EASA
European Union Aviation Safety Agency

EASA – Structures and Materials Safety

CMH-17 – DAMAGE RESISTANCE, DURABILITY, AND DAMAGE TOLERANCE TG

Koeln

July 15-17th. 2019

Dr. S.Waite
Senior Expert - Materials
Certification Directorate

Your safety is our mission.

An Agency of the European Union

EASA – CMH-17 F&DT TG – Working Meeting

Welcome to Koeln

- Introduction to ‘working meetings’ on Tuesday/Wednesday (held Monday)

  - introduction/awareness/standardisation meetings
  - working meetings (more efficient if separate from awareness/introduction/standardistion meetings – CMH-17 experience)

- Koeln - opportunity for more European industry involvement
- Aligned with draft EASA composite strategy

  - CMH-17 further development for other products (beyond CS25), e.g. GA, rotorcraft, propulsion, newer concepts (e.g. eVTOL) etc?

- EASA Structures Team awareness of process/evolving content
- Move towards ‘performance’ based regulation (industry defined ‘level playing fields’ more important – commercial and safety interest)

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Composite Materials Handbook – 17 (previously MIL-HANDBOOK-17) – developing Mission etc

Mission: Composite Materials Handbook creates, publishes and maintains proven, reliable engineering information and standards, subjected to thorough technical review, to support the development and use of advanced materials and structures

Goals and Objectives:

- Provide comprehensive, practical engineering guidance that has proven reliable for the design, fabrication, characterization, test and maintenance of composites.
- Provide reliable data, [illegible] of material property basis values and design information that
- Publish examples, app[illegible]tline limitations, strengths and weaknesses.
- Promote safe use of c
- Promote efficient met
- Provide educational re[illegible]ent and in-person training/content review.
- **Establish relationships with other standards organizations and engineering handbooks with similar goals to jointly develop and maintain consistent information to benefit industry.**

CMH-17 challenge –

- encourage correct use of the documents, particularly by new organisations and organisations new to composites
- applicability and appropriate substantiation required

Note that the use of "composite" in the title of the Handbook and throughout this document refers to advanced materials (including, but not limited to, composites).

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CMH-17 DAMAGE RESISTANCE, DURABILITY, AND DAMAGE TOLERANCE TG operates under direction of the…

SAFETY MANAGEMENT WORKING GROUP

Dr. Larry Ilcewicz, FAA/Seattle Aircraft Cert. Office
Ms. Cindy Ashforth, FAA/ANM

The objective of the Safety Management Working Group is to provide the basis for assessing and managing risk by various means to assure and improve aircraft safety. The group is leading the development of the chapter in Volume 3 - Chapter 17 "Structural Safety Management". Chapter 17 includes considerations, analysis procedures and practical applications of safety management. In addition, the Safety Management Working Group is coordinating current initiatives involving the structural safety task group and efforts by the damage tolerance and disbond & delamination task groups.

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DAMAGE TOLERANCE TASK GROUP (under Safety Management)

Dr. Douglas S. Cairns, Montana State University
Mr. Patrick Enjuto, NSE Composites
(NSE + DM Hoyt , and previously Tom Walker)
Mr. Allen Fawcett, Boeing
Mr. Mike Smeets, Fokker Landing Gear
Dr. Simon Waite, European Aviation Safety Agency (EASA)

addition of NSE resource important to CMH-17 V3C12/13/14 progress

+ many others leadership… e.g. Waruna Serenviratne

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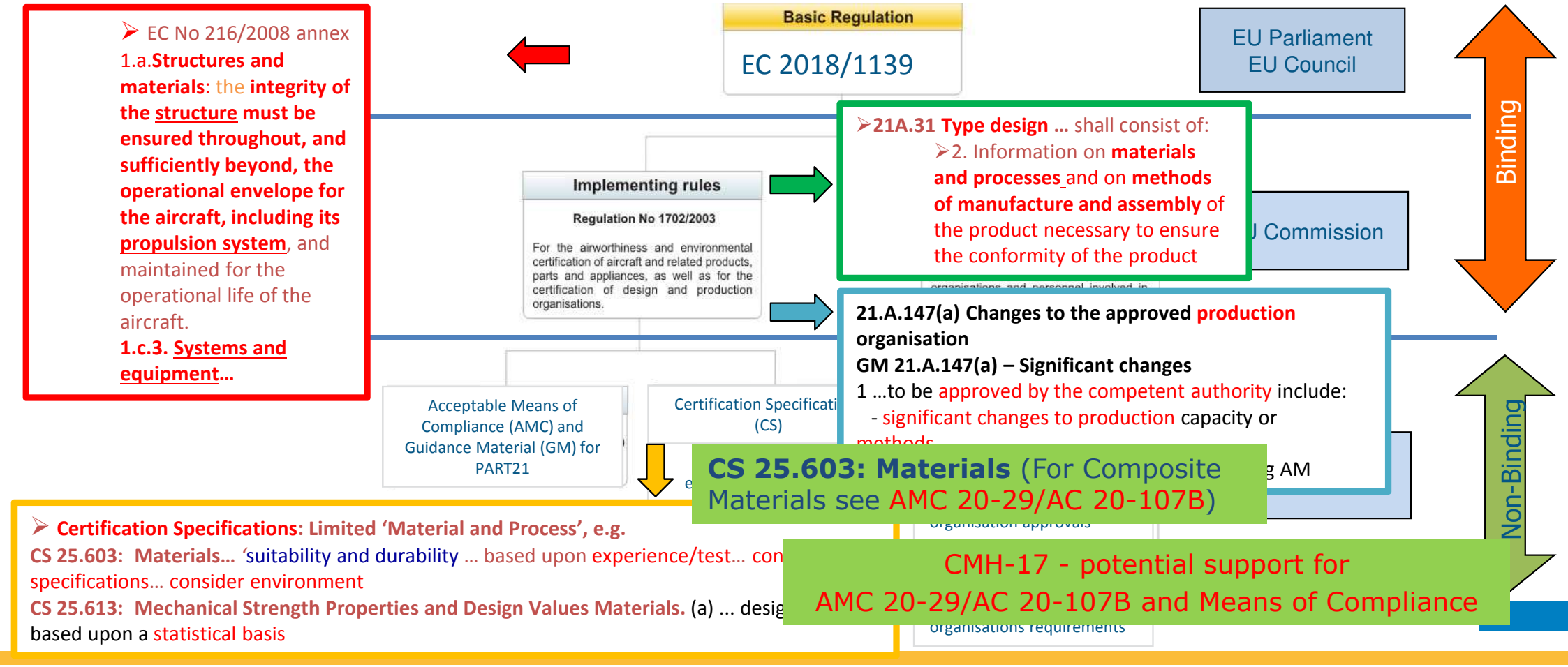
- **V3C12 DAMAGE RESISTANCE, DURABILITY, AND DAMAGE TOLERANCE**

Content – To be discussed today…

Includes regulation reference content

EASA - Existing Regulatory Framework

(CMH-17 regulatory context - moving away from **'prescriptive'** towards **'performance' based regulations**)



EASA – Regulatory Framework and change

Regulations: EASA priorities and resources…

21.B.100 Level of Involvement (LoI) (Opinion 07/2016 + NPA 2017-20, due 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*

Move towards 'performance' based regulations… e.g. CS23 amdt.5 relative to amdt.4

e.g. CS 23.573a5 'bonded structure' moved to ASTM

A '**level playing field**' challenge, particularly for new and/or small organisations

EASA – Composite Strategy (Draft)

CS22, 23, 25, 27,29, CS-P, CS-E, and ETSOs

1/ For the purposes of efficiency, 'when appropriate to EASA objectives and European Industry interests*', work with:

- other regulators**, e.g. FAA, TCCA, etc
- standardisation bodies, e.g. SAE, ASTM etc
- guidance development organisations, e.g. CMH-17

* all aspects, e.g. rulemaking, R&D, Certification (design, production, CAW), etc

recent priority has been CS25, with introduction of B787, A350…
- significant increase in numbers of engineers exposed to composites…

** Note: Industry\Regulator Composite WG

EASA – Composite Strategy (Draft)

EXAMPLE: CS25 Industry/Regulator Composite WG Charter

(Airbus, Boeing, Bombardier, FAA, TCCA, EASA):

- **Openly share knowledge** from past and current composite applications to transport airframe structure to **support safety and certification efficiency**, **without divulging competitive info (per equal-sharing principles),** in the longer-term pursuit of composite standards

- **Primary advantage** comes from industry **members with experience & knowledge** having a forum that **promotes a more efficient path to composite standards** that meet safety needs and promote certification efficiency

Could this model benefit other sectors of the industry, e.g. CS23, CS27, CS29? …

EASA – Composite Strategy (Draft)

2/ Identify European specific themes which may be different (CS25), or justify different priority, wrt the broader common interests. This may result in new themes, or complementary themes wrt the common interest:

Example 1 - **sandwich structures** (following various incidents across a range of products):

- R&D support for existing CMH-17/Airbus control surface Ground-Air-Ground (GAG)
- draft EASA Sandwich CM

Example 2 – **training** (prioritise maintenance, **small CS25 MRO DOAs not supported by TCHs**, internal EASA and NAAs…

- **standardise knowledge base/training at 'Level 2*' for those making composite airworthiness level decisions**

* see support slides

EASA – Composite Strategy (Draft)

3/ Identify European specific themes (other than CS25!):

Example 1 – **sandwich structures** (following various incidents across a range of products):
Expand scope of existing work to engage **European Rotorcraft and GA Industry**

- develop R&D support using existing CMH-17/Airbus control surface GAG team?
- **draft Sandwich EASA CM – monocoque applications… used more often outside CS25 applications**

Example 2 – develop regional CMH-17 activities in Europe for GA and Rotorcraft?
(recognising budget limitations for small and/or new organisations, and improved co
- develop upon a continental basis, e.g. European GA AFF/HFF?, WGCA?, C

Example 3 – training:
- training (prioritise GA/Rotorcraft DOAs (**particularly new small organisations**))
- CVE knowledge expectations (for new organisations in particular)?

existing acceptable level of safety…
partly based upon 'tribal knowledge' and 'grey hairs'

– many approaching retirement

- Knowledge Transfer?

EASA – ‘Acceptable Level of Safety’ and change

Composites - 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

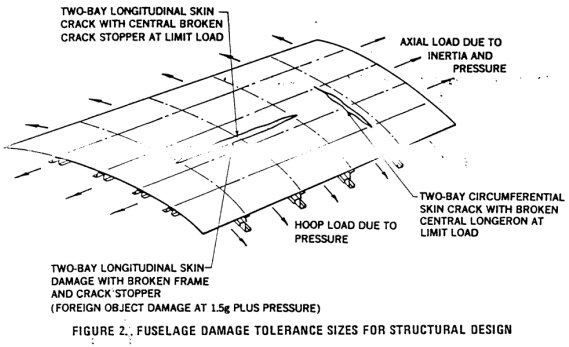


FIGURE 2.. FUSELAGE DAMAGE TOLERANCE SIZES FOR STRUCTURAL DESIGN

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

Design with a ‘robust’ design concept (ARAC?)

CMH-17 challenge
– correct use of the document, particularly by new organisations and organisations new to composites

EASA – Regulatory Framework and change

Regulations: EASA priorities and resources…

EASA Certification Organisational Structure: (see support slides)

- reorganised to facilitate and support technological innovation (e.g. UAS, eVTOL, Electric and Hybrid propulsion)

EASA – R&D Strategy: (see support slides)

- New EASA Basic Regulation 2018/1139, Article 86.1… **assist the Member States** and the **Commission** in **identifying key research themes** in the field of civil aviation

EASA – Regulatory Framework and change

Regulations: EASA priorities and resources…

Conclusion:

- move towards ‘performance’* based regulation means that industry activities are becoming increasingly important to industry and the regulators… e.g. CMH-17

- noting very limited resource, there is also further potential benefit to industry from further development and leadership** regarding shared activities, e.g. common practices and methodologies (e.g. DT), shared databases (shared cost for development of new materials and processes etc) for small organisations, GA, Rotorcraft, Propulsion*** etc

* aligned with FAA message given at CMH-17 Salt Lake City (2019), CS23/PART23 amendments, EASA Additive Manufacturing Certification Memo etc

**already being demonstrated by Airbus, Boeing, Bombardier, Fokker at CMH-17.

*** future developments? GA, evolve AFF/HFF (WGCA?) activities in Europe, developing FAA composites TSO proposal, rotorcraft thoughts? etc

EASA – Regulatory Framework and change

Regulations: EASA priorities and resources…

Conclusion:

- reminder: CMH-17 objectives include: ‘Establish relationships with other standards organizations and engineering handbooks with similar goals to jointly develop and maintain consistent information to benefit industry’.

Are there commonalities in methodologies, e.g. DT, databases etc, which can be identified, and broadly shared and applied across some sectors of the industry, and which can be developed via existing standards organisations, engineering handbooks, database mechanisms etc?
… avoid reinventing the wheel…

EASA – F&DT TG – Working Meeting

Questions?

Thanks to EASA support: Erika Amrhein, Julie Grogan-Malats

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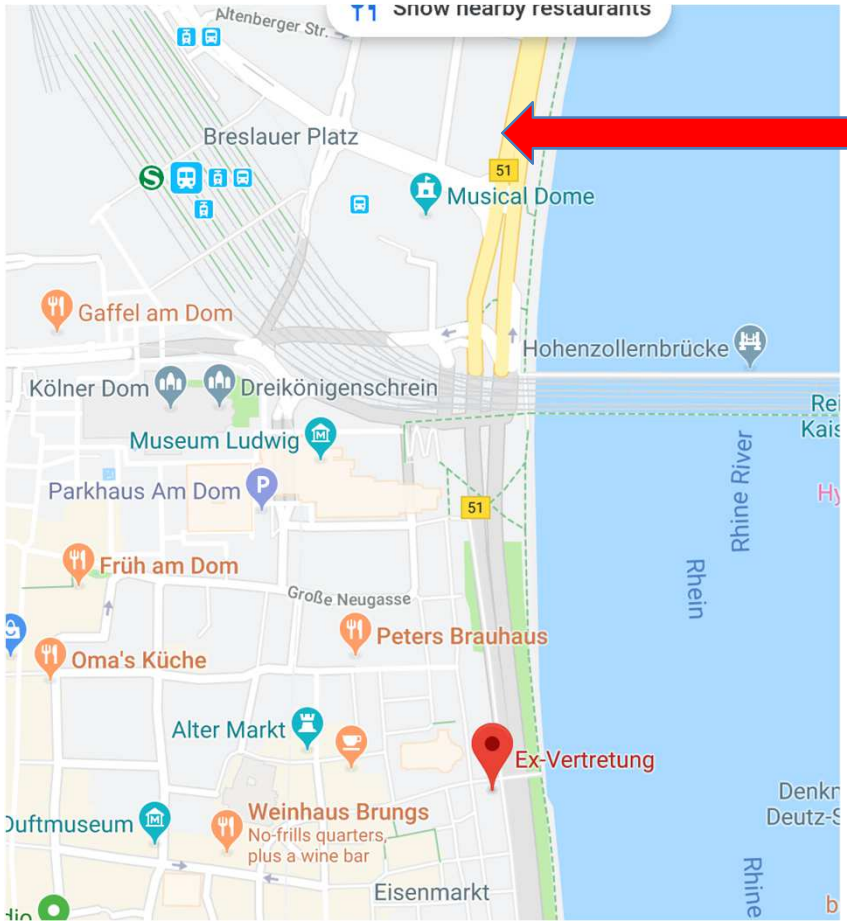
Support Slides

EASA – F&DT TG – Working Meeting

Ex-Vertretung: Frankenwerft 31-33, 50667 Köln: 0221 66990221



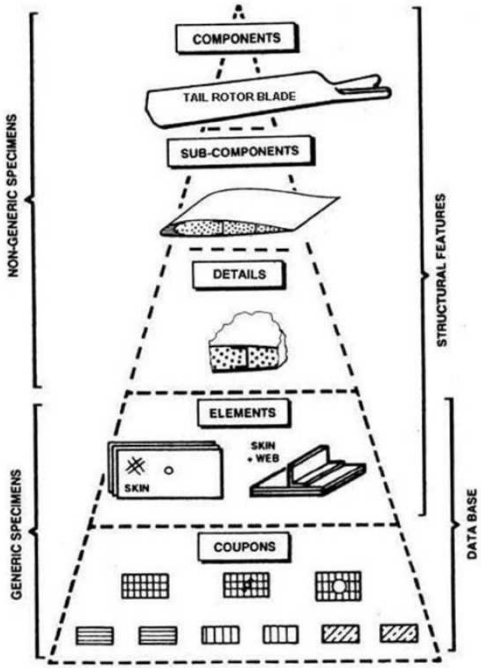
You are here…

Tuesday 16th July 2019
Time: 20:00hrs

EASA

Composite Shared Database - Options:

- limited established sharing of composite specs and compositions – unlike metals (proprietary data etc)
- complete test pyramid necessary …even if the same material is used by different organisations
- ‘engineering properties’ result from material, process, and ‘configuration deta
- potentially value in sharing base pyramid work, if the same material is used…



Regulators unlikely to be confident in higher pyramid design data if simple base pyramid properties cannot be consistently produced following standard procedures and test methods

Potentially more important for GA, noting typically limited mid-pyramid test data available, e.g. due to component definition/boundary condition validity, limited high pyramid load case testing….. and COST!

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Composite Shared Database Options: History – Not New

AFF/HFF*

- long established closed group of organisations (until recently**)
- functions and data sharing not limited to composites
- composites - shared base pyramid data + some higher level details
- wet lay-up and bonded joints

* AFF - Arbeitskreis Faserverbund Flugzeugbau, publishes a manual for composite aircraft called HFF Handbuch Faserverbund Flugzeuge.

** recent project development with AFF/HFF beyond Germany to be presented by Philipp Steinbach (Game Composites)

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Composite Shared Database Options:

National Center for Advanced Materials Performance (NCAMP)*:

- open group of global organisations (industry/regulators) following Standard Operating Procedures (SOPs)
- **base pyramid composite specific data sharing** (simple flat coupons etc)
- **two main levels of activity**:
  - **users of data for materials in the existing NCAMP database** (show equivalence using a reduced dataset and following SOPs)
  - **new material contributors**
- independent checking of data (panels tested etc)
  - **need for independent 'test houses' in Europe (FAA v EASA conformity requirements)?**

* Note: Originally Advanced General Aviation Transport Experiments (AGATE), formed in 1990s intended to support GA. However, evolved into NCAMP, currently populated by prepregs and CS25 supplier organisations. However, may become more relevant to GA again as more prepreg is used.

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Composite Shared Database Options:

National Center for Advanced Materials Performance (NCAMP)*:

NCAMP: EASA CM – S – 004 Issue 01 'Composite Materials – Shared Databases, Acceptance of Composite Specifications and Design Values Developed using the NCAMP Process'

'EASA accepts the processes and data generated, as described in para. 3.1.1, as appropriate and subject to review in accordance with standard project Certification and Validation processes, for:

- project Validations, e.g. for EASA Validation of FAA products
- EASA product Certification, **when applicant has fully engaged with the NCAMP SOPs***

*acceptable to NCAMP and EASA

small organisation issues recognised… limited resource, but need to maintain independence and satisfy 21A.239(b) and CVE functions: https://www.easa.europa.eu/faq/20110

EASA

Composite Shared Database Options:

NCAMP SOPs and European Functionaries: Authorised Engineering Representative (AER):

2.5.2 Authorized Engineering Representative (NCAMP AER)

The NCAMP AER is an individual qualified to conduct independent/un-bias engineering functions. The NCAMP AER is typically responsible for (1) reviewing and recommending acceptance of documents such as test plans and specifications, (2) witnessing specimen testing, and (3) accepting test data. Individuals desiring to hold this position must meet the requirements of NCAMP Authorized Engineering Representative (AER) Qualification Plan (NCAMP Document No. NQP 200) and be approved by the NCAMP Manufacturers Advisory Board members participating in a given program. An AER may be an independent/self-employed engineer or may be employed directly by the company that is performing the tasks for NCAMP. In the latter case, the AER must not work for the same engineering department and must be able to provide impartial engineering approval or recommendation for approval.

For document review tasks, the AER is usually paid by the entity that is funding the qualification program. For test witnessing task, the AER is usually paid by the testing lab or the entity that is funding the qualification program.

- independent review*/recommend document acceptance
- witness testing
- accept test data

Proposed: EASA CVE or NAA (with appropriate composites experience identified in capabilities)

- direct AER function

or

- finding appropriate AER

* supported by/or initially EASA/NAA (review, but not recommend)

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Composite Shared Database Options:

NCAMP SOPs and European Functionaries: Authorised Inspection Representative (AIR):

2.5.1 Authorized Inspection Representative (NCAMP AIR)

An NCAMP AIR is an individual qualified to conduct independent/un-bias inspection verifications. This individual's regular job function includes inspection verification of test panels and specimens. Companies and testing laboratories that participate in NCAMP activities typically have internal quality procedures and conduct internal inspection on test articles. In such cases, the NCAMP AIR may elect to conduct inspection verification on representative samples of test articles to ensure that the internal quality procedures and inspections are adequate. The NCAMP AIR may conduct more rigorous inspection verification frequency, at the sole discretion of the NCAMP AIR, if the internal quality procedures and inspections are deemed inadequate. Individuals desiring to hold this position must meet the requirements of NCAMP Authorized Inspection Representative (AIR) Qualification Plan (NCAMP Document No. NQP 100) and be approved by the NCAMP Manufacturers Advisory Board members participating in a given program. An AIR may be an independent/self-employed inspector or may be employed directly by the company that is performing the tasks for NCAMP. In the latter case, the AIR must not work for the same inspection/quality department and must be able to provide impartial inspection verification.

- independent test article inspection verification
- supports AER*

Proposed: EASA CVE (with appropriate composites experience identified in capabilities)

- direct AIR function

or

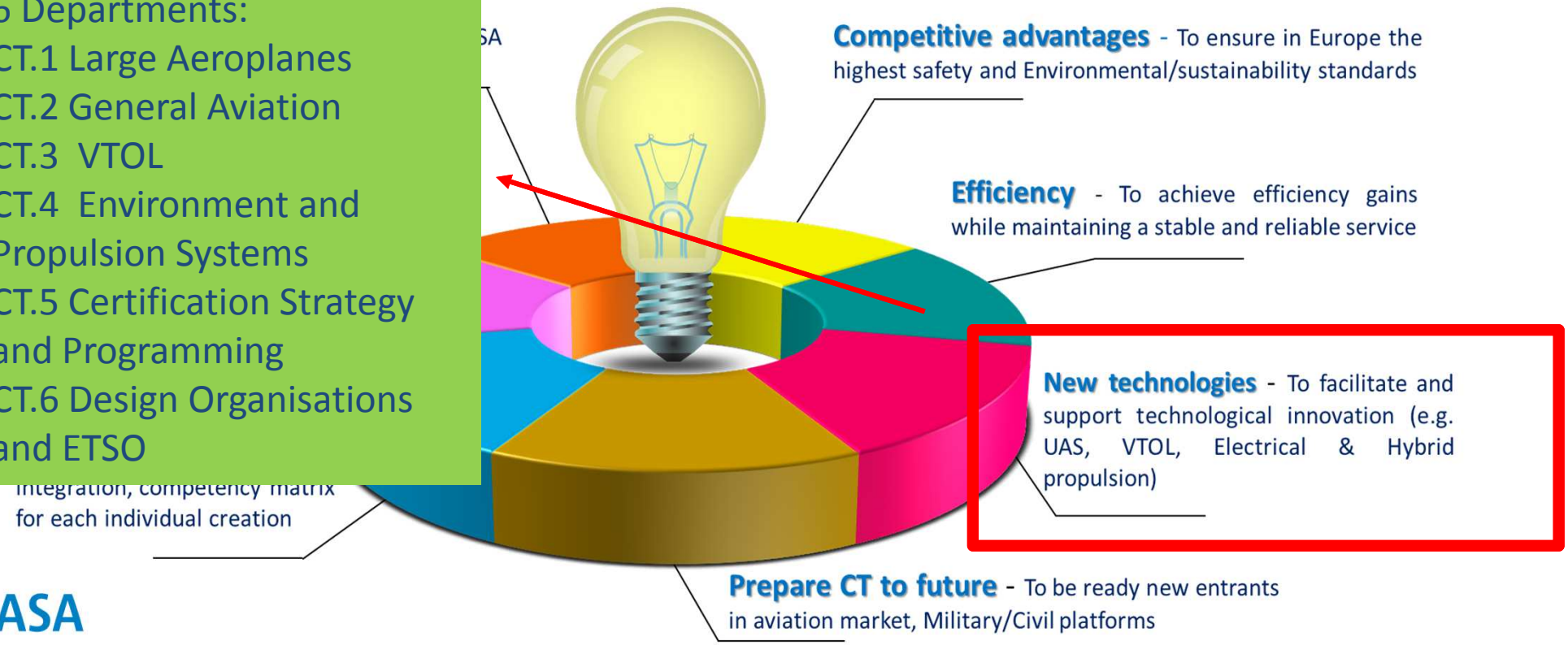
- finding appropriate AIR

* CVE not to be both AIR and AER on same project!

EASA Certification Organisational Structure and Change

EASA Certification Roadmap

Reorganisation in progress:
6 Departments:
CT.1 Large Aeroplanes
CT.2 General Aviation
CT.3 VTOL
CT.4 Environment and Propulsion Systems
CT.5 Certification Strategy and Programming
CT.6 Design Organisations and ETSO



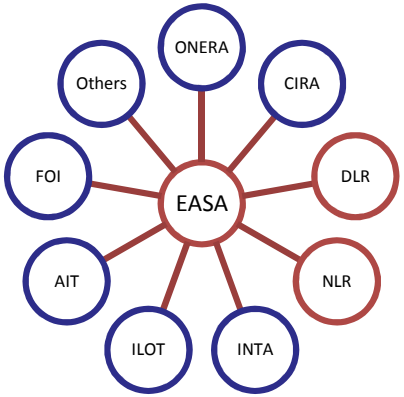
EASA – R&D Strategy*

A global approach for a coordinated research programme

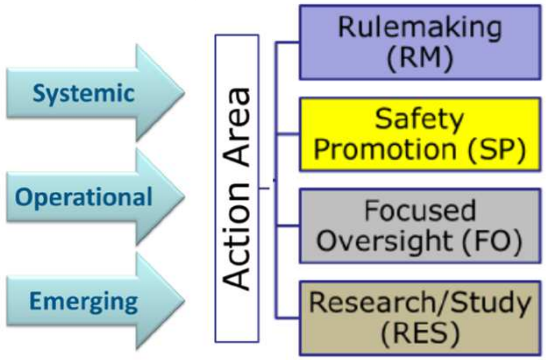
New EASA Basic Regulation 2018/1139, Article 86.1

The Agency shall
(1) ***assist the Member States*** *and the Commission in*
(2) ***identifying key research themes*** *in the field of civil aviation … falling within the scope of this Regulation.*

(1) Cooperation with national research centres



(2) Identification through the EPAS* of the priorities of future research programmes



* European Plan for Aviation Safety , also see support slides for further information

EASA – R&D Strategy

New EASA Basic Regulation 2018/1139, Article 87.4
European Aviation Environmental Report (EAER)

… at least **every three years**, **publish an environmental review**, which shall give an objective account of the state of environmental protection …

… primarily rely on information already available to Union institutions and bodies …

… shall also contain **recommendations** aiming to improve the level of environmental protection…

https://www.easa.europa.eu/eaer/

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European Union Aviation Safety Agency

easa.europa.eu/connect

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An Agency of the European Union