CMH-17 Damage Tolerance Initiatives Support

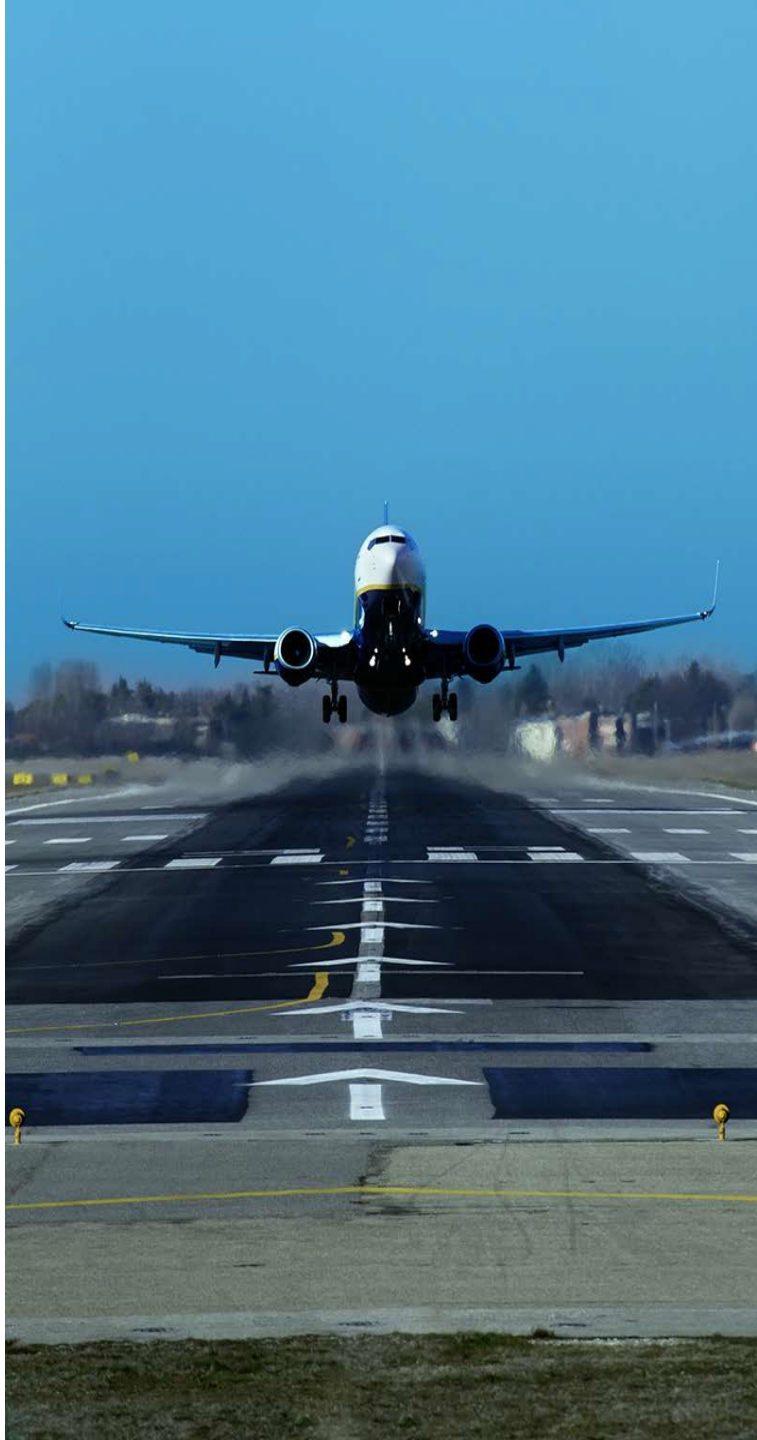
CMH-17 WG – Chap. 12 (Rev H)

CMH-17 EASA DT Workshop: FAA Advances, Industry Standards & Integrated Product Development

- Innovation and IPD Composite Maintenance and Damage Tolerance Principles
- FAA advances that depend on standards
  - ✓ Composite Applications: Technical Standard Order
- Thoughts shared at April ARAC Meetings

Presented to: Joint CMH-17/EASA/FAA Workshop
at EASA in Cologne, Germany

By: Larry Ilcewicz
Date: July 17, 2019



Innovation

FAA is aware of Industry's desire to jointly pursue innovation early in a project's life, such that future certification benefits from resulting knowledge transfer

- **FAA Certification Division reorganized directorates and processes to better meet industry needs, while staying close to technology advances (i.e., Policy and Innovation Division)**
  - Webster Definition of "Innovation": *…the introduction of something new.* Also *… the act or process of introducing new ideas, devices, or methods.*
- ***Innovation* occurred regularly through the course of composite applications to airframes**
  - Past success in *composite innovation* has been directly related to:
    1) use of Integrated Product Development principles,
    2) continuous technology readiness assessments throughout development,
    3) thorough understanding of technology strengths & weaknesses to establish design constraints, manage costs and
    4) related knowledge transfer, not only within a company, but also between suppliers, partners, customers and other technology users

Integrated Product Development

- **Modern airplane product development requires integration of functional disciplines, all focusing on achieving product value goals**
  - Product value diminishes with increased recurring costs (e.g., product fabrication), non-recurring costs (e.g., facilities, tooling, equipment, development, certification) and delivery delays
  - It is well-recognized that each functional discipline can affect other discipline's costs and schedules
  - Size & product scaling efforts must advance in parallel to gain value
- **Integrated Product Team (IPT) benefits**
  - 70% of product cost is determined in the first 5% of design process[1] (notional thought) illustrating the early importance of the IPT process
  - No other process would allow efficient solution to unknown problems
  - Specific goals established by discipline provide focus and successful implementation achieves a better product for all stakeholders

[1] Niu, Michaels C.Y. (2010) Composite Airframe Structures, 3rd Edition. Hong Kong: Hong Kong Conmilit Press Limited

Integration of Composite Maintenance and Damage Tolerance

Design for Repair

Early development of maintenance procedures

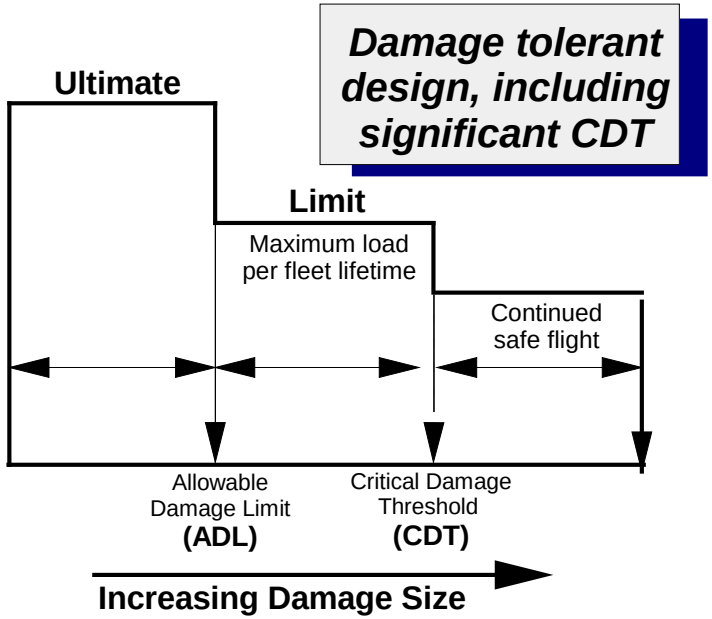
Well-defined ADL

Efficient, low-cost NDI procedures to locate damage (that always find CDT)

Damage tolerant design, including significant CDT

Reliable and simple NDE to quantify effects of damage

Cost-effective repair with minimal down time when damage is found



Taken from: "Composite Technology Development for Commercial Airframe Structures," L.B. Ilcewicz, Chapter 6.08 from Comprehensive Composites Volume 6, published by Elsevier Science LTD, 2000.

FAA Guidance Philosophy

- **The FAA is moving toward performance-based standards, such as the new part 23**
- **Within the Policy and Innovation Division of Aircraft Certification, *we are also moving away from prescriptive FAA guidance***
  - Across all technical specialties in aircraft certification
- **We will increasingly rely on industry documentation to provide means of compliance, which we can "accept"**

FAA Guidance Philosophy

- **FAA Guidance will be high-level only, and primarily designed to clarify requirements and points of emphasis for means of compliance (MOC), rather than describe the detailed MOC accepted by industry** (moving to industry standards)
  - We are hearing that we will release nothing more specific than AC 20-107B, and possibly even that is too prescriptive
- **This has a significant impact on the FAA's Composite Plan as well as similar documents, such as the Additive Manufacturing Roadmap**

FAA Guidance Philosophy Example

EXISTING SYSTEM:

- **Regulation:** 2x.603 says (in essence) “Suitability and durability of materials must meet approved specifications to ensure they have desired properties”
- **Guidance:** AC 23-20 titled “Acceptance Guidance on Material Procurement and Process Specifications for Polymer Matrix Composite Systems”
  - Applicable to the material and process specifications, or other documents, used to ensure sufficient control of composite prepreg materials
  - Includes a description of sections and content to be included in the specification
- **Industry Standards:** Specific NCAMP and SAE material specifications that meet the guidelines in the AC

FAA Guidance Philosophy Example

- **There are three types of documentation involved in the current scenario**
  1. Regulation (FAA)
  2. Expectations to meet the regulation (FAA)
  3. Documentation that meets the expectations (Industry)

FAA Guidance Philosophy Example

FUTURE SYSTEM:

- **Regulation:** 2x.603 says (in essence) “Suitability and durability of materials must meet approved specifications to ensure they have desired properties” — Unchanged
- **Guidance:** Policy that describes when composites fall into the category of materials that must meet an approved specification — New
- **Industry Standard 1:** Description of sections and content to be included in the specification — Responsibility Shifted
- **Industry Standard 2:** Specific NCAMP and SAE material specifications that meet the guidelines in the AC or ***non-standard proprietary information*** — Unchanged

** Disclaimer: This is not yet official, but everything points to this approach*

FAA Adv. Material & Process Innovation (CA..TSO)

Future FAA Process under study to facilitate innovation early in a project's life, including certification benefits from joint efforts with measurable outcomes

Innovation at the time of certification is met with rough seas without careful pre-development and measurable outcomes that demonstrate technology readiness

Benefits

1. **Knowledge Transfer**
2. **Technology Readiness**
3. **Safety Awareness**
4. **Value to Industry**

Outcomes*

1. Rules, guidance and policy (FAA expectations/Industry MOC)
2. M&P Qualification thru prototyping
   a) Repeated trials at appropriate scales
      (results: coupon tests, manufacturing trials)
   b) Design tools under development
      (load path measurements, design manuals)
3. FAA Level II Applicant Training (approved by experienced industry)
4. Innovation sooner than later

CE H, Composite Applications TSO

New composite initiative since 9/2018

Background:

- Develop a new TSO and associated guidelines for composite materials
  - Guidelines are essential in order to implement the TSO, since it is a new concept
- Allows companies to demonstrate technology readiness outside of a certification project
- Under the current system, we do not open certification projects for development of composite data, design tools or prototyping functional structures or airplane products
  - Some DAHs open projects to develop allowables and associated tools, then cancel the project. Resulting data, however, is FAA approved and can be applied to other projects, when shown to be applicable
  - Other parties have no avenue to develop data that is approved by the FAA
    - Some basic material data may be generated under NCAMP system accepted by the FAA
- There would be a significant advantage to the FAA to receive data packages with the TSO application that describe the limitations of the data – a learning tool and design guide

CE H, Composite Applications TSO

New composite initiative since 9/2018

Scope → There could be four classes of data

1. Basic lamina-level M&P control data (NCAMP-style data)
2. Advanced laminate or detailed design data
3. Design tools that are tied to the data from class 1 and/or 2
4. Repetitive manufacturing trials or large-scale hardware demonstration test

Each class must have measurable outcomes that can be self-certified

CE H, Composite Applications TSO

- **Deliverables**

1.	Hold workshop to gauge industry interest and identify a standards organization(s) to work with • Propose to fund through research plus-up	Winter 2020
2.	Identify if any standards organization documentation is required, and scope working agreement(s)	Spring 2020
3.	Draft Minimum Performance Standard, TSO, and associated guidance	Spring 2021

- **Goal is to develop a TSO product so that applicants can develop data that would be approved by the FAA without a certification project**
  - The data would be restricted to a well-documented design space
  - Certification activities are still required in order to use the material and data – it has to be shown to be applicable to the project; however, the tests used to develop the data would not have to be re-performed with project numbers, conformity, and witnessing (this is managed under the TSOA quality system)
  - Brings parity to third parties so they can develop data in an economical method, the same as current DAHs (may be suitable to airline/MRO consortium)

FAA Push for Performance-Based Rules and Limiting Prescriptive Guidance

Presented at SFO F&DT ARAC Mtg. 04/16/2019

A. Performance-Based Rules & Guidance

1. AC with a regulatory emphasis
2. Technical issues that need to be addressed
3. Guidance reference to ***accepted standard MOC***

B. Industry-derived Standard MOC

1. Regulatory involvement most efficient
2. Challenged to get started

C. Knowledge transfer relating to important technical details *(Educational)*

1. A detailed level below standard MOC
2. CMH-17 SoBR TG and DT TG updates for ***Best Maintenance & Damage Tolerance Practices***

D. Detailed technical guidelines of merit but not regulatory by nature

1. Best industry practices (these details would never be part of MOC for non-standard/evolving technologies)

Federal Aviation Administration