

# The FAA's AVS Strategic Composite Plan

Composite Transport Airplane  
Damage Tolerance and

Presented to: Maintenance Workshop

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Federal Aviation  
Administration



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# Overview

- **The FAA created an AVS Strategic Composite Plan (August 2013) that identifies three focus areas**
  - Continued Operational Safety (COS)
  - Certification Efficiency (CE)
  - Workforce Education (WE)
- **Priority is assigned to tasks based on issues that pose the greatest safety threats**



# Overview

- **Composite Plan required because:**
  - Composite technology is not standardized and is often proprietary. Lack of standardization creates certification challenges in regulatory compliance for each application.
  - The primary goal is to standardize composite guidance such that regulatory expectations are evident to the industry.
  - Educational initiatives will ensure the FAA workforce has a common understanding of the safety risks associated with composites throughout the lifecycle of the aircraft.



# Overview FY2016

| Continuous Operational Safety (COS)                        | Certification Efficiency (CE)                   | Workforce Education (WE)                 |
|--|---|--|
| <i>COS A: Bonded Structure</i>                             | <i>CE A: Hybrid F&amp;DT Substantiation</i>     | WE A: Composite Manufacturing Technology |
| <i>COS B: HEWABI (High-Energy, Wide-Area Blunt Impact)</i> | CE B: Advanced Composite Maintenance            | WE B: Composite Structures Technology    |
| COS C: Failure Analysis of Composites Subjected to Fire    | <i>CE C: Composite Structural Modifications</i> | WE C: Composite Maintenance Technology   |
|  | CE D: Composite Quality Assurance               |  |
|  | <i>CE E: Bonded Structure Guidance</i>          |  |
|  | CE F: General Composite Structure Guidance      |  |

Items in red are supported by this workshop



# COS Initiatives

- **Three COS items in the Composite Plan:**
  - A. Bonded Structure
    - Bonded repairs
    - Bond quality control
    - Sandwich disbond growth
  - B. HEWABI (high-energy, wide-area, blunt impacts)
  - C. Failure analysis of composites subject to fire



# COS A, Bonding

- **The Bonding initiative encompasses three distinct sub-subjects**
  - Bonded Repairs
  - Metal Bond Quality Control
  - Sandwich Disbond Growth
- **Background, Bonded Repairs**
  - The bonded repair process for both composites and metals is operator and process dependent, cannot be fully inspected after the fact, and is highly individualized due to lack of standard materials, processes and structural details.



# COS A, Bonding

- **Background, Bond Quality Control**

- The NTSB has cited metal bond processes, environmental durability and weak bonds as contributing factors in multiple incidents and accidents, including the Aloha Airlines accident in 1988 and rotor blade failures of several helicopter accidents. Efforts are underway to update testing standards for both metal and composite bonding for environmentally driven crack growth, and to publish corresponding industry guidelines.

- **Background, Sandwich Disbond Growth**

- A lost-rudder incident of an Airbus A310 aircraft that occurred in 2005 led to an emergency AD and other methods to mitigate corresponding safety risks. Forces generated from the rudder going into flutter overloaded the vertical fin to near failure. A NASA, FAA, and Industry effort is underway to develop standards and guidelines to control disbond growth for sandwich structures.





# COS A, Bonding

- **FAA Deliverables**

- Chapter in Order 8900.1 “Flight Standards Information Management System” outlining Bonded Repair Size Limits FY2016
- Revise Advisory Circular (AC) 65-33, “Development of Training/Qualification Programs for Composite Maintenance Technicians” to include specific guidance on bonded structure FY2017
- Short Course for Bonded Repair Design, Substantiation, and Approval FY2018
- Part 21 AC for Bonded Structure that includes Bonded Repair Best Practices FY2020



# COS A, Bonding

- **Prerequisite Industry Deliverables and Research**
  - Publication of the AC is dependent on successful completion of the following documents by industry groups: Best Practices in Bonded Repair (SAE), CMH-17 Repair Substantiation (CMH-17 Rev H), Standards for Metal Bond Process QC (ASTM D3762), Test Standards for Disbond Growth (ASTM) and CMH-17 Risk Mitigation Guidelines (CMH-17 Rev H)
  - Numerous FAA research projects on bonded structure are underway and planned for the next few years
  - FAA also researching current maintenance instruction practices

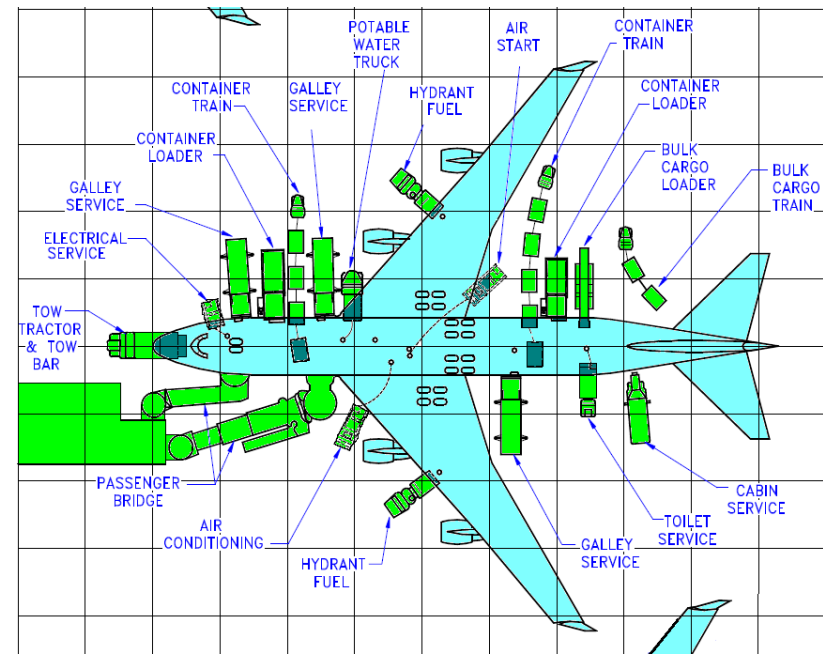


# COS B, HEWABI

- **Background**

The FAA is concerned with damage that occurs after part inspection when it is not visible to the naked eye. High-energy wide-area blunt impacts (HEWABI) are a type of this damage.

- Composite airframe structures may not show damage as readily as traditional metallic structures (less prone to plastic deformation / dents)
- In-service characteristic of transport airplanes where they are impacted by baggage carts and other service vehicles
- Also possible from damage in the factory or in production flight line
- In either case, reporting is essential for safety



# COS B, HEWABI

- **FAA Deliverables**
  - Policy requiring HEWABI evaluation during the certification of aircraft structures FY2016
- **Prerequisite Industry Deliverables and Research**
  - FAA has funded research in this area
  - The FAA will participate in the development of a chapter in CMH-17 specific to HEWABI to be used as future guidance for composite aircraft certification
- **The FAA is researching what additional risk mitigation activities can be taken**



# COS C, Failure Analysis of Surfaces Subjected to Fire after Part Failure

- **Background**

- Composite structure that failed in an accident may be subjected to fire, changing failure surfaces and potentially masking clues that could identify the root cause for part failure or the extent of damage

- **FAA Deliverables**

- Failure Analysis Handbook FY2022

- **FAA Research Planned**



# Certification Efficiency Initiatives

- **Certification Efficiency (CE) initiatives capture best industry practices via regulatory guidance and industry standards documents.**
- **Goal is to standardize methods to certify composite structures and repairs which will address the current industry practice of using proprietary databases and advanced procedures.**



# Certification Efficiency Initiatives

- **Six CE initiatives**
  - A. Hybrid Metallic/Composite Structure Fatigue and Damage Tolerance Substantiation
  - B. Advanced Composite Maintenance
  - C. Composite Structural Modification
  - D. Composite Quality Control
  - E. Bonded Structure Guidance
  - F. General Composite Structures Guidance
- **Additional standardization activities in the area of transport crashworthiness, fuel tank lightning protection, and composite flammability**
  - These FAA initiatives have some components specific to composites



# CE A, Hybrid Structure

- **Background**

- Fatigue and damage tolerance (F&DT) engineering protocol for composite aircraft structures differ significantly from metal engineering practices. These issues must be considered for the substantiation of most modern structures that include a combination of composite and metallic parts and assemblies.





# CE A, Hybrid Structure

- **Deliverables**

- Policy on interpretation of existing amendment 25.571 for composite structure (timing to be coordinated with ARAC)
  - FAA “White Paper” due 9/2016
- A new rule defining fatigue and damage tolerance requirements for the certification of composite transport aircraft FY2020
- Associated guidance for new part 25 rule FY2020

- **Prerequisite Industry Deliverables and Research**

- Publication of the policy is dependent on CMH-17 Rev H F&DT updates and ASTM test standards for laminate damage propagation
- All deliverables linked to the two-year ARAC Tasking formed 1/26/2015 under the Transport Airplane Metallic and Composite Structures Working Group



# CE B, Advanced Composite Maintenance

- **Background**

- Title 14 CFR part 147 appendix B requires that composite materials be included in the curriculum, however, no guidance exists to define the level of detail or application

- **Deliverables**

- Update maintenance technician training requirements FY2017
- Update chapter in Order 8900.1, “Flight Standards Information Management System” outlining minimum curriculum requirements FY2017

- **Prerequisite Industry Deliverables and Research**

- The FAA is researching current maintenance instruction practices



# CE C, Composite Structural Modifications

- **Background**

- Non-OEM companies are applying to the FAA to modify critical composite structures, such as with installation of antennas on 787 or A350 aircraft. Many of these new applicants do not have experience in modifying critical composite structure, and assume their standard practices of reverse engineering can be applied. FAA offices have requested guidance on how to approve modifications to critical composite structure.



# CE C, Composite Structural Modifications

- **Deliverables**
  - AC outlining best practices approving modifications to composite structure FY2018
- **Prerequisite Industry Deliverables and Research**
  - To be determined (team is being formed to write the guidance)



# CE D, Quality Assurance Guidance

- **Background**

- Material and process control is essential to composite certification and continued airworthiness. The aviation industry continues to explore advanced design options that include: low-temperature cure materials; bonding; and co-cured assemblies. These advanced design options may not be able to utilize traditional quality controls, analyses, and accelerated test methods.



# CE D, Quality Assurance Guidance

- **Deliverables**

- Revision to AC 21-26, “Quality System for the Manufacture of Composite Structures” FY2018
- Revision to online job aid for audit and surveillance of composite repair facilities FY2018
  - Note this guidance for maintenance auditing will be revised to incorporate best practices from manufacturing facility auditing

- **Prerequisite Industry Deliverables and Research**

- None



# CE E, Bonded Structure Guidance

- **Background**

- There is an existing part 23 policy memo covering bonded structure material and process, control, design, analysis, testing, manufacturing, and repair techniques. The policy will be expanded into a part 21 AC for all product types and will include sandwich construction guidance.

- **Deliverables**

- Part 21 AC for Bonded Structure that includes Bonded Repair Best Practices FY2020 (Note this is the same deliverable as COS Initiative A for Bonded Repair – that requires CMH-17 input)



# CE F, General Composite Structure Guidance

- **Background**
  - With the evolving/advancing composite technology and expanding composite applications, AC 20-107 “Composite Aircraft Structure” will require revision
- **Deliverables**
  - Revision to AC 20-107, “Composite Aircraft Structure,” to incorporate advanced composite technologies and lessons learned FY2020
- **Prerequisite Industry Deliverables and Research**
  - Will incorporate latest information from industry documentation and FAA research





# Workforce Education Initiatives

- **An essential component for COS and CE is a comprehensive educational development program**
- **Successful composite safety and certification oversight is dependent upon our workforce being knowledgeable of both basic and advanced composite technologies and terminologies**



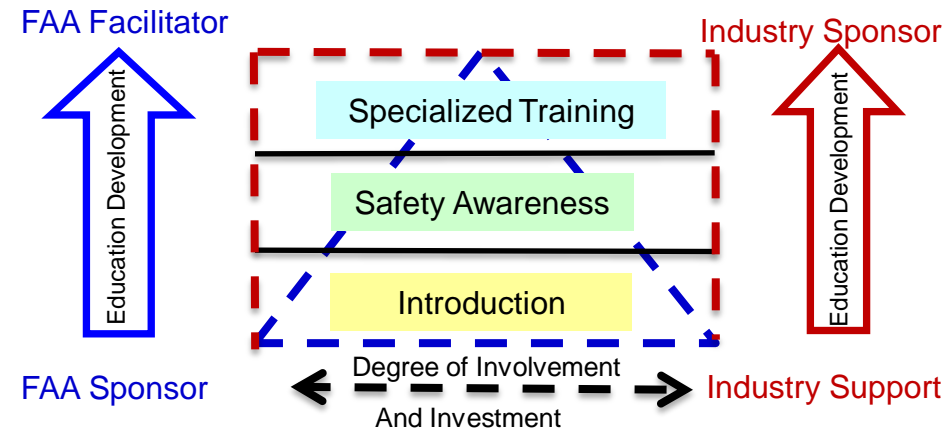
# Workforce Education Initiatives

## FAA composite training strategy using existing courses, FAA Centers of Excellence & industry support

Courses to support airframe engineering, manufacturing and maintenance functional disciplines

### Incl. three levels of competency:

- **Introduction** (“Composites 101”)
- **Safety Awareness** (courses for each functional discipline)
  - Skills needed for FAA workforce supporting composite applications
- **Specific Skills Building** (most courses developed by the industry)
  - Specialized skills needed in the industry and some FAA experts



# Workforce Education Initiatives

- **Three initiatives – developed by the FAA but available to industry as well**
  - A. Composite Manufacturing Technology
  - B. Composite Structures Technology
  - C. Composite Maintenance Technology
- **Additional activities supporting “composites 101” training and Composite DER designations**



# WE A, Composite Manufacturing Technology

- **Background**

- The Composite Manufacturing Technology (CMfgT) course was first offered in spring 2015
- It will be updated with the revision to AC21-26 (CE D)

- **Deliverables**

- Updated CMfgT course with revised content, lesson plans and a job aid FY2018



# WE B, Composite Structures Technology

- **Background**

- The Composite Structural Engineering Technology (CSET) course will be updated every four years.
- Update the structural DER seminar content on a recurring basis

- **Deliverables**

- Updated CSET course with revised content, lesson plans and a job aid FY2017
- Update Structural DER seminar content FY2016



# WE C, Composite Maintenance Technology

- **Background**

- Revise Flight Standards Service’s course #21900010, “Composite Awareness for the Aviation Safety Inspector,” on a five year basis (was just updated in 2015)
- Develop a computer-based short course for Aviation Safety Inspectors that have oversight responsibilities for complex composite repair facilities FY16

- **Deliverables**

- Course development request in process



# Summary

- **The FAA is proactively identifying and attempting to mitigate risks associated with the use of composite materials in aviation products**
- **Outcomes contained in the Plan include rulemaking, policy, and guidance to:**
  - ensure continued operational safety,
  - promote certification efficiency, and
  - provide workforce education

