

Notification of a Proposal to issue a Certification Memorandum

Additive Manufacturing

EASA Proposed CM No.: Proposed CM–S-008 Issue 01 issued 10 June 2016

Regulatory requirement(s): CS X.571, CS X.603, CS X.605, CS X.613, CS-E 70, CS-E 100 (a), CS-P 170, CS-P 240, CS-APU 60, GM 21.A.91, 21.A.101, 21.A.133, 21.A.147, 21.A.433, GM 21.A.435(a), 21.A.437, 21.A.447, 21.A.805, AMC 145.A.42(c)

In accordance with the EASA Certification Memorandum procedural guideline, the European Aviation Safety Agency proposes to issue an EASA Certification Memorandum (CM) on the subject identified above. All interested persons may send their comments, referencing the EASA Proposed CM Number above, to the e-mail address specified in the “Remarks” section, prior to the indicated closing date for consultation.

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.

Log of issues

Issue	Issue date	Change description
01	10.06.2016	First issue.

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1. Introduction

1.1. Purpose and scope

The purpose of this Certification Memorandum is to provide additional guidance regarding the usage of Additive Manufacturing (AM) technologies in products (Aircraft, Rotorcraft and Propulsion) and Parts and Appliances subject to EASA Type Certification.

AM is a term used to cover a range of emerging manufacturing processes (also known as 3D printing) that involve sequential-layer material addition throughout a 3D work envelope under automated control.

The unique feature of AM materials is that their final mechanical properties are obtained during the fabrication process. As such, the data used to design AM parts must account for not only the typical variability of the as-purchased material, but also for the variability seen in the manufacturing process. The applicant should, where relevant, show that AM design values they derive based on data collected from their internal facilities is also relevant for the various degrees of variation due to multiple fabrication facilities producing parts. The applicant also should show that values obtained from tests conducted on simple specimens accurately represent the final, mature production process applied to real parts.

1.2. References

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

Reference	Title	Code	Issue	Date
Part 21, Subpart J	Design Organisation Approval	---	---	---
Part 21, Subpart M	Repairs	---	---	---
GM to Part 21	Guidance Material for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organisations	---	---	---

1.3. Abbreviations

AM	Additive Manufacturing
AMC	Acceptable Means of Compliance
CM	Certification Memoranda
CRI	Certification Review Item
CS	Certification Specification
DO	Design Organisation
DOA	Design Organisation Approval
EASA	European Aviation Safety Agency



GM	Guidance Material
TCH	Type Certificate Holder
X	Place holder for Certification Specifications 22, 23, VLA, 25, VLR, 27, 29

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. metallic powder, wire, etc.) is consolidated by a machine into a near-finished part condition. For metallic materials, typically the as-purchased material is deposited in the machine by various methods and fused using lasers or electronic beams into near the final shape. Non-metallic materials may be heated and extruded through a moving nozzle to create a final part. As such, AM materials are more process dependent than their typical metallic or non-metallic counterparts. It is essential that design values used for AM materials reflect not only the variability of the constituent materials as purchased by the suppliers, but also the variability introduced by the manufacturing process used to fabricate production parts. AM variability is controlled through material specifications in combination with process controls defined in process specifications.

3. EASA Certification Policy and Guidance for DOA and POA Holders

Independent of the facility where parts are to be fabricated, the applicant should demonstrate compliance to the relevant paragraphs of the applicable CS listed under appendix 1 of this CM. The applicant should demonstrate by test or experience, that the material is suitable for the intended use of the part being fabricated and that the material is being purchased per an approved material specification. The applicant should demonstrate by test the capability of the fabrication method to produce a consistently sound structure which is performed under an approved process specification. Strength and design values used in analysis to show compliance to the certification specifications should be derived through statistically significant testing of materials both procured and processed per approved documented specifications. 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. The statistical basis of the design values must account for all sources of the material and process variability, including that introduced by fabricating parts at multiple facilities (where applicable).

The applicant is requested to provide details to the Agency on how constituent materials are being purchased and on how the fabrication process is being controlled. In addition an applicant should provide a description of how testing being used to derive design values statistically accounts for the variability introduced in production by both the material and fabrication methods used.

In accordance with the Guidance Material contained in Appendix A to GM 21A.91 the use of AM in Changes and Repairs to Type Certificates and Supplemental Type Certificates is considered 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 Certification Memoranda (relevant requirements under appendix 1 of this CM) should also be considered when evaluating the use of AM. The use of AM in repair and repair design would normally be classified Major, applicants are advised to consult the Agency when introducing AM in repairs including cases where they hold a privilege for repair design approval.

Design Organisation Approval Holders 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 be subject to increased oversight by the agency and that specific audits will 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.



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 a new AM process by a POA holder is a change which may be identified as a significant change in accordance with Part 21.A.147 and related guidance material. To ensure that such a change does not result in 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 the EASA Certification Directorate, 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 Part 21.A.147 (when applicable) and/or continued surveillance of the POA.

4. Whom this Certification Memorandum affects

This Certification Memorandum is applicable to applicants introducing AM during certification of Products, Parts and Appliances, Design Changes to Products, Parts and Appliances 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.

5. Remarks

1. This EASA Proposed Certification Memorandum will be closed for public consultation on the **22nd of July 2016**. Comments received after the indicated closing date for consultation might not be taken into account.
2. Comments regarding this EASA Proposed Certification Memorandum should be referred to the Certification Policy and Safety Information Department, Certification Directorate, EASA. E-mail CM@easa.europa.eu.
3. For any question concerning the technical content of this EASA Proposed Certification Memorandum, please contact:

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Appendix 1

The subsequently listed requirements will have to be considered introducing additive manufacturing technology in aviation:

- CS X.603 Materials
- CS X.571 Fatigue & Damage Tolerance
- CS X.605 Fabrication Methods
- CS X.613 Material Strength Properties and Material design Values
- 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
- GM 21.A.91 Classification of Changes to type design
- PART 21.A.101 Designation of applicable certification specifications and environmental protection requirements
- PART 21.A.133 Eligibility
- PART 21.A.147 Changes to the approved production organisation
- PART 21.A.433 Repair Design
- GM 21.A.435 (a) Classification of Repairs
- GM 21.A.437 Issue of Repair Design Approval
- PART 21.A.447 Record keeping
- PART 21.A.805 Identification of critical parts
- AMC 145.A.42(c) Acceptance of Components

