

EASA – Structures and Materials Safety

EASA – FAA AM INDUSTRY – REGULATOR EVENT (virtual meeting)

November 8-12/11/2021

S.Waite, Senior Expert – Materials, Certification Directorate, EASA
M.Gorelik, Chief Scientific and Technical Advisor – Fatigue and Damage Tolerance, FAA

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Federal Aviation
Administration

EASA FAA AM
Industry – Regulator Event (virtual)
8-12th November 2021

Welcome:

Rachel Daeschler

EASA – Certification Director

Note: If you have any technical problems, please contact
Phillip Brooke: philip.brooke@easa.europa.eu
Andrea Kalski-Bollmann: andrea.kalski@easa.europa.eu
See also the EASA website notification for this Event for
these contact details.

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Federal Aviation
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EASA FAA AM Industry – Regulator Event (virtual) 8-12th November 2021

<https://www.easa.europa.eu/newsroom-and-events/events/easa-faa-industry-regulator-am-event-0>

- building upon previous EASA FAA Industry - Regulator annual Events (alternate regulator hosting)

[2020 FAA–EASA AM Workshop Report and Proceedings](#)

(please use the following link to request access: [2020 AM Workshop - Home \(faa.gov\)](#))

[2019 EASA–FAA AM Workshop Proceedings](#)

<https://www.easa.europa.eu/newsroom-and-events/events/2019-easa-faa-workshop-additive-manufacturing>

[2018 FAA–EASA AM Workshop Report and Proceedings](#)

[Joint FAA—EASA Workshop on Qualification & Certification of Metal Additively Manufactured Parts](#)

2021



EASA - FAA



Industry-Regulator AM Event (Virtual)



EASA FAA AM Industry – Regulator Event:

Context: evolving regulation of the rapidly expanding use of Advanced Material and Processes (AMPs) technologies in many applications...



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EASA FAA AM Industry – Regulator Event:

Intent:

- compliment, not repeat, the many other AM related industry activities
- account for evolving regulatory processes
- prioritise development of ‘proportionate’ regulatory effort in support of industry priorities considering a ‘step by step’ approach, e.g. no/low criticality parts
- support development of the regulations, regulatory guidance, SDO document content etc (not just a ‘talking shop’), e.g. frequently evolve CM-S-008 content

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Agenda outline (total 3 - 4hrs per day, starting 15:30hrs CET)

Day 1 (Monday, November 8)

- Welcome (Rachel Daeschler - EASA Certification Directorate Director)
- Regulators (EASA, FAA) – Opening Remarks/Update
- **Keynote Speech:** (Loris Molent (DTSO (retired))) 'Thoughts on Fatigue Certification of Metal Additive Manufacturing for Aircraft Structures'
- Industry (EAAMIRG) – Opening Remarks/Update
- Working Group (WG) 1, 2, and 3 update and process introduction

Day 2 (Tuesday, November 9)

- Presentations (preparation for Wednesday Sessions)
 - Performance based regulation
 - AM Modelling/Simulation (3 presentations)
- WG Parallel breakout sessions

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Agenda outline (total 3 - 4hrs per day, starting 15:30hrs CET)

Day 3 (Wednesday, November 10)

- Performance based regulation and the SDOs
 - Co-ordination / Collaboration across the SDOs
 - Data generation / databases / guidelines
- AM Modelling/Simulation (Mini Workshop - presentations and discussions):

Day 4 (Thursday, November 11)

- WG Parallel breakout sessions (continued from Day 2)

Day 5 (Friday, November 12)

- Technical presentations (3 presentations)
- WG debriefs
- Authorities panel
- Wrap-up

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Agenda outline:

Working Groups* building upon previous meeting WG activities:

1. [Qualification of Additive Manufacturing \(AM\) Parts of No, or Low, Criticality \(for use in Certified products\)](#)
2. [Fatigue and Damage Tolerance \(F&DT\) and Non-Destructive Inspection \(NDI\) Considerations for Metal AM](#)
3. [AM Machine Makers and End Users – Key Process Parameters \(KPPs\), Qualification, Regualification, and the Ideal 'End State'](#)

*potential longer term output includes content/framework for:

- regulator guidance material, e.g. AMC, CM, PS etc
- support SDO alignment with industry and regulator needs

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EASA FAA AM Industry – Regulator Event 2021 – Detailed Agenda: Monday 8th Nov.

	Day 1	Monday		Presenter		Time (mins)
15:30-15:35		EASA Leadership	Opening Remarks	EASA Cert Director Rachel Daeschler	EASA	5
15:35-16:00		EASA	EASA Introduction and AM Update	Simon Waite	EASA	25
16:00-16:30		FAA	FAA AM Introduction Update	Michael Gorelik	FAA	30
16:30-17:15		Keynote	'Thoughts on Fatigue Certification of Metal Additive Manufacturing for Aircraft Structures'	Loris Molent	Molent.com Consultant (DSTO - Australia (retired))	45
17:15-17:35		Break				20
17:35-17:55		EAAMIRG - INDUSTRY	EAAMIRG AM Update	EAAMIRG INDUSTRY presenter(s) (John Van-Doeselaar (Airbus), Neil Mantle (RR))	AIRBUS, Rolls Royce	20
17:55-18:15		FAA	Applicant Specific Guidance Memorandum for Additive Manufacturing	Bob Grant	FAA	20
18:15-18:35		EASA FAA AM EVENT WG1	WG1 Progress and Meeting Plan - Qualification of Additive Manufacturing (AM) Parts of No, or Low, Criticality (for use in Certified products)	WG1 - Co-chairs (Simon Waite (EASA), Mitch Rife (Delta), Omiros Kastanis (EASA))	EASA, Delta	20
18:35-18:55		EASA FAA AM EVENT WG2	WG2 Progress and Meeting Plan - Fatigue and Damage Tolerance (F&DT) and Non-Destructive Inspection (NDI) Considerations for Metal AM	WG2 - Co-chairs (Michael Gorelik (FAA), Andreas Fischersworing-Bunk (MTU))	FAA, MTU	20
18:55-19:15		EASA FAA AM EVENT WG3	WG3 Progress and Meeting Plan - AM Machine Makers and End Users – Key Process Parameters (KPPs), Qualification, Requalification, and the Ideal 'End State'	WG3 - Co-chairs (Richard Mellor (RR), Don Godfrey (SLM))	Rolls Royce, SLM	20
					Total	225

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EASA Update:

1/ Regulation context reminder (existing and recent/new)

2/ Advanced Materials and Processes - Developing Rulemaking and Guidance

- EASA AM CM-S-008 'Additive Manufacturing' revision
- NPA 2020-11 'Miscellaneous'

3/ European Aviation AM Industry Regulator Group (EAAMIRG)

EASA – AM (see back up slides)

1/ Reminder: Existing Regulatory Context/Framework (moving toward, **performance' based regulations**)

- Regulations relating to **'material, process, manufacturing methods'** are built into the **'Binding Regulations'**

Where are the **'engineering properties'** developed in the pyramid?

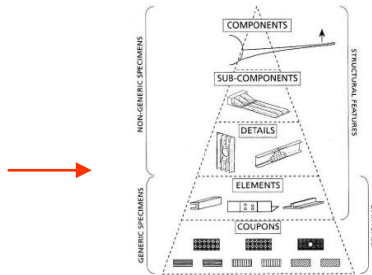
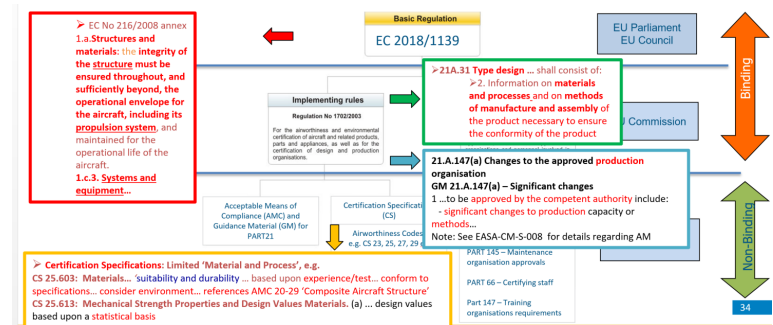


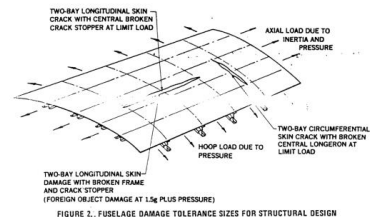
Figure 1 - Schematic diagram of building block tests for a fixed wing.



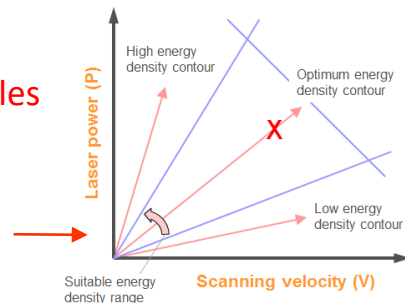
- **'Engineering Properties'** are defined by **'material, process, manufacturing methods'** & built directly into the (complex) part or repair

- change not to reduce the existing **'acceptable'** level of safety

- complex reference point
- use **'robust'** design concepts
- test v analysis?
- optimised design?



- sensitive processes and competing damage modes
- identify Key Process Variables & Parameters, including sensitivity of engineering properties to these...



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EASA – move towards ‘performance’ based regulations*:

Performance-Based Regulation (PBR): A regulatory approach that focuses on desired, measurable outcomes.

Prescriptive Regulation: A regulation that specifies requirements for mandatory methods of compliance.

- work with standardisation organisations and other industry groups, e.g. SAE, ASTM, NCAMP**, CMH-17*** , EAAMIRG, AIA etc

Note: PBR has been, and is being, applied to other industries, so there may be some useful ‘lessons learned’ for aviation (see the Food and Drug Administration presentation on Tuesday)

*<https://www.easa.europa.eu/sites/default/files/dfu/Report%20A%20Harmonised%20European%20Approach%20to%20a%20Performance%20Based%20Environment.pdf>

** extending shared database activities beyond composites to include AM

***new non metallic AM Volume 7 in development

EASA – Regulatory Framework and Change

EASA priorities and resources...

Need for 'harmonised' position continues to be noted!

21.B.100 Level of Involvement (LoI) (Part21 amdt Autumn 2019)

.... (a) **The Agency shall determine its involvement** in the verification of the compliance demonstration activities and data related to the application for a type-certificate etc... and **consider at least the following elements:**

1. ... the novel or unusual features of the certification project, including operational, organisational and knowledge management aspect
3. ... the criticality of the design or technology and the related safety and environmental risks, including those identified on similar designs

Note: flexibility associated with the move towards 'performance' based regulation potentially places more reliance upon industry for standardisation and providing a 'level playing field'

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Certification – Proportionate Certification – Proportionate to criticality?:

- What is '**Criticality**'? (PART 21 AMC 21.B.100(a) 'Level of Involvement' (LoI))... as defined in context of LoI:
*'... 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*** ...'*

* also systemic failure at pax. Level, e.g. multiple seat failures

- any application with potential criticality clearly would be expected to fully comply with all requirements (noting the **novelty** (and **complexity**) aspects of AM, such applications are unlikely to initially be considered by EASA, other than under experienced TCH control supported by an appropriate '**step by step**' approach)
- for other less critical applications 'certification proportionality' requires understanding of technical criticality...

need for broader awareness and understanding of Hazard Analysis...
- key to developing WG1 activities

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Changing technology... and supply chain knowledge management

Other relevant regulations and regulatory activities: Operational Suitability Data (OSD)

- need for the user communities

- *mandating that aircraft manufacturers, including those building helicopters, to submit data EASA considers important for safe operations. OSD covers pilot training, maintenance staff and simulator qualification; the master minimum equipment list (MMEL); and possibly other areas, depending on the aircraft's systems.'*

Example: Composites...

CM-MCSD-001 Issue 1 'Development of **OSD** for **Maintenance Certifying Staff**'

- training/knowledge link to AC20-107B/AMC 20-29/SAE AIR 5719

increasingly important if relying upon
'performance' based regulation

New Technology - some form of mitigation strategy
necessary to link TCH technology evolution with the
appropriate level of in-service
knowledge base and training

Composite Training Guidance
- similar concept for AM?
(avoid re-inventing the wheel when appropriate!)

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Changing technology... and supply chain knowledge management

Other relevant regulations and regulatory activities: support/awareness PART145 activities,
e.g. Point145.A.42(b)(iii) , CAO.A.20(c) or M.A. 603(c)

FABRICATION OF PARTS FOR INSTALLATION

(c) All necessary **data to fabricate the part should be approved either by the Agency or the type certificate (TC) holder, or Part 21 design organisation approval holder, or supplemental type certificate (STC) holder.**

(g) Examples of fabrication within the scope of a Part-145 approval may include but are not limited to the following:

- (1) fabrication of bushes, sleeves and shims;
- (2) fabrication of secondary structural elements and skin panels;
- (3) fabrication of control cables;
- (4) fabrication of flexible and rigid pipes;
- (5) fabrication of electrical cable looms and assemblies;
- (6) formed or machined sheet metal panels for repairs.

- see developing WG1 and WG3 activities

All the above-mentioned **fabricated parts** should be in accordance with the data provided in the overhaul or repair manuals, modification schemes and service bulletins, drawings, or should be otherwise **approved by the competent authority**.

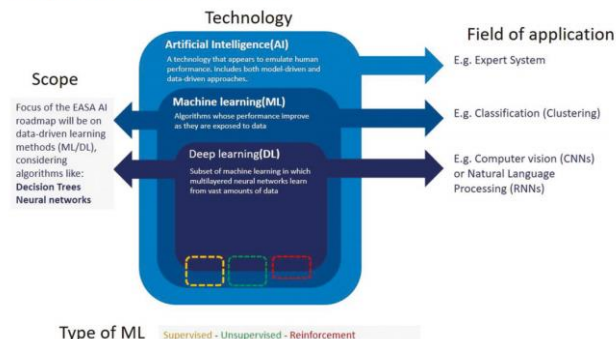
Note: It is **not acceptable to fabricate any item to pattern unless** an engineering drawing of the item is produced which **includes any necessary fabrication process and which is acceptable to the competent authority**.

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Other developing and potentially relevant regulations and regulatory activities:

- EASA Certification Re-organisational Structure – Certification Directorate Roadmap 2020
 - reorganised to facilitate and support technological product innovation
e.g. UAS, VTOL, Electric and Hybrid propulsion
- **Artificial Intelligence (AI) and Machine Learning (ML)*** - initial focus upon ML**....
‘use of data to train algorithms to improve their performance’

■ Figure 1. AI taxonomy in this Roadmap



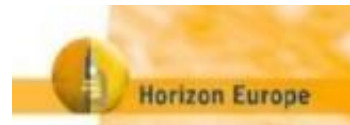
Potential ML impacts include:

- **design** and operation?
- **production and maintenance?**
 - air traffic management?
- drones, urban air mobility, U-space?
- safety risk management?
 - cybersecurity?
 - environment?
- **regulations...** existing regs, e.g. CS2x.1309 + etc?

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Other relevant regulations and regulatory activities: EASA – R&D:

- EASA Basic Regulation amendment... 2018/1139, Article 86.1... **assist the Member States and the Commission in identifying key research themes** in the field of civil aviation
- increasing number of EU integrated technology projects, e.g. combining Materials, Processes, Modelling and Simulation, Structural Health Monitoring etc...



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EASA Update:

2/ Advanced Materials and Processes (AMP) - Developing Rulemaking and Guidance

- as communicated during the 2020 AM Event, no need identified to amend rules specifically for AM, but broader rapidly developing **Advanced Materials and Processes (AMPs)**, and consideration of move towards '**performance**' based regs, will likely result in:
 - simplified CS across products, e.g. CS25, 27, 29, CS-E, CS-P (note: CS23 already simplified at amdt 5)
 - increased development of product and/or technology specific AMC, e.g. as CS25.603 does for composites:

'CS 25.603 Materials

(See AMC 25.603; For Composite Materials, see AMC 20-29...)'*

* Harmonised FAA AC 20-107B

To become AMC 20-xx for
AMP, including Composites,
AM, CMC etc?

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EASA Update:

2/ Advanced Materials and Processes - Developing Rulemaking and Guidance continued...

Example of likely evolution direction:

- recent **NPA 2020-11 ‘Miscellaneous’** (annual CS update cycle) used as opportunity to start process and provide:
 - minor update CS 25.605 to better reflect more recent AMP technology language and provide more continuity with language already used elsewhere, e.g. CS 25.603*...
 - update to AMC 25.603, 605, 613 to better reflect more recent integrated AMP technology considerations, e.g. emphasise use of the test/analysis pyramid etc

**‘ The suitability and durability of materials used for parts, the failure of which could adversely affect safety, must –’*

CS25 amdt due Dec. 2021

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2/ Advanced Materials and Processes - Developing Rulemaking and Guidance, continued...

EASA CM-S-008 issue 1 'Additive Manufacturing'

- inform EASA early in process if intending to use AM (Project Cert, DOA, POA etc)
- **'Step by Step'** approach etc (no criticality/minimal airframe or pax safety first, iaw Lol etc)

EASA AM CM issue 1 released April 2017 - **needed revision:**

- **increasing criticality of applications** in TCH certifications
- **developing in-service community lead interest**, e.g. STCs, MROs, interiors etc
- **growing diverse spread of industry supply chain experience/knowledge management**
 - input from EASA/FAA Workshops, SDO meetings, conferences etc

CM revision (30/4/21) iaw intent shared during the 2020 AM Event

Note: CM is a temporary document, next rev. 2022/23?, subject to content evolution

<https://www.easa.europa.eu/document-library/product-certification-consultations/final-certification-memorandum-ref-cm-s-008>

Part of EASA AM Strategy supported by **EASA AM Working Group**
(internal, across products and domains, e.g. POA, DOA, PAT145 etc) and **EAAMIRG**

becoming
broader EASA
AMP WG (to be
confirmed)

European Aviation AM Industry Regulator Group (EAAMIRG)

EAAMIRG – Summary

Scope/Mission:

- define European Aviation AM interests and priorities
 - safe and efficient AM design, production, in-service utilisation, and certification
- work constructively with other AM groups, e.g. AIA
 - recognising need for harmonisation in increasing complex global industry
 - avoid 'reinventing the wheel'

Organisations Involved - initially European TCHs, 1st Tier suppliers, EASA, European NAAs

- meetings (approx. 3 per year)

- need to develop membership recognised
 - e.g. MROs, Operators etc?

EAAMIRG – Industry and Regulator membership:

- Airbus – Commercial
- Airbus – Defence and Space
- Airbus – Helicopters
- **Boeing***
- BAZL (Switzerland)
- **CAA UK***
- Dassault
- EASA
- **FAA***
- **GE***
- GKN
- ITP
- LBA (Germany)
- Liebherr
- MTU
- Rolls Royce
- Safran
- Thales
- Traficom (Finland)

* **NEW!** non-EU 'associate members' invited to support harmonisation intent

European Aviation AM Industry Regulator Group (EAAMIRG)

EAAMIRG Activities:

- support **revision to EASA CM-S-008 issue 3**
- identify **EAAMIRG priorities** (based upon priority matrix, and outputs from various workshops etc)
 - **Part Classification and Authority Engagement** (LoI etc)
 - improve **standardisation of the ‘criticality’ determination process**
 - improve industry and regulator understanding of the subject
(note: potential to support the CM ‘Parts of No Criticality’ discussion in user communities)
 - **Standardisation: understanding and use of ‘standards’**
 - **better understand and identify common ‘good practices’ when using standards** relative to
 - Criticality of application
 - organisation experience
 - organisational structure in the end to end product chain, e.g. large integrated organisations (including machine suppliers etc) v small organisations in extensive subcontractor chains

supporting WG 1
‘no/low criticality’ theme

supporting WG1 and WG 3

to be continued...

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AOB: Project Certification – AM Certification Review Items (CRIs)

Note: CRIs are regulatory tools used to address delivery of Special Conditions (potential changes to CSs etc) and/or support Means of Compliance evolution, typically beyond established CSs and interpretation of the CSs, e.g. new technology applications

Recent certification projects:

- intent to continue to make reference to CM-S-008 for no/low criticality applications without CRIs, when applicable. However:
 - criticality of applications is increasing
 - increasing cross discipline applications, e.g. structures/systems, propulsion/systems
 - increasing use of multiple subcontractors (some not from aviation background)

- need to standardise/improve knowledge transfer within supply chains

therefore, need for CRIs likely to increase,
particularly MoC CRIs
to be continued...

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Conclusions:

- increasing use of AM across aviation product applications of increasing ‘criticality’
- Rulemaking adapting to ‘advanced materials’, e.g. developing Ceramic Matrix Composites (CMCs), Polymer Matrix Composite (PMCs), etc... **not only AM!**, e.g. EASA CM-S-008 revision, CS25 amdt, AMC 20-XX ‘Materials and Processes’ TBD
- Rulemaking adapting to ‘performance’ based approach
 - certification effort proportional to ‘criticality’, ‘novelty’, ‘complexity’ (LoI) etc
- need to consider impact of other developing technologies upon AM evolution, e.g. AI, ML, modelling and simulation, SHM etc*?
- need to consider impact of other developing technologies upon regulation**?

* How can this be substantiated and certified?...lack of predictability, explainability, robustness, unintended function, lack of standardisation, bias, variance, complexity, extensive data management... many interacting ‘black boxes’? ...need for ‘trustworthiness’ etc

** ‘knowledge management’ with industry via Innovation Partnership Contracts (IPCs) and Memoranda of Cooperation (MoC) + other mitigating actions, e.g. fleet leader, sampling?

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Conclusions... continued:

- Regulators adapting to industry lead need, e.g. EASA AM CM rev. 'Parts of no/low criticality' - improve safety and business case via refined understanding/management of 'criticality'?, use of shared databases, improve knowledge management?, use of CRIs (only if necessary - across panel disciplines, increasing criticality etc)'
- Industry – Regulator WGs and standards bodies of increasing importance to these processes
e.g. European Aviation AM Industry Regulator Group (EAAMIRG), NIAR, AIA, SAE, ASTM, CMH-17
- Industry and Regulators expected to continue with a '**Step by Step**' approach to using AM, supported by EU R&D etc

Note: the next rev. to the EASA AM CM will likely address

- updated coverage of AM Parts of 'no/low criticality'
- parts of higher criticality... TBC 'step by step' approach

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Questions?

Support Slides

easa.europa.eu/connect



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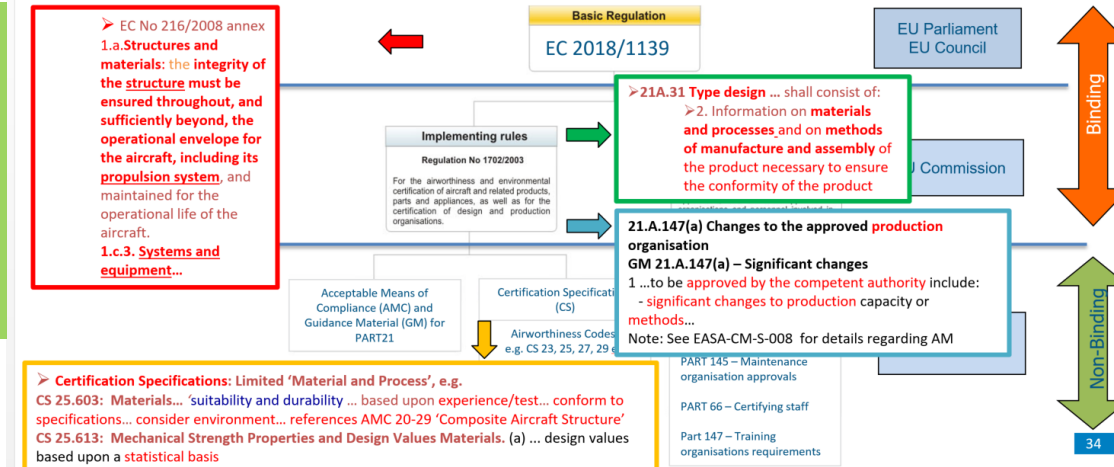
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Backup Slides

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Reminder: Existing Regulatory Framework (moving toward **performance based regulations**)

consideration of materials, processes, methods of manufacture and assembly' etc are 'binding' in the Basic Regulation (BR)



Regulations relating to 'material, process, methods of manufacture, and assembly' are generic from BR to CS/AMC guidance level

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AM 'Engineering Properties' are:

- defined by the 'material and process'
- built directly into the part or repair

Where are the
'engineering
properties'
developed in
the pyramid?

a challenge:

- 'complex parts' – base pyramid coupon data may not represent the complex part properties (although stable simple base pyramid data is essential...otherwise, how can the higher pyramid work be trusted?)
- 'sensitive processes' – a major challenge if completing production activities in a more challenging maintenance environment

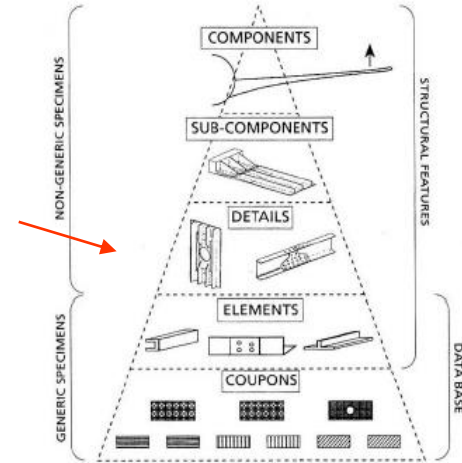
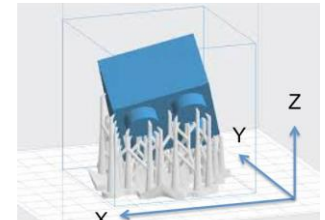


Figure 1 - Schematic diagram of building block tests for a fixed wing.

e.g. AM, composites, bonded joints, advanced alloys



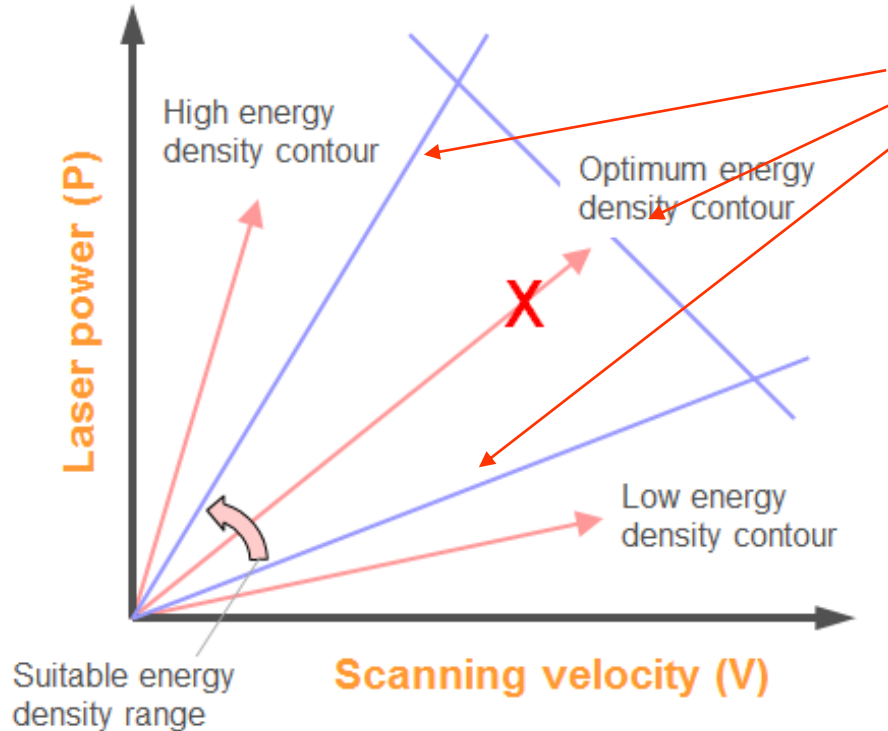
e.g. no access to
free edges –
fatigue issue?



e.g. support structure on
the build platform

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Too many materials, processes, applications ...what does EASA need to understand?



Metallic/non-metallic and many processes generalisation:

Boundary definitions:

- **Key Parameter (KP)** definition?
- **Competing defect/damage modes?**
- **Statistical credentials** (A, B-Basis etc)?
- **Sensitivity** (% change in 'engineering properties' wrt boundaries and KPs?)

- 100+ control parameters
20, 30, 40....'KPs'?

EASA – Regulatory Framework and change

The Regulations – EASA priorities and resources:

applies to baseline structures,
changes, and repairs

safety is the priority...

‘change should not reduce the existing acceptable level of safety’

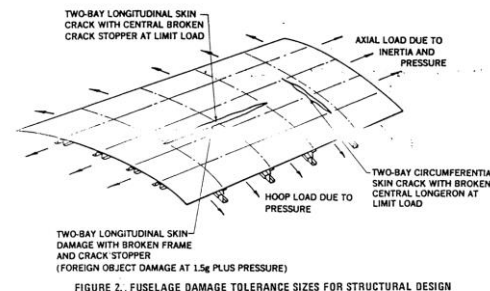
Based upon:

- experience
- reaction to incidents and accidents
- R&D
- ‘engineering judgement’
- regulations existing at the time of certification
- Type Certificate Holder (TCH) in-house design practices

Design with a ‘robust’ design concept

(beyond scope of detailed ‘threat assessment’)

Note: part of broader ‘test v analysis’ issue relating to new technology, equivalence, and existing ‘acceptable’ level of safety – divergent situation... wish to replace test with analysis versus increased complexity and competing failure modes?



e.g. Design for Redundant Structures ...Tom Swift
For conventional metals, a cracked frame and 2 cracked frame bay skins

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EASA AM Strategy: Certification Memo (CM) CM-S-008 Issue 01: Additive Manufacturing:

... share intent early with EASA in order to support integration within existing regulatory framework, e.g. POA, DOA audits etc

responsibilities shared within EASA via subject contacts, identified in CM, and internal EASA AM WG meetings etc

- Cert. Directorate (Chief Expert - Airframe) R. Minter – richard.minter@easa.europa.eu
- Structures S. Waite (AM WG chair) – simon.waite@easa.europa.eu
W. Hoffmann - wolfgang.hoffmann@easa.europa.eu
- Propulsion M. Mercy - matthew.mercy@easa.europa.eu
O. Kastanis - omiros.kastanis@easa.europa.eu
M. Weiler - michael.weiler@easa.europa.eu
- Systems T. Ohnimus - thomas.ohnimus@easa.europa.eu
- Cabin Safety A. Enache - alexandru.enache@easa.europa.eu
- DOA **O. Tribout** - olivier.tribout@easa.europa.eu
D. Lamothe - dominique.lamothe@easa.europa.eu
- POA R. Tajas - rosa.tajes@easa.europa.eu
- Maintenance TBD
- ETSO



Reminder: applies to CS-22, CS-VLA, CS-23, CS-25, CS-VLR, CS-27, CS-29, CS-E, CS-P, CS-APU, + ETSOs

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CM-S-008 Issue 01: Additive Manufacturing* – Draft Revision Outline:

<https://www.easa.europa.eu/document-library/product-certification-consultations/proposed-update-easa-cm-s-008-certification>

add reference to developing 'certification' specific related documents: AIA Recommended Guidance for Certification of AM Component (Feb. 2020)

emphasise importance of identifying **key parameters** and demonstrate **sensitivity of the engineering properties to these key parameters in proportion to criticality (LoI)**. Also added **caution regarding developing optimised designs** (potentially more low RFs and appropriate testing challenge)

added Policy sections (see following slides) addressing:

- 'Knowledge Management and Training'
- 'Certification Plans and Means of Compliance (MoCs)'
- 'Parts of No/Minimal Criticality'.... **ensuring that they remain so!**

CM revision (30/4/21) iaw intent shared during the 2020 AM Event

- CM is a living/temporary document. Next revision planned in 2022, subject to content evolution and industry need

Table of Content

1. Introduction

1.1.Purpose and scope

1.2.References

1.3.Abbreviations

2. Background

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

4. Whom this Certification Memorandum affects

5. Remarks

Appendix 1

Appendix 2

EASA - AM

CM–S-008 Issue 01: Additive Manufacturing – Draft Revision Outline:

New para. – Parts of No Criticality, main points :

Example –using existing guidance strategies: SAE AIR6291 ‘Guidelines for Repair Process Evaluation of Aluminium Bonded Structure’

‘1. SCOPE

...intended to be used as a **process verification guide for evaluating implementation of key factors** in repair of metal bond parts or assemblies in a repair shop environment. **This guide is to be used in conjunction with a regulatory approved and substantiated** repair, and **is intended to promote consistency and reliability.**

1.1. Purpose

‘...intended to be used as a **guide for regulatory and Customer personnel** during the evaluation process of a substantiated repair submitted to the aforementioned parties by a repair station acting on behalf of a Customer to carry out a repair to aluminum bonded structure. This AIR **is also intended to be used as a supplement to AS 7118 during an audit to evaluate repair station processes.**

This document may be used as a reference for a Customer to understand some key considerations that should be taken into account

This document is NOT intended to be a design handbook for repair stations that wish to substantiate repairs that extend beyond the size limits of an OEM approved repair manual, such as a CMM, SRM, AMM, etc.’

Useful customer and supply chain knowledge management messages...

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CM–S-008 Issue 01: Additive Manufacturing – Draft Revision Outline:

New AMC CS2x.603, 605, 613 supporting text: Further supporting text relating to materials regulations, main points (see support slides):

- generic **guidance intended to support AMC 2x.603, 2x.605, and 2x.613**
- considered applicable to all materials and processes, e.g. composites, bonded structures, AM, advanced alloys - also considered to **provide support to other CSs, including CS-23, CS-E, and CS-P**, - **text to be proposed for CS25 AMC amendment** (later broader AMC 20-xx 'Materials and Processes' expected)
- **AMC CS2x.603:**
 - data to be based upon **stable 'representative' materials and process**
 - the **'effects of defects' identified** in production and in-service environment be **characterised at appropriate part configuration complexity level** and defined and maintained within the specifications
 - the potential for anisotropy and environmental influence be considered and statistically addressed in the database

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New AMC CS2x.603, 605, 613 supporting text: Further supporting text relating to materials regulations, main points (see support slides):

- generic **guidance intended to support AMC 2x.603, 2x.605, and 2x.613**
- considered **applicable to all ‘advanced’ materials and processes**, e.g. composites, bonded structures, AM, advanced alloys
- considered to **provide support to other CSs, including CS-23, CS-E, and CS-P** (later broader AMC 20-xx ‘Materials and Processes’ expected)

Note: amdts to AMC 25.603, 605, 613 in progress, release for comment Q4 2020
- AMC 20-XX ‘Materials and Processes’ to follow?

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CM–S-008 Issue 01: Additive Manufacturing – Draft Revision Outline:

New AMC CS2x.603, 605, 613 supporting text: Further supporting text relating to materials regulations, main points:

- **AMC CS2x.605:**
 - the potential for anisotropy and environmental sensitivity to be assumed (unless already demonstrated)
 - **test programme for new fabrication steps to identify critical parameters which govern the final strength and other ‘engineering properties’**
- **AMC CS2x.613:**
 - 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 the numbers of specimens may be reduced for practical reasons below the levels normally expected for generation of statistically significant values. **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 should be agreed with the agency.**

RMT.0018 Opinion's proposal (1/3)

- Design approval Holder (DAH) may voluntarily identify parts that would not require EASA Form 1 (criteria: negligible safety impact in case of non-conformity → Guidance provided in GM (next slide)).
- DAH identifying such parts in the ICAs may also identify special verifications to be conducted on the part by the installer (mitigates potential risk in case of a non-conformity → more parts can fulfill the negligible safety impact criteria → GM is provided) .
- For General Aviation, permit identification of parts that would not require an EASA Form 1 by EASA in CS-STAN (criteria: negligible safety impact in case of non-conformity → Guidance provided in GM, guidance more relaxed for CS-STAN).
- Existing alleviations in OPS (e.g. CAT.IDE.A.100(a)), standard parts for gliders and 21.A.307(c) remain as today.

Note: EASA CS-STAN contains design data, including acceptable methods, techniques, and practices for carrying out and identifying Standard Changes/Standard Repairs (SCs/SRs). Designed in compliance with these certification specifications, ...not subject to an approval process, ...can be embodied in an aircraft when the conditions set out in the relevant paragraphs of Part 21 for SCs/SRs, i.e. 21.A.90B or 21.A.431B, are met... must not conflict with information and limitations given by the TCH. Some SCs and SRs carry restrictions relative to some product types, and are typically for use with smaller aircraft.

RMT.0018 Opinion's proposal (2/3)

Guidance Material:

- 'Negligible safety effect when installed on the product' means that any non-conformity of the part or appliance not identified by the installer that conducted the specific verifications mentioned in 21.A.307 (c),:

- for ELA1 and ELA2 aircraft, has an effect equal or lower than:
 - a slight reduction in operational or functional capabilities of the aircraft or its safety margins;
 - some physical discomfort on occupants; or
 - a slight increase in the workload of the flight crew nor requires the use of emergency procedures; and,

- for any other aircraft,:
 - **has no effect on the operational or functional capabilities of the aircraft nor on its safety margins;**
 - **has no physical discomfort on occupants; nor**
 - **does not increase the workload of the flight crew nor requires the use of emergency procedures.**

RMT.0018: Be aware...(3/3)

- BR (Basic Regulation) introduced the concept of non-installed equipment. This is not considered in this Opinion. It will be dealt with in another RMT.
- Existing BASAs do not consider this concept. Although the future rule would not create limitations to export European parts if they are produced i.a.w. old rules, it would be desirable to change BASAs to cater for these parts. Vice versa, some exemptions to the foreign form (e.g. FAA 8130-3) could be considered for these parts.

RMT.0018 Opinion's proposal

- Maintenance of these parts will be permitted outside approved MROs.
- Maintenance performed to be recorded for traceability purposes – maintenance record
- Installation on the aircraft of the part after maintenance as per existing continuing airworthiness rules – except for the need of an EASA Form1 with the part.

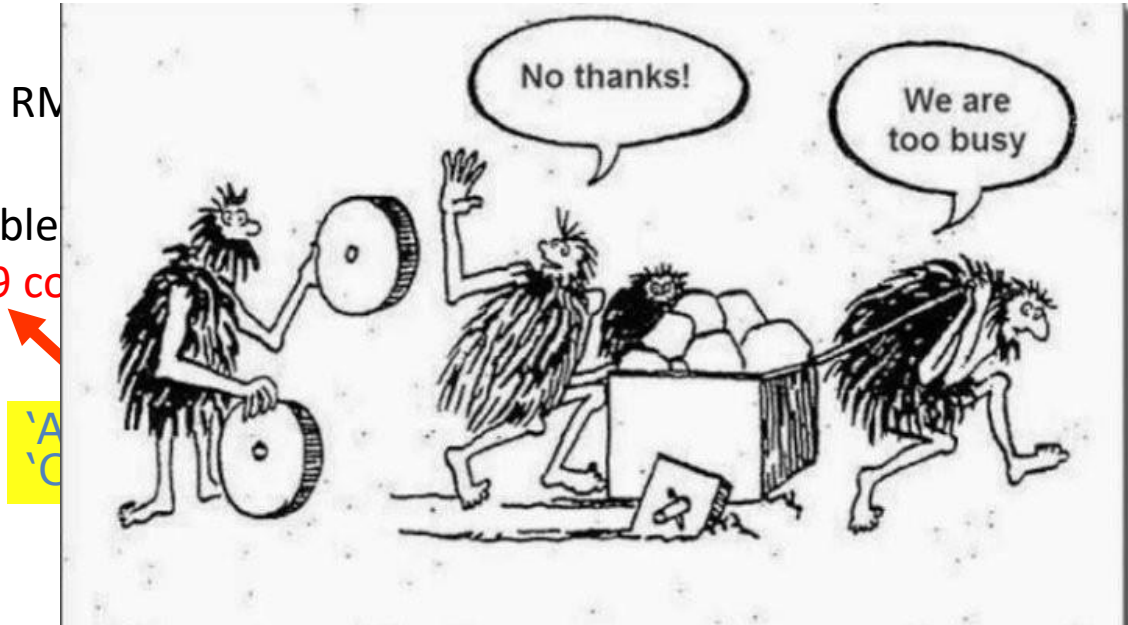
Can we learn something useful from other 'similar' technologies and associated regulatory evolution...?

Example: Composites:

No need to re-invent the wheel
(when appropriate!)

EASA MDM.059 RM

- includes possible
to SAE AIR 5719 co



ng appendix linked

Isaac Asimov – 3 Laws of Robotics

1. A robot must not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

Note: These rules soon become problematic.... weak v strong AI etc

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AOB: Opinion 07/2019 RMT.0018

'Installation of parts and appliances that are release without an EASA Form 1 or equivalent'

Decision planned for 2021/Q3

(from EASA presentation AEA European conference Jan 2020
see support slides)

RMT.0018 - Parts without EASA Form 1: Why?

- Currently, all parts need an EASA Form1 (or equivalent) to be installed during maintenance (standard parts and raw/consumable material are excluded).
- An EASA Form1 can only be issued by POAs, i.e. by a production organisation under the oversight of an aviation authority
- ... **but not all parts have the same safety relevance.**
- **The future rule will permit that certain new parts are installed on a product during maintenance without an EASA Form1.**

The image shows a sample of EASA Form 1, titled 'AUTHORISED RELEASE CERTIFICATE EASA FORM 1'. It is a structured form with various fields for recording maintenance actions, including sections for 'Particulars of work done', 'Signature of authorised person', and 'Signature of responsible person'. The form is used to document the completion of maintenance tasks on aircraft parts.

Note: EASA CS-STAN* contains design data, including acceptable methods, techniques, and practices for carrying out and identifying Standard Changes/Standard Repairs (SCs/SRs). Designed in compliance with these certification specifications,
... not subject to an approval process,
... can be embodied in an aircraft iaw conditions set out relevant paragraphs of Part 21 for SCs/SRs
... must not conflict with TCH information/limitations. Some SCs and SRs carry restrictions relative to some product types, and are typically for use with smaller aircraft

***criteria: negligible safety impact in case of non-conformity**

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Basic Regulation (EU) 2018/1139 – safety of third parties on the ground:

When assessing Parts of No Criticality, BR requires:

Article 4 – Section 2:

The measures taken under this Regulation shall correspond and be proportionate to the nature and risk of each particular activity to which they relate. In preparing and enacting such measures, the Commission, the Agency and the Member States shall take into account, as appropriate for the activity concerned: [...]

(b) to what extent third parties or property on the ground could be endangered by the activity;

Annex II - 2. AIRWORTHINESS ASPECTS OF PRODUCT OPERATION

2.1. The following must be shown to have been addressed to ensure safety for those on board or on the ground during the operation of the product:

(a) the kinds of operation for which the aircraft is approved must be established and limitations and information necessary for safe operation, including environmental limitations and performance, must be established; [...]

AM



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An Agency of the European Union 