Certification Memorandum

Additive Manufacturing

EASA CM No.: CM–S-008 Issue 03 issued 30 April 2021

Regulatory requirement(s):
Primarily impacted product CSs:
CS X.571, CS X.603, CS X.605, CS X.613, CS 2X.853, CS23.2240, CS23.2260, CS23.2325, CS E.70, CS E.100 (a), CS P.170, CS P.240, CS APU.60,
Other potentially impacted requirements:
21.A.15, AMC 21.A.15(b), 21.A.31, GM 21.A.91, 21.A.101, 21.A.131, 21.A.133, 21.A.147, 21.A.247, 21.A.433, GM 21.A.435(a), 21.A.437, 21.A.447, 21.B.100, 145.A.42(b), CAO.A.020, M.A.603(c)

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Log of issues

Issue	Issue date	Change description
01	04.04.2017	First issue.
02	03.11.2020	Issue 2 includes new supporting text for the existing basic CS materials requirements and guidance regarding the use of AM in non-critical parts. Issue 2 also adds emphasis on the importance of the appropriate transfer of knowledge and training. Note: In order to improve the readability of this document all changes compared to the previous Issue 01 dated 4th April 2017 are tracked.
03	30.04.2021	Issue 3 include all changes introduced based on the comments received during the public consultation of Issue 2 from 3rd to 24th November 2020.

Table of Content

1. Introduction

1.1. Purpose and scope

The purpose of this Certification Memorandum is to provide guidance regarding the introduction and use of Additive Manufacturing (AM) technologies across a broad range of Products (Aircraft, Rotorcraft and Propulsion) and Parts and Appliances subject to EASA Type Certification, including CS-22, CS-VLA, CS-23, CS-25, CS-VLR, CS-27, CS-29, CS-E, CS-P, CS-APU, or equivalent requirements.

Issue 2 of this CM has been raised following rapid development in the planned use of AM since the initial release of the CM and following considerable dialogue with the industry (in accordance with the intent of this CM at issue 1). It includes new guidance intended to support the existing certification specifications (CS) or materials and processes (see para.3 and Appendix 1). Issue 2 also includes some guidance associated with the use of AM in non-critical applications and emphasises the importance of appropriate knowledge and training.

Note: AM is a term used to cover a broad range of new and emerging manufacturing processes (also known as 3D printing) that involve sequential-layer material addition (metallic and/or non-metallic) throughout a 3D work envelope under automated control. This CM does not address established and approved methods which may demonstrate similarities with the evolving definitions of AM, e.g. a repetitive weld build-up repair process accepted prior to the issue of this CM.

Note: This CM does not attempt to catalogue the use of, or repeat detail from, evolving industry guidance documentation related to AM materials, processes, or applications. The use of such guidance, e.g. as developed by standardisation bodies, industry/regulator groups etc, may be accepted based upon demonstration of appropriate applicability and substantiation, as agreed with the competent authority.

1.2. References

It is intended that the following reference materials be used in conjunction with this Certification Memorandum:

Reference	Title	Code	Issue	Date
AIA	AIA Recommended Guidance for Certification of AM Component	---	---	February 2020

1.3. Abbreviations

ADOA	Alternative Procedures to Design Organisation Approval
AIA	Aerospace Industry Association
AM	Additive Manufacturing
AMC	Acceptable Means of Compliance
ASTM	American Society for Testing and Materials
CACRC	Commercial Aircraft Composite Repair Committee
CDI	Compliance Demonstration Item

CM	Certification Memoranda
CMH-17	Composite Materials handbook – 17
CRI	Certification Review Item
CS	Certification Specification
DEV	Deviation
DO	Design Organisation
DOA	Design Organisation Approval
EASA	European Union Aviation Safety Agency ("the Agency")
EB-PBF	Electron Beam Powder Bed Fusion
ESF	Equivalent Safety Finding
ETSO	European Technical Standard Order
FAA	Federal Aviation Administration
GM	Guidance Material
LoI	Level of Involvement
L-PBF	Laser Powder Bed Fusion
MoC	Means of Compliance
NDI	Non Destructive Inspection
POA	Production Organisation Approval
PSE	Principal Structural Element
SAE	Society of Automotive Engineers
SC	Special Condition
STC	Supplemental Type Certificate
STCH	Supplemental Type Certificate Holder
TC	Type Certificate
TCH	Type Certificate Holder

2. Background

Additive Manufacturing (AM), also known as 3-D printing, refers to a range of manufacturing methods where the as-purchased material (i.e. powder, wire, etc.) is consolidated by a machine into a near-finished part. For example, for metallic materials, typically the as-purchased material is deposited in the machine by various methods and fused using lasers, electron beams, plasma or electrical arc into a near final shape component or surface, whilst non-metallic materials may be heated and extruded through a moving nozzle to create a final part. Consequently, these methods can produce complex parts with 'engineering properties' which are highly material, process, and configuration dependent and which may generate significant variability if production is not governed by strict process control documentation. Therefore, design and production of a certifiable part will rely upon close communication between design organisations, production organisations, and material suppliers. Individuals or organisations responsible for the design of the AM part (or any repair activities using AM) for the purposes of this CM should pay special attention to many important parameters in the development of parts or repairs, ideally before initiating discussion with EASA, including:

- understanding of the criticality of the application (accounting for potential new damage and failure modes etc). General guidance supporting the understanding and determination of criticality may be derived from various sources, including Cx.1309, and the definition used to support Point 21.B.100, see also para.3 'Parts of no criticality'. Noting the current novelty of AM use in aviation applications, EASA would expect applicants to use a 'step by step' approach to product criticality evolution, i.e. initially develop experience with applications of no, or very limited criticality (significantly below potentially hazardous or catastrophic), prior to considering more critical applications. Furthermore, EASA certification expectations of an applicant will be proportionate to the application criticality and novelty.
- identification of the Key Parameters and demonstration of understanding of the sensitivity of the engineering properties important to the safety of the final parts and products to these Key Parameters.
  Note: The definition of Key Parameters and the management and demonstration of the sensitivity of the engineering properties to these parameters are yet to be standardised by industry.
- statistical coverage of engineering properties important to safety (noting the potential for many influencing parameters, variability, and different competing damage and failure modes). When certification is by analysis, it is essential that design values account for variables introduced throughout the AM process used to fabricate production parts, including consideration of the variables associated with the constituent materials (e.g. powder or wire) and post processing. Note: The statistical management of complex part design value development by 'point' or 'detail' testing is yet to be standardised.
- appropriate transfer of knowledge and control between those in the supply chain, as necessary to ensure the development of complete and achievable specifications which allow consistent production of safe certified parts.

As required by point 21.A.31, the specifications (for both, material and process) as well as the method(s) of manufacture, shall be introduced in the type design under the design approval holder responsibilities.

3. EASA Certification Policy and Guidance for DOA, ADOA and POA Holders*

*see Appendix 1 for associated regulations

All aviation parts and products are required to meet the relevant certification specifications or other means agreed or prescribed by EASA, e.g. DEV, ESF, SCs etc,respectively, including the ETSO minimum performance standards, according to the type certification basis, e.g. regarding strength, durability, flammability etc., regardless of the material and process combination used to generate the engineering properties.

EASA review (within the EASA AM Working Group, see Appendix 2) indicates that no CS level change is required to specifically address the use of AM, although some broader revisions to material and process related CSs are in progress (NPA 2020-11). However, the detail supporting the showing of compliance for some CSs, see Appendix 1, may be changed when using AM in place of more conventional technologies, e.g. the number and types of tests used in the test and analysis pyramid may be different. Section 3 in this CM also includes developing AMC text for CS2x.603, 2X.605, and 2x.613.

Independent of the facility where parts are to be fabricated, the applicant should demonstrate by test and/or experience, that all materials in the supply chain, e.g. raw materials etc, are being purchased per approved material specifications and supported by approved inspection and control methods, as appropriate and as required by the material specifications. It should be shown that the derived design values are based upon representative and statistically significant test data (to the level required by the applicable CS and application) which adequately addresses the Key Parameters, including consideration of machine-to-machine variation within and between facilities. Therefore, it is also important to demonsrate consistency through manufacturing hardware control, robust machine qualification, maintenance, calibration and monitoring processes.

Furthermore, it should be shown that values obtained from tests conducted on simple specimens accurately represent the mechanical properties of the intended parts. However, complex parts and processes may, dependent upon criticality, require testing in the test/analysis pyramid in addition to test coupon level tests to truly represent the engineering properties resulting from the material , process and fabrication method used for the application. Certification by testing may be considered for complex parts (an approach yet to be standardised). For some configurations, this approach could be supported using appropriate Fatigue and Damage Tolerance design, including crack propagation analysis.

In addition to the established production process parameters, actual part properties are influenced by multiple other factors, including part orientation during the build process and the support structure required during the build operation (which is subsequently removed). These need to be addressed accordingly during certification.

Similarly requiring particular attention, from both design and production perspectives, are inaccessible surfaces which may be difficult to inspect and cannot be machined or surface treated such that the engineering properties may be different to those of the bulk material and/or other machined or surface treated material. Furthermore, the machining or application of surface treatments to accessible AM surfaces may also result in material properties which may be different from those resulting from machining or surface treating of similar more conventionally manufactured (other than AM) parts using the same material due to the existence of different manufacturing anomalies at, or near, the surface.

Noting the points above, it is important to identify all Key Parameters which govern the engineering properties which are important to maintaining safety of the final parts and to demonstrate understanding of the sensitivity of these properties to the Key Parameters, particularly relative to the mature fixed process.

All material and process related production defects, including those defects resulting from repair processes in maintenance environments, are to be identified by the responsible organisations and the 'effects of defects' are to be characterised at the appropriate levels of part configuration complexity, such that the strength and other properties used in the design data can be defined and maintained using the specifications. Furthermore, in support of ensuring that a safe product is produced should any defects outside those identified and characterised within specifications (i.e. often refered to as anomalies or flaws) remain undetected during production, all likely damage modes are to be identified and characterised at the appropriate levels of the configuration complexity. These can be addressed within the fatigue and damage tolerance process accordingly (supported by an appropriate threat assessment), as required by relevant CSs. This is necessary in order to ensure that the impact upon criticality (including the potential impact upon any associated hazard analysis) is fully understood, noting that new governing damage and failure modes may be introduced relative to previous experience, resulting in potentially new damage sequences and safety consequences. Such considerations may be of increasing importance if the potential benefits of AM are to be fully exploited, e.g. weight optimised designs or optimised production processes may introduce new failure modes and expose the structure to more low reserve factors when compared to more conventional designs which have defined the existing 'acceptable' level of safety. For example, parts typically designed to be static strength critical could become fatigue critical, or changes in damage mode may change the critical failure modes in a structural element of a critical system, etc.

Note: Design organisations, other than the TCH, are unlikely to have access to the TCH design and/or hazard analysis assumptions, particularly as they relate to the airplane level of safety. These considerations emphasise the importance of the need to follow a cautious 'step by step' approach to the introduction of AM in applications which could be of significance to safety.

AM variability is to be shown to be controlled through material specifications (including consideration of raw material/feedstock specifications) in combination with process controls defined in process specifications, including post processing operations. The applicant is responsible for ensuring that design values used in the evaluation of any parts produced using AM are applicable to the material and process specifications used to fabricate the parts and that the design values are applicable to the facilities at which the parts are fabricated. This should be supported by appropriate process and inspection controls throughout the process chain that ensure product integrity is maintained.

Applicants should provide evidence that materials and processes are addressed by specifications and/or fabrication control documents that are under revision control.

The use of additive manufacturing should also be considered when establishing the certification programme in accordance with 21.A.15, 21.A.93, or 21.A.432C.

Repair Designs and Design Changes:

In accordance with the Guidance Material contained in Appendix A to GM 21.A.91, the use of AM in Changes and Repairs to Type Certificates and Supplemental Type Certificates is considered to be a change to the material, process, and method of manufacture and should be evaluated as such when classifying changes and repairs. For repair, and repair design, the guidance contained in this CM (including relevant guidance under Appendix 1 of this CM) should also be considered when evaluating the use of AM. The use of AM in repairs and design changes may be classified Major based upon the level of substantiation required, ref. GM 21.A.435(a), being also a function of criticality and novelty (i.e. novelty to the applicant and/or industry). Design Organisations are advised to consult the Agency when introducing AM in repairs, including cases where they hold a privilege for repair design approval.

Impact of AM on design organisations:

Design Organisation Approval Holders as well as Design Organisations using ADOA are advised to involve the Agency at the earliest opportunity during the development and implementation of AM. It is envisaged that the use of AM will lead to a higher level of involvement of EASA in compliance verification. In addition, specific audits may be scheduled to examine the introduction and use of AM within the scope of the design organisation audit cycle. These audits may take place concurrently with the review of AM applications rather than post approval.

Note: The introduction of additive manufacturing may, depending upon circumstances, represent a significant change to the Design Assurance System of the DOA Holder according to point 21.A.247.

Impact of AM on production organisations:

Production Organisation Approval holders are advised to inform their respective competent authorities at the earliest opportunity before the implementation of AM processes.

Implementation of an AM process by a POA holder is controlled through the applicable design data identified and transferred to the POA holder under the responsibility of the design approval applicant or holder. The design approval applicant or holder is also responsible for showing that the applicable design data complies with the requirements of point 21.A.31. The POA holder shall ensure compliance to the applicable design data of the items it produces under its POA.

Implementation of an AM process that is new for the POA holder is a change to the approved production organisation that may be identified as a significant change in accordance with point 21.A.147. However, depending on circumstances, such a change may not necessarily be a significant change.

It is ultimately the responsibility of the design approval holder to ensure that the production methods (e.g. processes, fabrication technologies etc), or any changes, are appropriately addressed. Therefore, a robust communication process between the POA holder and the DOA holder should be demonstrated (which includes appropriate engagement with the material supplier and other impacted subcontractors). Production Organisations are therefore reminded of the published design data requirements in point 21.A.131.

To ensure that such a change to the approved production organisation does not result in any non-compliance with Part 21 Section A Subpart G, it is in the interest of both the competent authority*and the POA holder, to establish a relationship and exchange information that will permit the necessary evaluation work to be conducted before the implementation of the change. In case of such a change, the competent authority is recommended to inform EASA, and, as usual, these parties are also recommended to cooperate closely. It is recommended that the use of AM will be subject to specific oversight by the competent authority, either in the frame of significant change(s) according to point 21.A.147 (when applicable) and/or continued surveillance of the POA holder.

*reference point 21.A.234 and point 21.A.134 for DOA holder and POA holder considerations respectively

Transfer of knowledge and training:

The existing regulations require that industry staff have appropriate levels of knowledge and training throughout design, manufacture, and in service activities, e.g. PART 21.A.145(a), GM 21.A.139(b)(1) etc. This also applies to the regulatory authorities, ref. PART 21.B.25(c) and GM*.

Historically, this has not been problematic for conventional technologies because the technology introduction has typically been at an adequately slow rate allowing much of the knowledge transfer to occur over time, often relying upon on the job training and/or staff movement throughout design, production, in-service, and regulatory organisations. However, as technology development and integration has accelerated, it has become an increasing challenge to develop a knowledgeable workforce at the rate desired by industry, particularly as more critical applications are planned. This has already been evident in the composite industry, as the recent step change to include large passenger aircraft with extensive composite PSE structures has occurred. This has required some additional focus upon knowledge transfer and training expectations, as evidenced in recent SAE CACRC activities.

The ultimate responsibility of the TCH/STCH/DOAH regarding the product TC, or STC, including changes, requires that appropriate knowledge transfer and training occurs as necessary to ensure a safe product or repair, paying particular attention to functional and organisation interfaces, e.g. between DOA holders and the POA holder, and between subcontractors. This knowledge transfer and training should ensure that all stakeholders have appropriate and current knowledge regarding the AM technologies being used and that all staff roles and responsibilities are fully understood in order to help ensure that parts produced according to the design data, including the approved manufacturing process specifications, will result in a consistently safe structure. Such interfaces have been challenging, in some cases, for more conventional technologies, therefore, it is considered appropriate for organisations involved in AM technologies to benefit from 'lessons learned' and to pay particular attention to training and knowledge transfer.

*Note: In order to improve certification efficiency, it is important for industry to familiarise competent authorities with new technology applications because this should improve the potential to quickly agree upon appropriate means of showing compliance with the requirements.

Certification Plans and Means of Compliance:

As and when required by standard EASA certification processes, e.g. for a major type change, EASA typically expects applicants to submit a certification plan, referenced to the appropriate CSs and other means prescribed or required by EASA in the certification basis, supported by MoCs on how the applicant intends to demonstrate compliance with the certification basis.

Furthermore, CS 27.602 and CS 29.602 for critical parts require a critical parts plan for rotorcraft and CS-E, e.g. CS-E-515 for Critical Engine Parts, requires an Engineering Plan, a Manufacturing Plan, and a Service Management Plan.

Note: EASA encourages applicants using additive manufacturing to consider using and adapting the concepts and elements identified as being appropriate content in Engineering, Manufacturing, and Service Management Plans, if established means and format of communication of such data with the regulatory authority does not already exist. The content and extent of data included can be adapted and proportionate to criticality for broader use beyond critical engine applications, e.g. for parts of no criticality. Such an approach could support a consistent and standardised delivery of end to end data to the regulatory authority which may be beneficial for an integrated technology, such as AM, when defining and maintaining control throughout design, manufacturing, and the airworthiness of the part in service, see also the final note in Section 3.

Applicants engaged with post TC activities are also reminded that Instructions for Continued Airworthiness are required to ensure that the product, and changes to it, can be maintained in an airworthy condition.

Further developing guidance CS2x.603, CS2x.605, and CS2x.613:

Further to the previous discussion in this CM, the following text is intended to support existing AMC 2x.603, 2x.605, and 2x.613 content, particularly when associated with the need to avoid catastrophic failure due to fatigue, manufacturing defects, environmental deterioration, or accidental damage, e.g. per CS2x.571. It should be read in conjunction with the referenced CSs and AMCs.
Note: EASA is considering broader revision of the text below in order to support future broader advanced materials and processes AMC content which will also be applicable to other CSs, including CS-23, CS-E, and CS-P (which use different CS numbering and nomenclature when addressing materials and process issues).

Text supporting interpretation of CS2x.603:

Strength and other properties assumed in the design data, including damage tolerance characteristics when applicable, may be governed by, and may be significantly sensitive to, the associated manufacturing and fabrication processes, e.g. advanced alloys, AM parts, composites, bonded structures etc. Therefore, the experience and/or tests used to establish the suitability and durability of materials must be based upon representative, and stable, material and process combinations as appropriate to the intended application. This requires that all material and process related production defects and those defects resulting from repair processes in in-service environments be identified and the 'effects of defects' be characterised at the appropriate levels of part configuration complexity, such that the strength and other properties used in the design data can be defined and maintained using the specifications.
Note: Those defects considered to be typical of the material and process characteristics, often termed anolomies, flaws etc, are typically those identified and substantiated within the specifications.

The potential for anisotropy (including environmental influence) should be investigated and all material properties relevant to the final part's application and the demonstration of compliance with the requirements of the applicable CS should be statistically addressed in the material design data.

Text supporting interpretation of CS2x.605(b):

Unless demonstrated otherwise, the strength and properties resulting from each new material and process configuration should initially be assumed to be anisotropic and to be affected by the environment.

The test programme required for new fabrication processes should help establish and evaluate the critical parameters which govern the final strength and other required properties of the structure, at build and during the aircraft life time. The sensitivity of the strength and other required properties of the structure to these parameters should be evaluated to ensure the resulting process is robust enough to deliver a consistently safe product.

All critical inspection and/or process controlled fabrication steps should be clearly identified and substantiated. In particular, all inherent features and defects of the structure resulting from the fabrication process that affect strength and other properties require thorough characterisation and correlation with NDI and/or process control parameters in order to ensure aircraft level safety is maintained. Furthermore, equipment used for process critical manufacturing steps (i.e. those not supported directly by inspection, or other procedures) must be demonstrated to be under adequate control. Guidance from internationally recognised standardisation bodies may be used to support definition of these activities.

Note: Control, demonstrated understanding of the critical parameters, and the sensitivity of 'engineering properties' to these parameters, will be essential to showing 'equivalence' if the use of shared databases is intended.

Text supporting interpretation of CS2x.613(b):

The development of material strength properties and material design values should include consideration of anisotropy. Note: this is already specifically addressed in AMC 25.613 for tests of premium material selection.

The use of some materials and processes may result in complex parts which require development of design values above the base of the test pyramid when coupon testing may be unrepresentative. When complex higher pyramid testing is required to produce statistically credible data, then the number of specimens may be reduced for practical reasons below the levels normally expected for generation of statistically significant values. However, until industry standards exist for such situations, the need for (and approach taken to) use of higher test pyramid test articles, and small datasets, to generate design data is likely to require further supporting mitigating actions which should be agreed with the regulatory authority.

Parts of no Criticality:

The CSs apply to a broad range of products, parts, structures, and systems, etc, which may be associated with a broad range of criticalities relative to safety. General guidance supporting the understanding and determination of criticality may be derived from various sources, including Cx.1309 and the definition used to support Point 21.B.100 (see below) etc. Furthermore, organisations, other than the TCHs, may consult the TCHs, and supporting product documents, for more specific guidance.

For example, recent guidance regarding the definition of ***criticality*** is included in AMC 21.B.100(a):

'… measure of the potential impact of a non-compliance with part of the certification basis on product safety or on the environment'.

The supporting guidance continues:
'…The potential impact of a non-compliance within a Compliance Demonstration Item (CDI) should be classified as critical if, for example:
— a function, component or system is introduced or affected where the failure of that function, component or system may contribute to a failure condition that is classified as hazardous or catastrophic at the aircraft level …'

Note: The amount of work associated with the certification process is correlated with criticality and/or novelty (novelty to the industry and/or applicant).

Several CSs applicable to some products include specific specifications which are applicable to subsets of parts, structures, or systems, which are considered to be more critical to maintaining safety than others, e.g. parts the failure of which could contribute to a catastrophic failure, e.g. Critical Parts, PSEs, etc. Note that the terminology and management of risk associated with parts, structure, or systems, is sometimes different across the range of products and CSs. This section of the CM does not attempt to address these more critical applications or associated processes and the appropriate product specific CSs should be consulted accordingly. Note: Industry - EASA dialogue continues regarding the definition and management of criticality.

Noting that AM is new to many in aviation, it will be a particular challenge for those, other than the TCHs, to develop appropriate knowledge regarding material, process, and application in order to be adequately competent to obtain certification of AM parts of any significant criticality in the near future (emphasising the importance of addressing the knowledge and training issues, as discussed above). However, some simple applications can readily be determined to be of no criticality, i.e. being of no, or minimal, safety concern, e.g. some interiors items, some minor propulsion applications etc.

For parts of no criticality, i.e. being of no, or minimal, safety concern either at aircraft or passenger level, the applicant will be required to demonstrate, at least:

- appropriate scope and capability regarding the AM technology to be used
- that the AM item does not adversely impact the existing criticality of the application (relative to conventional technologies used for the application) or introduce any features that may compromise any existing hazard assessment, e.g. relating to fire threats, or the potential to introduce sharp edges for interior parts, either as a completed part or in its likely damaged states.
- conservative design practices have been used, including consideration of attachments to surrounding structure etc
- for structure, or other parts, for which strength properties are important to maintaining fit, form, and function, e.g. maintaining shape, supporting its own weight, or limited low loads (see note below), that a minimal set of coupon test data is presented showing that the material properties consistently meet or exceed the application requirement , e.g. in tension, shear, and compression, such that it can be shown that safety will not be compromised. This may be important for ensuring that repair or replacement does not introduce new damage modes, damage sequences, or safety outcomes etc, such that the criticality of the item is increased. Alternatively, direct part testing (certification by ‘point’ or ‘detail’ testing), may be more appropriate in order to determine unique failure characteristics. However, such an approach may be challenging, e.g. defining meaningful load cases and/or completing practical testing may be difficult etc. A standardised approach is yet to be developed and agreement with a competent authority will be necessary until such standards are developed. Note: The need for, and use of, fatigue data relative to the identification and assessment of ‘parts of low criticality’, relative to ‘parts of no criticality’ is yet to be established.
- agreement to use this approach with the regulatory authority on a case by case basis, unless the repair or replacement application can be readily shown to fall within the scope of this CM guidance, in which case such data would need to be available to the regulatory authority in accordance with established regulatory authority practices, e.g. during audits, upon request etc., as required by the scope of the applicants approval.

  Note: The use of small datasets should follow acceptable statistical practices.

Furthermore, for DOA holders with established minor modification approval capability, such parts manufactured using AM can be addressed under a minor change approval provided all other aspects of the change meet the requirements for minor classification.

Note: In order to help identify interior items which might be considered as being candidates for such consideration, the mass thresholds below are considered to be appropriate, as adapted from Note 1: EASA CM –S-002 issue 1 ‘Application of CS 25.561(c)(2) 1.33 ‘Wear and Tear’ Factor – Frequent Removal of Interior Structures’:

'Interior items of mass < 0,45 kg (1lb) (or < 0,15 kg (1/3lb) if attached to a seat, ref. AC 25.562-1). However, this low criticality candidate threshold will not be considered for any safety equipment mountings (PBE, Fire Extinguishers, Oxygen Bottles, etc.).'

Items addressed by ETSO, will be expected to demonstrate similar considerations.

Note: For the purposes of certification efficiency, particularly for parts of no criticality, being of no, or minimal, safety concern either at aircraft or passenger level, and in order to help to provide a 'level playing field', EASA is of the opinion that industry may benefit from:

- developing common standards regarding expectations for compliance data, e.g. statistics, testing etc.,
- developing simple common data presentation protocols for the purposes of certification

These actions may aid the certification and regulatory authority audit processes.

Such a task could be addressed through use of an appropriate standardisation organisation, or other industry/regulatory authority groups, and should not compromise the classification and criticality of the product as agreed between applicants and the regulatory authorities through normal product certification processes.

4. Whom this Certification Memorandum affects

This Certification Memorandum is applicable to individuals and organisations introducing AM during certification of Products, Parts and Appliances, Design Changes to Products, Parts and Repairs to Products in compliance with the material and fabrication related requirements in CS-22, CS-VLA, CS-23, CS-25, CS-VLR, CS-27, CS-29, CS-E, CS-P, CS-APU, or equivalent requirements. It is also relevant to DOA and POA Holders and their competent authorities. The intent of this CM is also applicable to ETSO applicants.

Note: The content of this CM may also be of relevance to Part 145, Part CAO, and Part M Subpart F organisations for awareness purposes. These organisations, and supporting DOAs not directly supported by TCHs, wishing to fabricate parts per Point145.A.42(b)(iii) , CAO.A.20(c) or M.A. 603(c) are reminded of the associated criteria requiring the use of appropriately approved data, design support, and approval.

5. Remarks

1. Suggestions for amendment(s) to this EASA Certification Memorandum should be referred to the Certification Policy and Planning Department, Certification Directorate, EASA. E-mail CM@easa.europa.eu.
2. For any question concerning the technical content of this EASA Certification Memorandum, please contact the appropriate EASA focal point as identified in Appendix 2.

Appendix 1: Applicable regulations and guidance

All aviation parts and products are required to meet the relevant certification specifications and other means prescribed or required by EASA as part of the type certification basis, e.g. regarding strength, durability, flammability etc., regardless of the material and process combination used to generate the engineering properties. However, those CS likely to require particular attention associated with the introduction of AM include:

- CS X.571 Fatigue & Damage Tolerance
- CS X.603 Materials
- CS X.605 Fabrication Methods
- CS X.613 Material Strength Properties and Material design Values
- CS X.853 Compartment Interiors
- CS 23.2240 Structural Durability
- CS 23.2260 Materials and processes
- CS 23.2325 Fire Protection
- CS E 70 Materials and Manufacturing Methods
- CS E 100 Strength (a)
- CS P 170 Materials and Manufacturing Methods
- CS P 240 Strength
- CS APU 60 Materials

Note: The need to specifically include CS2x.619* in the highlighted list above has been discussed between industry and competent authority on several occasions. However, the current consensus is that the material, process, fabrication requirements, and other specifications listed above, should be adequate to address the material, process, and fabrication, aspects of Cx.619, as has generally been the case for the use of composite materials and processes. However, the need to consider the other aspects of CS2x.619, and the other specifications listed in CS2x.619, should be considered independently based upon the part configuration and the relationship between test and analysis, noting that the need for additional factors should also become evident via representative testing of the complex AM part (and/or details) as defined in an appropriate test and analysis pyramid.
*CS 23.2265 for CS23

Further to the CSs above, the showing of compliance with the following PART 21 regulations may be impacted by the introduction of AM into aviation products:

- Point 21.A.15 Application
- Point 21.A.31 Type Design
- GM 21.A.91 Classification of Changes to type design
- Point 21.A.93 Application
- Point 21.A.101 Designation of applicable certification specifications and environmental protection requirements
- Point 21.A.131 Scope – Applicable Design Data
- Point 21.A.133 Eligibility
- Point 21.A.147 Changes to the approved production organisation
- Point 21.A.247 Changes in design assurance system
- Point 21.A.432C Application for repair design approval
- Point 21.A.433 Repair Design
- Point 21.A.447 Record keeping
- GM 21.A.435 (a) Classification of Repairs
- GM 21.A.437 Issue of Repair Design Approval

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