satisfactory service history of like or similar components.*". This principle has not been challenged during the recent updates of AC 27/29 (change 4), where only minor formal changes have been made on MG8.		yes	Partially accepted	It is necessary to have a simple practical title which should generate the thoughts expressed in the comment. However, the differentiation between high and low stresses is implied in the link between size and criticality as addressed in leading paragraphs of the policy, e.g. para.2 and 3 of section 3.1. The inspection/detection discussion is addressed in referenced AMC 20-29, which also references AC 29 2C MG8 etc. The CM does not exclude any ability to develop early detection of bonded repair failures by inspection plans or even due to the visibility of structures. The CM does not exclude the potential benefit of future advances in technology. It simply provides current status. However, please see the note added to the end of the policy text and see the response to comment 5. Note: Reference to good rotor blade repair experience added to the 'background' text. Note: This CM is primarily addressing repairs, not baseline structures. However, reference to good rotorcraft baseline structure has been added. Also note that there have also been some metal bond problems with metallic rotor blades and some delamination problems with some composite blade baseline structures. EASA does not believe this policy, including the proposed amendments above, to represent a significant change to current practice for the rotorcraft industry. Note: the policy provides a link to the appropriate CS requirements.
43	*Airbus Helicopters*	3.1	14	"*Per item one above, the design and process specifications should make manufacturing defects for which inspection methods are not available, (i.e., weak bonds) extremely rare. Regardless, the design of the repair still must account for these rare events and be considered in the damage tolerance evaluation.*" Considering precautions taken for the definition and implementation of repair processes for critical parts and assemblies, the quality and reliability of a repair is considered sufficient to avoid complete failure of a bonded repair. This is also supported by the decades of experience in performing repairs.	Suggestion is to delete "*Regardless, the design of the repair still must account for these rare events and be considered in the damage tolerance evaluation.*", in line with comment #3 above.		yes	Partially accepted	The text simply repeats basic baseline structure F&DT expectations, particularly relating to weak bonds, and reminds the reader that it also applies to repairs. Note: the text has been amended and clarified.

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44	*Airbus Helicopters*	3.1	13	"*… or failed within constraints of the arresting design features…*" What is meant by an "arresting design feature" ?	Concept to be clarified		yes	Partially accepted	Arresting design features include design details which slow or stop damage growth such that structural integrity is maintained. Text slightly amended to include a possible example: *'within damage arresting design features, e.g. fasteners that exist within the base structure or repair design''.*
45	*Airbus Helicopters*	1.4 Bonded Joint\ Structure	5	Reference to CS 23.573(a)(5) here is not understood in relation to the definition.	Suggestion is to remove this reference	yes		Accepted	
46	*Airbus Helicopters*	1.4 Disbond	6	"*adhesion failure or separation*": the difference between both terms is not understood.	Suggestion is to delete "*or separation*"	yes		Accepted	
47	*Airbus Helicopters*	1.4 PSE	7	PSE is used in different CS, probably the wording is not everywhere the same	Delete reference to AMC 25.571 para.2 and prepare a wording covering all CS	yes		Partially accepted	EASA acknowledges that various definitions of PSE exist. However, it was considered appropriate to use one definition for this document. In this case the CS-25 definition has been used because it is considered to be adequately generic to address the majority of concerns and the CM evolved primarily in response to the expanded CS-25 composite applications. Note: More importantly, the term 'critical structure' has been defined as a common term in this CM in order to ease reading of the text and to address the important structures as defined in each CS.
48	*Steinbeis Flugzeug- und Leichtbau GmbH* *Deutscher Aeroclub - DAeC*			As member of the technical committee of the German Aero Club (Deutscher Aeroclub - DAeC) I herewith response to the call for comments for the proposed Certification Momorandum CM-S-005 "Bonded Repair Size Limits". The technical committee of DAeC is the group, where all regional sub-associations of the DAeC meet regularly to discuss and harmonise the German procedures regarding the technical side of gliding and other air sport activities within the DAeC. This includes: ...development of the syllabus for the training of the German licences for certifying staff for sailplanes ...organisation of the actual training courses for this certifying staff - here the proper processes for composite repairs are demonstrated and performed with practical hands-on training lessons ...organisation and harmonization of training courses for additional technical staff, where also repairs are demonstrated and performed ...harmonization of the proper procedures regarding the certification and paperwork of such repairs - the DAeC typically is not the applicant for such repair approvals but often the staff performing the repairs are DAeC trained members of our association ...harmonization of the maintenance organisations of the regional sub-associations - these associations are					

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				typically holding a M/F and/or Camo organisation approval and conduct regarding repairs and inspections This system is working very good in Germany for more than 40 years. The repairs performed within this system include structural repairs on composite sailplanes, which have had considerable damages. Typical examples are: a rear fuselage torn away which needs repair or replacement of the empennage section. A wing damaged over more than 20% of the wing span. A cockpit shell which is broken along more than 50% of the circumference. In all such cases it was possible to repair these gliders according to the repair instructions given in the maintenance manuals of the aircraft or according to documents developed by the manufacturer or the standard procedures - all as demonstrated in our training courses. Nevertheless in all such cases the size of the bonded repair size exceeded the limit as specified in the CM-S-005 "Bonded Repair Size Limits", as a complete failure of this bonded joint would result into a complete failure of the structure. (Not even limit loads would be carried by this structure in case of total failure of the bonded joint.) In reality such a failure does not occur and furthermore the repair processes have shown regarding strength and durability during the development of these processes and within the scope of the regarding certification processes. If your proposed CM-S-005 "Bonded Repair Size Limits" would have been applied in those last 40 years, we would have today at least more than 100 sailplanes less in Germany. Despite the fact that all these repairs resulted into fully airworthy aircraft which have today amassed thousands of flight hours after their repair without any problems. Therefore I sincerely doubt that the concept of the proposed CM-S-005 "Bonded Repair Size Limits" is applicable to sailplanes and the procedures practiced for a long time in Europe. I can therefore not concur to your proposal and urge you to re-think the proposal or to limit this Certification Memorandum to those sectors of aviation where it might be applicable. In my opinion, the CM-S-005 "Bonded Repair Size Limits" is not applicable to sailplanes as practical experience has shown for more than 40 years.					
49	*Lufthansa Technik AG*			Lufthansa Technik (LHT) supports EASA's efforts to provide an improved guidance for this matter. Bonding processes become more and more important				Partially accepted	EASA recognises and understands the current situation as described by LHT.

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				and will be more frequently applicable as the composite usage extends to critical parts of the structure. The drafted policy, in general, reflects Lufthansa Technik's philosophy and aspirations with respect to flight safety and repair quality. However, it is our firm believe that key to a high level of flight safety is the availability of technical information and data to the commercial aerospace community, especially to operators and their designated MROs. Our view is that this policy could lead, in some aspects, to the fact that the availability of instructions for continued airworthiness will be further limited due to commercial instead of technical reasons. We have seen in the recent past that such restriction regarding to the access of data and information, being in full control and sole discretion of the OEM's, resulted in increased cost to the airlines. This concerning trend could be further supported by unclear definition of the "critical structure" and thereby of the scope and applicability of the draft policy. Lufthansa Technik's business unit "Airframe Related Components" has, over decades, used its vast engineering knowledge and comprehensive experience regarding bonded structures to set high quality standard and provide an industry leading service to our worldwide customers. We have used our expert knowledge and data on bonding materials and processes to even improve the original design, leading to more robust bondlines with extended service life proven over decades pf operation. We don't see the necessity to further restrict the opportunities for market players outside the OEM community to provide such repair services. It is our understanding that the current regulations and guidance materials are sufficient in most areas. Clarifications in certain areas would be helpful though. For example, clear definition of "critical structures" (e.g. by reference to PSE) would support an increasing level of quality associated to repairs and jointly enable MROs and airlines to develop appropriate and cost effective repair solutions. We would appreciate the support of the airworthiness authorities on this matter and therefore ask for your consideration of the above comments in any upcoming guidance- or rulemaking processes. We would also like to offer our willingness and commitment to constructively and actively participate in the upcoming policy process by adding our experience and knowledge. LHT continually strives to offer alternative, reliable and cost-effective bonded repair solutions to the market in the future. We would appreciate any upcoming opportunity for a mutual meeting to further discuss the above matter.					Regarding documentation, EASA can only comment in relation to the technical information that is considered to be necessary to support the safe design and execution of a repair. Unfortunately, EASA cannot comment regarding business arrangements and the commercial aspects etc. Regarding PSE definitions etc., and further to responses to other comments, EASA can only state that the CM does not change the classification of structures, or associated repairs, as defined by the TCHs for their respective products. It is simply a phrase used to collectively identify structures significant to airworthiness for the purpose of ease of reading the AMC, allowing for different definitions across the various CSs. The CM also simply highlights in 'background discussion' further criteria which may have influence upon criticality for which deviation from TCH data may be of some consequence to safety. EASA remains open to discussion regarding this subject and values efforts to improve consistency and quality of bonded repairs. Note: EASA believes that the amended texts to 'purpose and scope' and at the end of the policy allows some flexibility regarding this comment. Please also see the response to comment 5.

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50	*Dornier Seawings GmbH*			**Determination of the procedures for Bonded Repairs in accordance with CS 2x.603 and AMC 20-29** The wording "Size Limits" can result in a misleading interpretation that the only parameter for the criticality of a repair is its size. In reality, "the criticality of a repair is depending on the level of reconstruction of the original structural framework". In this context the following repair principles have to be applied to reach full reconstruction condition: – Design Allowables are the strength basis for repaired structures. – The manufacturing processes to achieve Design Allowable values must be properly defined and established. – The staff performing respectively checking repairs must be adequately skilled and experienced. – Depending on size of repairs, affected components and/or locations, difficulty/complexity etc. adequate support from the responsible DO must be provided. – Deviations from the original design or from original manufacturing principles have to be carefully evaluated (e.g. dry — dry bonding instead of an original wet — wet bonding) and adequately treated. As long as compliance with Design Allowables is met, the repair size is not a limiting factor. The above summarized principles constitute since decades the basis of numerous repairs successfully performed on composite structures which are comparable to the Seastar airframe. Hence our proposal is to go on with these well proven proceedings. Additionally you find additional comments from our side to proposed CM-S-005 Issue 01.				Partially accepted	The differentiation between high and low stresses, criticality, and size is implied paras.2 and 3 of section 3.1. EASA believes that the amended texts to 'purpose and scope' and at the end of the policy will address the comment. Please see the response to comment 5.
51	*Dornier Seawings GmbH*	Title	1	"Subject Bonded Repair Size Limits in accordance with CS 2x.603 and AMC 20-29" The wording "Size Limits" can lead to the misleading interpretation that the only parameter for the criticality of a repair is its size. In reality, the criticality of a repair is depending on the design principles of the TD and the location of a damage within the structural framework.	Title should read more precisely: "Subject Determination of the Criticality and Limitations of Bonded Repairs in accordance with CS 2x.603 and AMC 20-29"	Suggestion	Substantive	Not accepted	It is necessary to have a simple practical title which should generate the thoughts expressed in the comment. However, the differentiation between high and low stresses is implied in the link between size and criticality as addressed in leading paragraphs of the policy, e.g. para.2 and 3 of section 3.1.

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52	*Dornier Seawings GmbH*	1.4 Definitions Figure 1	8	Figure 1 shows parts of a company paper which shows the understanding and definitions of bonding of a department of a commercial aircraft manufacturer as applied in aircraft production. For general aviation aircraft manufacturers and especially for repairs, different definitions apply: The upper figure depicts a single part, which is typically designated an integral part. Integral parts are produced in an integral curing process. The bonding process is usually not considered as part of the production process of integral parts. The production of integral parts again is in general not subject of repair procedures. The middle figure depicts an uncured part bonded to a cured part by means of an additional adhesive film. The referenced company paper designates this technology as co-bonding. This process may be used by some aircraft manufacturers in production and repair. For CS23 aircraft, a different process where curing and jointing of an uncured part in coexistence with an already cured part takes place is used more often. The utilisation of uncured material and the absence of a bonding film make a big difference in the process. Kissing bonds due to misfit of the parts to be joined and failures in the application of the bonding film are excluded by the process. As the curing takes place in coexistence with the already cured part, this process should be referred to as co-curing. The lower picture depicts the joining of two rigid parts by what is commonly understood as the bonding process. The vast majority of descriptions of bonding failures refer to this common scenario, which of course offers the most possibilities for failures due to possibility of misfit of the part to be joined and mistakes in the application of the adhesive.		Suggestion	Substantive	Noted	EASA agrees with many of the comments. EASA also understands that many definitions of bonding process exist. It is for this reason that the basic terms, as to be used in the CM, were defined. The CM does not prevent use of other terminology, provided that it is clearly explained by the applicant. EASA believes that the 3 cases presented represent the range of basic concepts. Regarding the upper figure, co-cure may form part of a complex repair involving a number of details, elements etc. EASA also understands that there is disagreement regarding the term 'bonded structure', e.g. regarding co-cured sandwich structures etc. Such discussion is beyond the scope of this CM. Note: EASA is preparing a CM addressing the use of Sandwich Monocoque Structures in Critical Applications
53	*Dornier Seawings GmbH*	2 Background 1st paragraph	9	"In the past, bonded repairs have generally been limited to less critical structure." This is true for large aeroplanes. It should be added however for CS-23 aeroplanes and sailplanes this statement does not apply. Repairs to critical structures including wing main spars have been conducted successfully since approx. 50 years. Safety logs about incidents resulting from such repairs do not exist.		Suggestion	Substantive	Partially accepted	EASA believes that the amended texts to 'purpose and scope' and at the end of the policy will address the comment. Please see the response to comment 5. Furthermore, the text in the 'background' section has been amended to emphasise that the statement applies 'particularly to large aeroplane applications' and also reference made to successful more extensive bonding in smaller aircraft and rotorcraft have also been added.

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54	*Dornier Seawings GmbH*	2 Background 3rd paragraph	9	"A key technical problem associated with weak bonding is that environmental effects may continue to degrade the bond strength over time in an unpredictable manner." Clear distinction should be made, if a repair is conducted utilising the original production material and processes or if different processes and arbitrary adhesives are used. In case of utilisation of original production material and processes, it has been already demonstrated for the material and processes that environmental effects do not degrade the bond strength over time in an unpredictable manner.		Suggestion	Substantive	Noted	EASA agrees that use of original materials should help to produce a good repair. However, there is some doubt that even the original materials applied to an old degraded structure will always result in good repairs. Therefore, it is reasonable to expect evidence to support the environmental degradation potential on a case by case basis, rather than assume that use of original materials will always produce a good repair.
55	*Dornier Seawings GmbH*	2 Background 7th paragraph	9	"The potential for older critical structure to include bonded repairs (particularly those not meeting the intent of this policy), which may have deteriorated due to environmental aging, should be considered within fleet leader and fleet sampling programs." See comment to 2. Background, 3rd paragraph, page 9, if original materials and processes are utilised, environmental aging effects are already covered by the compliance showing for the TD. Repairs conducted in that manner need not to be monitored other than the entire aircraft structure.		Suggestion	Substantive	Noted	See comment 54.
56	*Dornier Seawings GmbH*	2 Background 8th paragraph 11th, 12th, 13th paragraph	9 - 10 10	"The information developed for complete bonded repair substantiation is not readily available to the engineering community operating in the field." "In-service bonded repairs…" "Therefore, field conditions and the availability of experts…" "…repairs performed in the field…" "Field repairs may need to be performed…" The term field repair and in-service repair are not clearly defined. As contribution to clarification following definition is suggested: • in-service repair • standard repair • large repair The term field repair should be avoided due to unclear definition of "field". Suggested definitions are based on the criticality of a repair and the related release to service procedure. in-service repair: no criticality, e.g. damage size below the maximum non-detectable failures as demonstrated for the TD in fatigue and strength investigation. In the compliance showing it is demonstrated that the structure has ultimate load capability even with these failures in place. In-service repairs can be conducted by any		Suggestion	Substantive	Partially accepted	EASA understands that various definitions exist for types of repair. However, for the purposes of this CM, 'field' has been replaced with 'in-service', meaning the broader definition as it is commonly understood, i.e. not in-production, but after first release from initial production activities. 'In-service' repair definition added to 'definitions' section for the purposes of this CM.

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				person without proof of qualification required, as it was already demonstrated that the structure has full ultimate load capability over the entire service life even with damages of this size in place. Thus the quality of the repair is completely negligible. The repair is carried out without subsequent release to service as the aircraft never was out of service (in-service repair). standard repair: damage size bigger than the max. non-detectable failures and loss of serviceability. Application of repair procedures identical to the production procedures or procedures from a SRM. Is conducted by a qualified MO without the necessity of consultation of the TC holder or another DO. Release to service according Part-21 required after conduction of the repair large repair: all damages that require a special repair design with the appropriate substantiating data.					
57	*Dornier Seawings GmbH*	2 Background 13th paragraph	10	"The bonded repair should not exceed substantiated size limits." Completely agreed if the repair is carried out that way that it cannot achieve the full strength of the original TD any more (e.g. using material and processes other than originally specified in the TD). If however original production material and original production processes are applied and the stress levels in the material in general and in the bonding in particular does not exceed the stress levels as demonstrated in the TD, a size limit of repairs is not necessary. This can be supported by test data from Dornier Seawings GmbH, showing that primary structure repaired by standard repair procedures has full ultimate load capability and full fatigue strength.		Suggestion	Substantive	Noted	TCH demonstration for specific material and process is essential. This should include demonstration of satisfactory repair durability and performance if applied to aged surfaces etc. Note: Text has been added to the end of the policy to allow some flexibility regarding this CM, see the response to comment 5.
58	*Dornier Seawings GmbH*	2 Background 14th paragraph	10	"Reverse engineering practices, as often applied on metallic structure, or even when used to generate design data through conservative assumptions, will generally not equip the designer with a full understanding of the knowledge basis necessary to expand bonded repair size limits defined in the SRM." The degree of understanding of a design achievable by re-engineering depends highly on the extent and thoroughness of re-engineering practices applied. A metallic structure can also not be re-engineered simply by using an arbitrary aluminium sheet of the same thickness for a repair. Additional information like alloy and rolling direction must also be analysed. The same applies for composite material. If in the re-engineering all necessary analyses are carried out thoroughly enough, it is definitely possible to gain a sufficient knowledge basis for the conduction of repair designs.			Objection	Noted	This paragraph must be read in the context of the previous paragraph, i.e. it suggests that a non-TCH will be less able to justify 'reverse engineering' than the TCH. Although 'reverse engineering' of metallic structure may also be problematic, this paragraph is emphasising that, for bonding (the subject of this CM), the non-TCH cannot be certain that they can replicate the 'engineering properties' because they are generally defined by a more integrated relationship between materials and processes specific to the product configuration (unless directly supported by the TCH). Furthermore, the TCH should have developed a stabilised process. EASA believes that the amended texts to 'purpose and scope' and at the end of the policy will provide some flexibility regarding this comment. Please see the response to comment 5.

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59	*Dornier Seawings GmbH*	2 Background 15th paragraph	10	"In some cases, it has been argued that a part utilizing bonding can be remanufactured well beyond published relevant bonded repair size limits using TC Holder specified materials, processes, tooling, and structural details without additional data since it is considered to be substantiated by the original type certification. Unless assistance has been provided by the TC Holder, it is unlikely that this process can be safely accomplished by a 145 organisation without further substantiating data being developed." Completely agreed.				Noted	
60	*Dornier Seawings GmbH*	2 Background 17th paragraph 2nd bullet point	11	*• some repaired components may require a full fatigue and damage tolerance assessment.* See comment to 2. Background, 13th paragraph, if original production material and original production processes are applied and the stress levels do not exceed the stress levels as demonstrated in the TD, fatigue and damage tolerance assessment are already covered by the TD substantiating data.				Noted	'Some' repaired components, i.e. which potentially includes critical structures , require F&DT assessment, whether it be at TC for SRM purposes, or for specific repairs, i.e. the consideration of defects, BVID etc applies to baseline structure and repairs. Furthermore, the repair may introduce new processes, even when the same material and cure cycle is used as used for the baseline structure. The point regarding the use of original materials may be true, but requires appropriate substantiation, e.g. evidence of repair durability when applied to an ageing structure etc.
61	*Dornier Seawings GmbH*	3.1 EASA policy 3rd paragraph point 1, 2, 3	13	*"1. Repair designs must be approved in accordance with Part 21, and must be performed and inspected by properly trained/qualified individuals with suitable experience."* *"2. Repair designs must have structural substantiation based on tests or analyses supported by tests."* *"3. The data supporting the bonded repair should include inspections that are capable of detecting complete or partial failure (within arresting design features) of the bond line."* Completely agreed. If the repair design utilises original production material and processes, no substantiating data exceeding the substantiating data for the TD is required to substantiate the repair.				Noted	See response to comment 60.
62	*Dornier Seawings GmbH*	3.1 EASA policy 4th paragraph 5th paragraph	13 14	All critical structure will have a repair size limit no larger than a size that allows Limit Load strength to be achieved with the repair failed or failed within constraints of the arresting design features (in the repair or base structure). This approach is needed to ensure Limit Load capability in the event of bonded repair failures such as "weak bonds", which result from rare processing mistakes or other problems in combination with the service environment that cannot be ruled out through a threat assessment. As noted in item 2 from above, bonded repairs must be designed to be damage tolerant in order to preclude catastrophic failure due to fatigue, corrosion, manufacturing defects or accidental damage throughout the operational life of the aircraft. Manufacturing defects, which can be		Suggestion	Substantive	Partially accepted	See response to comment 60. Note: The basic F&DT assumption is that the process should include typical substantiated defects/flaws, and that total failure will not occur. This needs to be demonstrated. However, in the rare event of a more extensive defect/flaw, LL provides a minimum reference point for repair design. EASA acknowledges that some material and processes may result in partial, or progressive, failure modes. However, this may be difficult to quantify and would require very specific demonstration by the applicant. Therefore, the default minimum reference point should be LL. However, if better substantiated process can be demonstrated, e.g. perhaps matching production capability, then the text added to 'purpose and scope' and at the end of the policy allows some flexibility regarding this CM, see the response to comment 5.

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				detected with available inspection methods (i.e., porosity, disbonds and other anomalies) must be controlled within inspectable limits and included in the damage tolerance assessment as appropriate. Per item one above, the design and process specifications should make manufacturing defects for which inspection methods are not available, (i.e., weak bonds) extremely rare. Regardless, the design of the repair still must account for these rare events and be considered in the damage tolerance evaluation. The regulatory considerations for accounting for these rare events may be addressed as follows: • When complying with CS 23.573(a)(5)(i), all CS-23 critical structure must have a bonded repair size limit no larger than a size that allows limit load strength [per loads defined in 23.573 (a)(3)] to be achieved with the repair failed or failed within constraints of the arresting design features (in the repair or base structure). The EASA conclusion takes as a basis the assumption that every bonded repair is either completely sound or fails in its entirety. This assumption is unrealistic. Comparable to riveted joints, where a joint consisting of a certain number of rivets also does not fail in its entirety because one rivet is defective, a bonded joint does not fail in its entirety because of a limited defective spot in the entire bonding. In reality, processes are never 100% perfect or 100% faulty, but everything in between. The threshold at which the size of structural defects does not allow safe ultimate load capability any more and that damage propagation does not occur over the entire service life is already investigated and demonstrated in the TD certification process as compliance showing for CS 23.573. This threshold is the definition of a failed bond. Bonds with bigger structural defects are detectable in production. Provided that original production materials and processes are applied, as it is the case for most CS-23 aircraft repairs, it is assured by the TD substantiating data that bonded joint defects are below the threshold described above and do not affect the design's ultimate load capability. In this case, it is not necessary to limit the size of a bonded repair in general. In this context, it is important however that the approved MOs are capable of understating and applying the original production processes in order to conduct repairs successfully.					

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63	*Dornier Seawings GmbH*	3.1 EASA Policy 9th paragraph	14	3.1. EASA Policy 9th paragraph, page 14, suggestion, substantive comment "The inspection of bonded repairs, including the specified inspection methods, interval and detection criteria, should be defined based on substantiating tests, analyses, trials, and other safety risk mitigation procedures." Completely agreed. Every bonded repair must be inspected the same way as a production bond before the structure is released to service. If original production materials and processes are utilised in the repair process and if the stress levels remain the same, there is no need for special inspections or inspection intervals for a certain repair.		Suggestion	Substantive	Noted	
64	*AFF*	general		The term repair "size" suggests that the physical size (alone) steers the severity of damage. Secondly: the damage size is something the repair designer cannot influence. It is a given from the incident. Third: in GA it is indeed common practice to for instance repair complete torn off fuselages. The term "rebuilt" might then be more appropriate.	Make clear that sometimes an INCREASE in repair area could even increase the safety of a bond due to better accessibility. Where the damage/repair size is large additional measures might be needed for quality control or risk mitigation (e.g. performing the required bonding in increments, post repair load test)	S		Noted	It is necessary to have a simple practical title which should generate the thoughts expressed in the comment. However, the differentiation between high and low stresses is implied in the link between size and criticality as addressed in leading paragraphs of the policy, e.g. para.2 and 3 of section 3.1. EASA also agrees that sometimes defining a larger repair than that being necessary to clear the damage can be a safer option, e.g. because it allows the use of more convenient slice locations in the part, which is more likely to result in a successful repair etc. The CM does not prevent this approach. EASA believes that the amended texts in 'purpose and scope' and at the end of the policy will allow some flexibility regarding the comment. Please see the response to comment 5.
65	*AFF*	general		The document does not give a guideline of what to do in real life. It lists, rightly, influencing parameters and things to be considered. In addition is summarizes existing information from other sources. But it does not give a practical guide of how this is done.	Add a flowchart showing the information flow between TC holder, 145 and required actions (apply for repair etc.). Show when which potential influence factor should be considered – how does for instance a repair designer know if and how lightning protection is an issue?	S		Noted	1/ This is intended to be a harmonised CM. Therefore, it would become impractical to include flowcharts for all situations. Furthermore, this CM does not change exist regulatory flow paths. It simply discusses higher level aspects of the repair design. 2/ Any DOA (TCH, or non-TCH) should have adequate understanding of the appropriate CS requirements for the product to be aware of the issues. AMC 20-29 provides further coverage.

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66	*AFF*	Definitions	5-7	The definitions leave room for misunderstanding and confusion: The term “secondary” becomes in this document a little confusing – although the intention is to make it clear. Note 6 says the term “secondary bond” should be avoided. This is contradicted in Figure 1. The term “structural bond” implies that there is such thing as a “non-structural bond”. The term ‘secondary bond’ implies that there is such thing as a ‘primary bond’ The explanation of the term “bond”, according to the paper is synonym with “structural bond” and ”bonded joint/structure”	Suggest to remove the statement in note 6 “When used, the understanding of the term Secondary Bond should be clarified with the user”. The paper should be in itself concise and only use the one term for one thing. As far as understood by the author there are: - Bonds o Co-cured o Co-bonded o Secondary bond - Bonds with additional fasteners o Possible for any of the above Suggest to split the definition section is ‘definitions used in this paper’ and “other terms commonly found”	S		Noted	Inconsistent terminology is used throughout the industry and literature. Therefore, the CM attempts to recognise this and require clarification by the user regarding its intent, if the definitions in the CM are not used. The CM also attempts to provide a recognised set of basic definitions, ref. 1. However, it also allows flexibility for the applicant to define more specific definitions, as is evident in other comments in this CRD. The CM also indicates the regulators preferred intent is to not use the term ‘secondary bonding’ (a subset of the term ‘Structural Bonding.) However, it recognises the reality that it is sometimes used. Note: The use of ‘structural’ in ‘structural bonding’ in the context of this CM implies structural significance of the bond.
67	*AFF*	Definitions	7	The discrimination of composite and metal is not clear with respect to metal-composites (e.g. sandwich with metal facings). Likewise the paper does not consider other types of bonding employed in airplane design (wood inserts, transparencies)	Add to document	S		Partially accepted	The CM does not attempt to specifically address wood. However, some of the points in the CM remain applicable to wood. Text amended to identify that reference to composites is typically concerned with PMCs.
68	*AFF*	Section 2	9	First paragraph. This statement does not address the history in GA/23 airplanes which is looking back on a longer history of successfully designing, producing and repairing critical bonded composite structure.	Limit the applicability of the paper to part 25 airplanes. (then most of the other comments can be disregarded)	S		Partially accepted	EASA believes that the amended texts to ‘purpose and scope’ and at the end of the policy will address the comment. Please see the response to comment 5.
69	*AFF*	Section 2	10	“Field repair” is not defined. In EASA world the term should not exist since repair is always to be performed within an appropriate organization.	Change wording (or define the term)	S		Accepted	See response to comment 56. The phrase, ‘operating in the field’ deleted.
70	*AFF*	unclear		Who does repairs approval when TC by ELA process?	Clarify	O		Noted	This is an evolving process(i.e. development of the ELA concept) which will probably include some standard repairs allowing self-approval. Until then, use existing approval processes.
71	*AFF*	-	-	Size, or any other limitation for repair considered relevant by the DO cannot be enforced unless it is a formal limitation.	Add recommendation for limitation for repairs in AMM limitation section.	S		Accepted	Agreed. Text added to section 3.1 to address documentation of limits etc.
72	*AFF*	-	-	The responsibility of DO and Repair station in who has to demonstrate what is not necessarily clear.	Clarify the intention of process how to substantiate a repair design by ultimate load test and further applicability to similar designs	S		Noted	This CM is not intended to change the existing regulatory process. The standard certification process of test, or analysis supported by test, should be followed as appropriate to the design, the test pyramid available, and appropriate previous experience. Note: This intent is to substantiate repair philosophy and scope in design, not subject each and every repair to LL or UL test.

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73	*AFF*	2	9	"However, it has become evident to the EASA and other CAAs that this is not clearly understood by some organizations supporting repair activities." Wording is a bit unfair. Also CAA's have different views.	Suggest to reword to "....is not clear understood or interpreted in a consistent manner" without the discrimination between authorities and organisations involved in repair.	S		Partially Accepted	Although EASA agrees that the CM may also have an internal regulatory standardisation benefit, the point is that the regulators have seen evidence of limited understanding of repair limits, particularly regarding the reference to UL and LL. This CM, and AMC 20-29, were developed to make a simple message clear, i.e. the principles of the long existing rule CS 23.573(a)(5) also apply to repair, not only baseline structure. Note: the text has been amended.
74	*AFF*	2	9	- "rigorous assessment validation" does it include (LL) testing?	Clarify in how far is LL testing is acceptable to substantiate the repair design (which should be good for UL)?	S		Noted	The standard certification processes of test, or analysis supported by test, should be followed as appropriate to the design, test pyramid available, and appropriate previous experience. The need for test to UL for any particular repair design or repair philosophy will be a function of previous experience of similar repairs and agreement with the local certifying agency. Note: This intent is to substantiate repair philosophy and scope in design, not subject each and every repair to LL or UL test.
75	*AFF*	2	9	"fleet leader and fleet sampling programs"	not necessarily practical for (smaller) GA type designs only available in small QTY	O		Partially accepted	This text existed in the background discussion and has been removed in response to other comments because the issue needs to be addressed outside this CM. However, EASA considers such action to be a potential appropriate action necessary to verify engineering design assumptions against reality. Furthermore, EASA is aware of examples of GA organisations completing fleet leader investigations etc.
76	*AFF*		10	reverse engineering however is widely used, especially in CS22 world	Suggest to discriminate	O		Partially accepted	This is understood by EASA. The text of the 'Purpose and Scope' has been amended to clarify that the primary scope for the CM is CS-23, CS-25, CS-27, and CS-29 has been reinforced. Note: EASA believes that the amended texts to 'purpose and scope' and at the end of the policy will allow flexibility regarding the comment. Please see the response to comment 5.
77	*AFF*		11	"additional considerations" where are those specific to composite repair? The considerations do also applies to metal.	These sort of additions make the document long and distract from the intention.	O		Partially accepted	'Further to the text above' deleted. The paragraph is intended to help make non-TCH repair organisations aware of other criteria which may have governed TCH structure, damage limitation, and repair classifications. Furthermore, the criteria may be of significance to the non-TCH thought process when considering deviation from TCH data.
78	*AFF*	2.1	11	First sentence unclear		O		Accepted	'must' added.
79	*AFF*		13/14	"All critical structure will have a repair size limit no larger than a size that allows Limit Load strength to be achieved with the repair failed" "Residual strength requirements with the repair failed should be shown by tests or analysis supported by tests"	This is not a practical definition for standard cases (in GA) as twisted fuselages, smashed torsion shells or even broken wings. Showing residual strength with repair failed by test is not practical because it means to first repair failed, then repair the repair. It is unlikely that a second structure, other than the to be repaired one, is available perform such test.	O		Partially accepted	This is understood by EASA. Note: EASA believes that the amended texts to 'purpose and scope' and at the end of the policy will allow flexibility regarding the comment. Please see the response to comment 5. The need to test any particular repair design or repair philosophy will be a function of previous experience of similar repairs and agreement with the local certifying agency.

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80	*Fedex*			BRSL_policy.docx <u>FAA Policy Statement on bonded repair size limits.</u> *'It has been argued that a part can be remanufactured well beyond published repair size limits using OEM specified materials, processes, tooling, and structural details without additional data since it is substantiated by the original type certification. Unless receiving assistance from the OEM, it is unlikely that this can be accomplished without further substantiating data development.'* I believe the Operators and MROs are very much capable of 'remanufacturing' without the OEM help and this wording need to be revised. The drawings and SRM can be used for substantiation for remanufacturing.				Not accepted	The paragraph is intended to help make non-TCH repair organisations aware of other criteria which may have governed TCH structure, damage limitation, and repair classifications. Furthermore, the criteria may be of significance to the non-TCH thought process when considering the possible consequences deviation from TCH data.
81	*European sailplane manufactures*			Summarized on behalf of the European sailplane manufacturers this document contains all comments which were expressed by the different companies represented by the two associations "European Gliders Manufacturers association" and "Verband deutscher Segelflugzeughersteller" and from several additional organisations. Therefore this summary of comments contains the views and inputs from more than 20 manufacturers and other organisations which would be covered by the proposed CM-S-005. A full list of these organisations and also about the different types of organisation approvals of these organisations is found in Appendix 1 of this letter. This group will be abbreviated in the following with ESM (European sailplane manufactures) but that includes for the purpose of this document also the maintenance organisations listed in Appendix 1. This group of organisations includes most manufacturers of sailplanes worldwide (representing approx. 90% of the global annual sailplane production) and also several manufacturers of small aeroplanes (CS-23, CS-VLA and CS-LSA) and touring motor gliders. Since more than 40 years typically these sailplanes and aeroplanes are designed and built using composite materials and many of these companies can claim to belong to the pioneers, which introduced these materials into the aviation community. The total number of aircraft produced by these companies exceeds 20.000 examples and these aircraft are operated world-wide. Due to the fact that most manufacturers had the privilege to conduct maintenance under the				Partially Accepted	EASA agrees with many of the points. Although the original Policy, section 3.1, only addressed CS-23, CS-25, CS-27, and CS-29, the 'title' and 'Purpose and Scope' has been amended to make clear that the CM does not apply to CS-22. However, some aspects of the CM may be beneficial to new organisations, materials and process etc., i.e. when no established safe history exists.

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				regarding national rules before 2003 and due to the fact that major repairs are typically developed and certified by the design organisations of these manufacturers, these organisations have an extensive knowledge about repairs as covered in the CM-S-005. At the times of introduction of composites into sailplane design and production not only material allowables, but also the processes for production and repair where developed – typically in close co-operation with the materials suppliers and the regarding aviation authorities – therefore the comments summarized here reflect not only the reaction to CM-S-005 but the basis of knowledge about the materials used since the late 1960´s. Additionally the group of organisations includes several maintenance organisations which have often specialized into the field of composites repairs and regarding maintenance tasks, therefore not only the design side but also the application side is well covered by this group.					
82	*European sailplane manufactures*			Most importantly the ESM do not concur to the main principle as described in the CM-S-005. This principle is to limit the size of a bonded joint in a repair to a size where failure of this bonded joint still leaves enough strength for the structure to carry limit loads. Rationale: The design of composite sailplanes is based strongly on the use of bonded joints and typically the main structures of sailplanes are not designed necessarily with multiple load paths or fail safe principles. Typical design elements in these aircraft are fuselage and wing halves which are bonded together or the bonded joint of a main spar in a wing or empennage. Due to the fact that these bonds are typically made from materials also used in the process of laminating the load carrying shells and structural reinforcements, these bonded joints have no higher failure probability that the structure itself. Therefore in production and also in repair the use of large bonded joints is an everyday affair and should not be considered as a special process or even limited by a document developed by any aviation authority. See for Appendix 2 which shows typical examples of production and repairs using large bonded joints. Typically the design material allowances for the bonded joints and the manufacturing procedures used for these bonded joints need some consideration, but otherwise the ESM do not see a need for bonded repair size limits.					See response to comment 81.

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83	*European sailplane manufactures*			The ESM and other organisations have already developed extensive documents describing the proper processes for repair of the composite structures used in sailplanes but also aircraft as certified in the CS-23, VLA and LSA categories – therefore again the ESM do not see a need for a document as the proposed CMS-005. Rationale: Beside the internal processes described in the manuals of the approved production and maintenance organisations such documents are also including the design allowables and design principles used by the manufacturers. Furthermore the manufacturers have published repair instructions for their products and these are found sometimes as dedicated repair manuals or as part of the maintenance manuals – in both cases these documents are part of the type certification process and are listed in the regarding TCDS of the aircraft. Last but not least in close cooperation between manufacturers, maintenance organisations (including aeroclubs and other sporting organisations), material suppliers, research organisations and authorities several documents and books have been written about proper repair procedures. A list of such documents has been included into several technical notes / service bulletins – some of them have been approved in the last ten years by EASA. An exemplary list of such documents is included in Appendix 3 of this document.					See response to comment 81.
84	*European sailplane manufactures*			The ESM are rather concerned by the observation that principles used in the design and certification processes of large aircraft are used in the proposed CM-S-005. Rationale: The CM-S-005 is obviously based on the principles expressed in the AMC 20-29, which were published by EASA within Decision ED Decision 2010/003/R. In the "Applicability" section of this AMC 20-29 it is clearly stated: *"This AMC provides Acceptable Means of Compliance with the provisions of CS-23, CS-25, CS-27 and CS-29. Many of the concepts included in this AMC may also be applicable in part or in full to other CSs. However, when using this AMC as an Acceptable Means of Compliance for these other CSs, appropriate engineering judgement should be exercised and early agreement with the Agency sought."*					See response to comment 81.

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				The ESM do not agree that here EASA has first developed a document clearly dedicated to the design and certification principles used for large airplanes (the AMC 20-29) and now uses this very same document to impose such concepts to small aircraft (such as covered by CS-22 / LSA / VLA and the lower end of CS-23) as it is done here in the proposed CM-S-005. This approach is clearly the "one size fits all" approach taken so often by EASA which today should be considered as obsolete and un-appropriate. Without going too much into the details of AMC 20-29, some important differences between "large aircraft" and "small aircraft" need to be noted here: a. the composites materials used are often not the same – e.g. prepreg materials cured in an autoclave versus hand-laminated composites curing under room temperature and post-cured to much below 100°C b. bonding materials not the same – e.g. dedicated bonding films versus resin systems for bonding identical to the resin systems used in the composite structure c. design principles different – e.g. fail-safe versus safe life d. damage tolerance and fatigue life certification procedures different – e.g. different ways to show compliance, different approaches to fatigue life, different principles to material allowables e. repair principles different – e.g. dedicated specialized repair procedures and still ongoing development of possible repairs versus long existing repair procedures already published since many years and with very good service experience In summary the ESM have to point out that use of AMC 20-29 as the basis for the proposed CM-S-005 is not very useful as long as it should be also applied to small aircraft. Additionally it should be observed, that many small aeroplanes in the CS-23 category also use identical materials and design and production processes long established in the sailplane communities and should therefore be allowed also to apply regarding repair principles. Good examples are the products from companies like Grob Aircraft and Diamond Aircraft, which in both cases have been developed in an evolutionary iteration which started with sailplanes and touring motor gliders.					

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85	*European sailplane manufactures*			The ESM are concerned that the format of a Certification Memorandum is used. Rationale: Whereas AMC material like the AMC for the different CSs and documents like the AMC 20-29 have some clearly defined background regarding applicability and method of publication, the certification memorandums are somewhat rather non-defined documents. The manufacturers have made the experience that such documents tend to be either something, which is not used in a systematic way during certification processes (therefore not using the knowledge contained in such CMs) or are used as a "semi-soft law" which by far exceeds the role such a CM should have. Furthermore the publication of such CM and also of the regarding consultations is by far less transparent than the procedures as used for developing hard and soft laws like regulations, CSs and AMCs. The ESM do not find it helpful how such CMs and also the proposed CM-S-005 are handled today.				Noted	See response to comment 81. Note: The scope of a CM is clearly limited to a support function, as currently stated on page 1 of all CMs: 'EASA Certification Memoranda clarify the European Aviation Safety Agency's general course of action on specific certification items. They are intended to provide guidance on a particular subject and, as non-binding material, may provide complementary information and guidance for compliance demonstration with current standards. Certification Memoranda are provided for information purposes only and must not be misconstrued as formally adopted Acceptable Means of Compliance (AMC) or as Guidance Material (GM). Certification Memoranda are not intended to introduce new certification requirements or to modify existing certification requirements and do not constitute any legal obligation. EASA Certification Memoranda are living documents into which either additional criteria or additional issues can be incorporated as soon as a need is identified by EASA.'
86	*European sailplane manufactures*			The ESM point out that the discussion about bonded repair size limits does not reflect experiences made outside the aviation communities. Rationale: The practices developed in the sailplane industry for major repairs and bonded repair joints are today also the basis for repairs on wind energy turbines, which often use the same materials and construction methods as the modern composite sailplanes. Nevertheless for wind turbines much longer service lifes are needed and certified today. Whereas most sailplanes have today service time limitations in the range of 12 000 hours, wind turbines have to be certified for time periods which are longer by a factor of 10 or even more. Due to the fact that repairs on these turbines need to be as durable as the blades of such turbines, regarding tests have been made using repair approaches and principles which often come directly from the sailplane communities. This is further proof that limiting the size of bonded repair joints is not justified with regard to service life considerations.				Noted	Note: The experience of other industries is not excluded as supporting data, provided that it is 'applicable'.

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87	*European sailplane manufactures*			We realize that this letter may exceed the original scope of your consultation and does not fit into the format of the comment response document supplied with the proposal of CM-S-005, but hopefully we have summarized here the inputs given by a large number of actors in a appropriate way. Last but not least we consider this consultation also as a mosaic stone in the large picture of "Simpler, lighter, better rules for General Aviation" and the according "GA Roadmap" which both are championed extensively by EASA and the European Commission – therefore we hope that our input helped to clarify more the need for our part of the European aviation industry and the many small companies working in these fields for many years. Please do not hesitate to contact us for further discussion.				Noted	See response to comment 81.
88	*J2R Consulting*		generic	With a title as 'Bonded Repair Size Limits', I understand that this CM is clearly 'design oriented' as the AMC 20-29 is. As far as FAA Advisory materials are concerned, guidelines for repair processes are covered by AC 43-214 entitled: *Repairs and Alterations to Composite* *and Bonded Aircraft Structures'*, issued on 11 April 2013 and superseding AC 145-6. This recent AC has a good value, would it be 'formally' authorized to refer to it in this EASA CM or not? If not, could we develop a similar AMC in Europe?				Accepted	AC 43-214 (previously AC 145-6) added to reference list and referenced in text.
89	*J2R Consulting*		generic	Regarding size limits for structural bonding on structures with an airworthiness significance which can be identified as either primary structures or critical structures, or PSE's, current design precautions for large vehicles (CS-25 and 29) are a 'copy and paste' of those specified a long time ago by FAR 23-573. This means installing mechanical arrestors to prevent a 'single disbond' to propagate to an extent which would not guaranty DLL capability any longer. When we repair a structure with a bonded patch, we introduce a new bonded joint. According to this CM, the size limits of this new bonding line are not exceeding those taken into account for the original design, but not less to allow for more possible variability in a repair station. Going through the chapter background, the CM acknowledges a possible higher variability in repair station: (*In-service bonded repairs are typically performed less frequently than production bonding*				Noted	Part of the intent of the CM was to make clear that any factors arising from in-service conditions should be considered by the TCH and also make the non-TCH DOAs aware of the potential need to consider such factors (information that they are unlikely to have). The main intent (and value) of the CM is to simply highlight to all that the design reference, as is usually the case, is UL, not LL, capability and that the principles for safe bonded structures apply to both bonded base structure and repairs, i.e. strict process is the priority. The need for inspection of bonded repairs (beyond normal inspection practice), particularly in ageing structures, is likely to be the subject of future regulatory activity. The increased variability in service could be important for ageing composites. Furthermore, the CM also recognises (following comments above), that there are successful examples, based upon established process, of bonded base structure and repair which have bonds which are larger than would allow LL to be retained. This CM allows credit for such situations, e.g. when the TCH has direct control of an unusual large in-service repair etc. Note: EASA believes that the amended texts to 'purpose and scope'

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				activities and often occur in less stabilized service environments. As a result, an in-service bonded repair is more likely to have material property variation 8, which may alter the basis for repair substantiation and result in less than Ultimate Load capability in the repaired condition. Therefore, field conditions and the availability of experts in bonded in-service repairs, should be considered in developing supporting maintenance documents. Such considerations may yield more conservative (smaller) repair size limits for repairs performed in the field than may be allowed with bonded factory repairs.) Despite this argument size limits for the bonded joints created by a repair are not more restrictive than the ones for the original design. If no changing the size limits allowed for in the original design and not covering materials and processes, it is difficult to understand the added value of this CM. The sole difference seems to be the fact that a scheduled inspection program must be implemented for a bonded repair, which is not the case for an 'original structural bonding'.					and at the end of the policy will allow flexibility regarding the comment. Please see the response to comment 5.
90	*J2R Consulting*		generic	Nevertheless, I think they are already more restrictive that this CM in the fixed wing Industry I am familiar with (I mean no bonded repair for those damage reducing strength below DUL) and that this CM is not applicable at all for rotors. Nobody can imagine rotor blades with fastened patches.				Partially accepted	Text amended to recognise exceptions, e.g. rotor blades etc. This was in an early draft, but was unintentionally lost in development.
91	*J2R Consulting*		6	OEM stands for Original Equipment manufacturer				Accepted	Rectified – OEM removed from CM, replaced by TCH (or appropriately approved TCH original component subcontractors).
92	*J2R Consulting*	Fig.1	9	The sketches illustrate the definitions of co-curing, co-bonding and secondary bonding for a solid laminate construction. A similar illustration of these definitions in the case of sandwich construction would be quite useful for two reasons: - Bonded repairs are much more widely used on sandwich construction than they are on solid laminate one. - How co-curing is today defined for sandwich may be controversial (ref. AC 29-2C dated 12/01/2011(11) ***Cocure****: The process of curing several different materials in a single step. Examples include the curing of various compatible resin system pre-pregs, using the same cure cycle, to produce hybrid composite structure or the curing of compatible composite materials and structural adhesives, using the same cure cycle, to produce sandwich structure or skins with integrally molded fittings).* Since the honeycomb is a hard material, in this situation, one can find people arguing that such a sandwich construction is co-bonded and not co-cured.				Noted	Noting that there are many definitions for bonded structure, the CM only attempts to identify and standardise some basic definitions. Note: A CM is in development which is intended to address the use of sandwich monocoque structures in critical structures. This may present the opportunity to include discussion and diagrams defining other bonded structures in more detail.

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93	*J2R Consulting*		14	In bullet 1, I would suggest to enforce what we can find in AMC 20-29 regarding structural bonding: 'Selection of repair materials and processes should allow to achieving cohesive failures of the bonded line, and not adhesive. As far as possible, process control specimens should be used to verify it. *NB: As an example, I remember the presentation made by Alan Baker from DSTO at EASA, where small witness patches are bonded in the vicinity of the repair, cured under the same vacuum bag and then removed with a torque wrench to check the quality of the bonding.*				Accepted	Page 13 amended to reflect this point. Note: EASA is aware of Alan Baker's developing work and plans to monitor progress.
94	*J2R Consulting*		15	I would suggest to add that bonded repairs should be designed in such a way that the separation of the patch might not constitute the critical failure mode of the repaired structure.				Partially accepted	EASA agrees. Page 9, para. 3 '…However, the potential…' was intended to address this point. Amended text added 'A bonded repair should be designed such that its failure does not become the critical failure mode for the baseline structure.'
95	*Nordam*		6	More clarity of the definition of critical structure as per EASA subpart M GM 21A.435 (a)3(ii) "An example of a Major repair is a repair to life limited or critical parts". Without defining what parts or systems are deemed to be critical, interpretation will vary. Type certificate holders define Primary Structure Element (PSE) which is definitive, whereas "critical" parts will be subjective. If other elements are going to be included as critical structure then these will need to be equally defined. In conclusion for Major/Minor Classification we either need a better definition for "critical" or refer to PSE's which are already defined in the OEM manuals.				Noted	The single term 'critical structure' is used, as defined in the CM, to refer to structure important to safety, as defined in each CS (for ease of reading, respecting the differences between the CSs). The CM is not intended to change existing or previous TCH structure classifications or retrospectively address differences between classifications. 'Purpose and Scope' text slightly amended to add '(as classified by the TCH)'. The definition of 'critical structure' has been slightly amended. Note: recognising the sub-contractor process, the term 'TCH (or appropriately approved TCH original component subcontractors)' has been introduced to allow the possibility of more extensive repair in some cases.
96	*Nordam*		10	When performing reverse engineering processes, NORDAM are not altering the configuration of or modifying parts. As such, there is no alteration to design and type certificate holder original design data does not require re-substantiation. Reverse engineering addresses the replication of the part only using recognised methods and techniques under controlled conditions. Substantiation of repairs through replacement with reverse engineered parts would suggest that fatigue and damage tolerance testing as initially performed by type certificate holder to verify material and design would still be applicable. Assuming there is no change in OEM opinion at the time of policy release, design data, particularly limit loads will not be available to Part 21 and part 145 organisations.				Noted	EASA understands that design data may not be available to the non-TCH. However, please note the response to your comment above regarding subcontractors. Note: criticality could have been defined based upon criteria other than fatigue, e.g. static strength. The TCH part will have been subject to development work, process stabilisation, First Article Inspection work etc, using its own equipment, tooling, and facilities. The top level drawings and processes do not necessarily capture this extent of information. This is explained in the CM. Note: Text has been added to the end of the policy to allow some flexibility regarding this CM, see the response to comment 5.

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97	*Nordam*			General comment: Any repair to a Critical structure is considered a major repair, clarification is required if this document is written to address processing and incorporation of major repairs only, in which case NEL seek OEM authorisation as a matter of policy. However, if this document addresses all repair categories including minor repairs, then the comments contained in point 2 cover NEL's position on this.				Noted	The 'purpose and scope' has been amended to clarify that it may help the classification process for non-TCH repair and that it does not apply to repairs finally determined to be minor. repairs. Nordam is correct to seek OEM support, as described. Note: recognising the sub-contractor process, the term 'TCH (or appropriately approved TCH original component subcontractors)' has been introduced to allow the possibility of more extensive repair in some cases