

FAA Composite Plan

Aviation Safety (AVS) Initiatives of Interest

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March 02-03, 2016



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Administration



Outline

- **Background: Composite Safety and Certification Initiatives, CS&CI (1999-2013)**
- **AVS Composite Plan (2014-)**
- **Summary and Closure**

Background - Part 23 TC Projects with Extensive Use of Composites in Airframe Structure



Raytheon Premier I



Cirrus Design Corp. SR20



PAC USA Lancair LC40-550FG

List of Composite Certification Initiatives from GA Experience

- **Base material qualification and equivalency**
- **Material & process specifications for composites and adhesives**
- **Critical environment for application of load requirements**
- **Environmental resistance guidelines: update to “ ΔT rule”**
- **Static strength substantiation approach**
(analysis & building block tests versus load enhancement for environment & material variability in large scale tests)
- **Common design databases** (cooperative work with RITA)
- **Bonded joint processing issues**
(e.g., surface preparation, layer thickness)
- **Structural integrity & damage tolerance of bonded joints**

List of Composite Certification Initiatives from GA Experience (cont.)

- **Fatigue & damage test parameters**
(for damage tolerance test substantiation)
- **Severe accidental and large debond damage considerations**
- **Substantiation of secondary structures**
- **Stiffness variation and flutter assessment**
- **Analysis and tests for un-pressurized fuselage structure**
- **Updates for advanced material forms & manufacturing processes**
- **Flammability considerations**
- **Crashworthiness considerations**

Composite Rotorcraft and Propeller Fatigue & Damage Tolerance Efforts

- **2000 to 2002 ARAC efforts for a new rule (27.573 and 29.573) and advisory circular materials** (released in 2011*)
 - Based on insights derived from the certification and service experiences
 - Unique team of industry practitioners, regulatory officials and technical specialists, each with different experiences from composite applications
 - Considered a range of dynamic components and airframe applications
 - *Several options developed for acceptable means of compliance, including flaw tolerance/safe life and damage tolerance (with & without growth)*
 - Working group believes engineering practices will continue to evolve with service experiences, suggesting a need to re-consider the AC in 5 years
- **Advisory circulars (AC 20-66 and AC 35.37-1) for composite propeller fatigue & damage tolerance were also updated in 2002**

* *Essentially the same as when the ARAC ended in 2002*

Milestones Achieved via CS&CI

- FAA policy/training for base **material qualification & equivalency** testing for shared databases (update 2003)*
- Policy/training for **static strength** substantiation (2001)
- New rule & AC for **damage tolerance & fatigue** evaluation of composite **rotorcraft structure** (2002, 2005 & 2009 releases)
- AC for **material procurement & process specs** (2003)*
- Tech. document on composite **certification roadmap** (2003)
- Policy on substantiation of **secondary structures** (2005)
- Policy for **bonded joints & structures** was released (2005)*
- Tech. document on **composite maintenance & repair** (2006)
- Composite **maintenance & repair awareness** training (2008)*
- **AC 20-107B** (Composite Aircraft Structure) (2009)*
- National Center for Advanced Material Performance Policy (2010)
- **Revision G** to **CMH-17** (2012)



AVS Composite Plan

- **The FAA will continue work with industry and other regulatory bodies to ensure safe and efficient use of composites in aircraft products.**
- **FAA created an AVS Strategic Composite Plan (Aug. 2013) that identifies 3 focus areas**
 - Continued Operational Safety (COS)
 - Certification Efficiency (CE)
 - Workforce Education (WE)
- **Updated Annually**
- **Priority is assigned to tasks based on issues that pose the greatest safety threats**



AVS Composite Plan

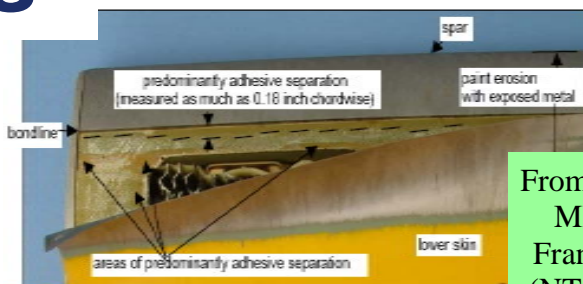
- AVS Composite Plan Consists of a **Strategic Management Plan** and a **Working Plan**
- Based on **safety management** approach
- The Plans are linked to:
 - Best Industry Practices
 - Certification and Field Experiences
 - Focused Research
 - **Technological Advances** in Aircraft Structures
- Priority is given to **structural engineering** issues, related **manufacturing procedures & maintenance practices** resulting from service experience and industry input.

COS Initiatives

- **Continued Operational Safety is always the FAA's highest priority**
 - Continued operational safety depends upon the use of approved designs, materials, and methods. Alternatives require additional qualification data and further proof of structural substantiation.
- **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

Bonding Field Difficulties

- Helicopter main rotor blade metal bonding problems
 - 2008 NTSB Safety Recommendations
 - Possible metal bond processing problems
- Rudder debonding
 - NDI to control current field problems
 - OEM shared technical solutions & design concerns with industry in FAA 2009 Tokyo Workshop
- Extensive repair deficiencies
 - DER-approved *repair design and processes* without supporting data
 - Inappropriate material substitutions, poor workmanship & inadequate tooling
 - Discovered when rigging on aircraft



From Air Force MP3 Mtg.
Frank Zankar (NTSB, 2008)

In-flight Rudder Failure
(Large damage causing flutter)
Air Transat Flight 961 [3/6/05]



COS A, Bonding

FAA Deliverables

- **Published Policy Statement PS-AIR-20-130-01 “Bonded Repair Size Limits” November, 2014**
- **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**
- **Part 21 AC for Sandwich Structure 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)**
 - *One example: Vol 3, Chapter 14 Substantiation of Bonded Repair*
- **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

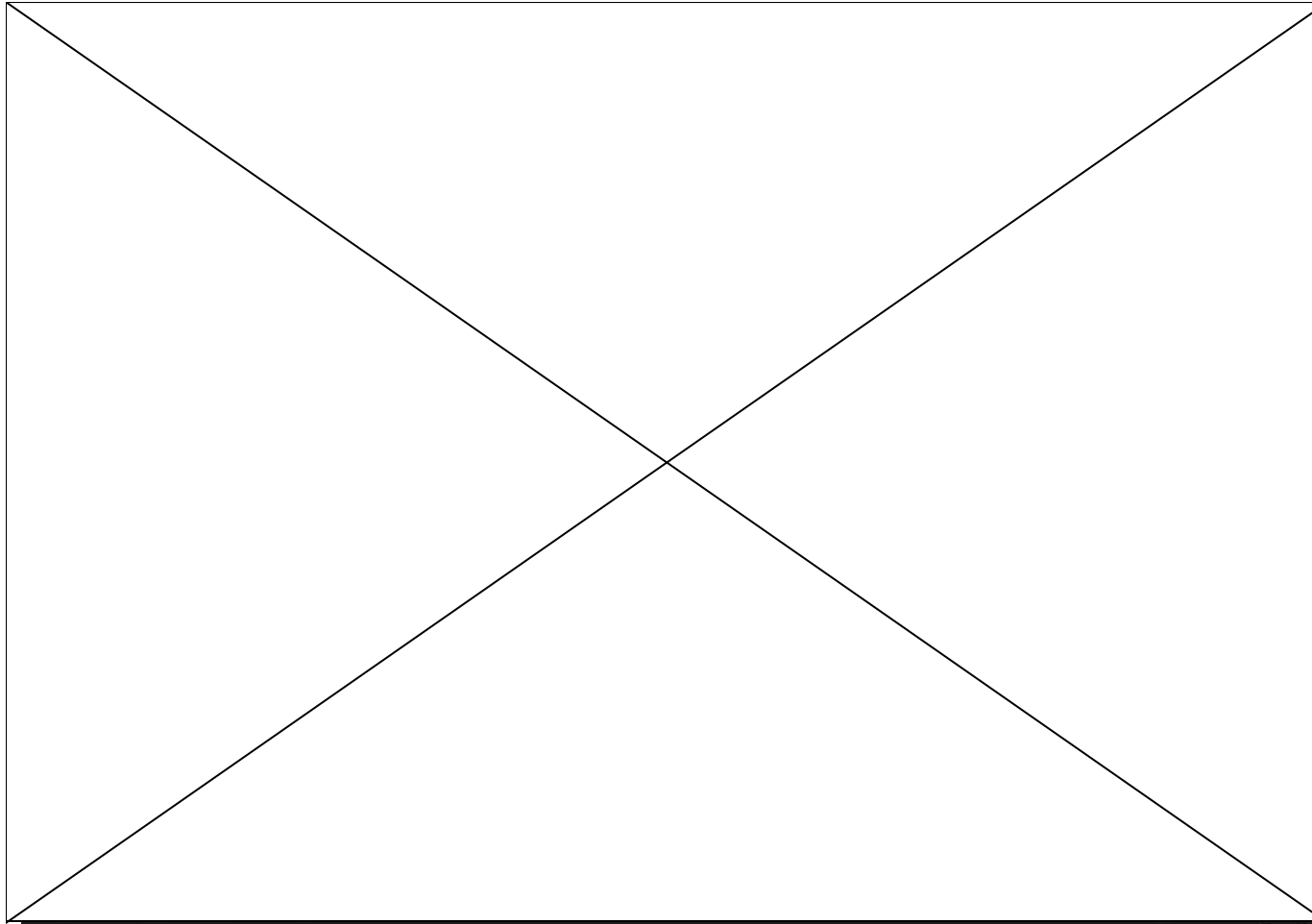
Background

The FAA is concerned with serious 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 (e.g., service vehicle collisions).

- Composite airframe structures may not show damage as readily as traditional metallic structures (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

Our Tenth Anniversary Year Studying a Key Area

HEWABI = High Energy Wide Area Blunt Impact



According to comments on Flightaware:
Occurred March 23 2014,
UPS Boeing 757-200
(N462UP) on Spot 90 at the
Miami International Airport
Repaired by AAR Aircraft
Services Miami, and returned
to flight status on April 13.

The truck belongs to a catering company. It was being driven by a female who was not supposed to be driving, hence the reason they jumped out and switched really quick.

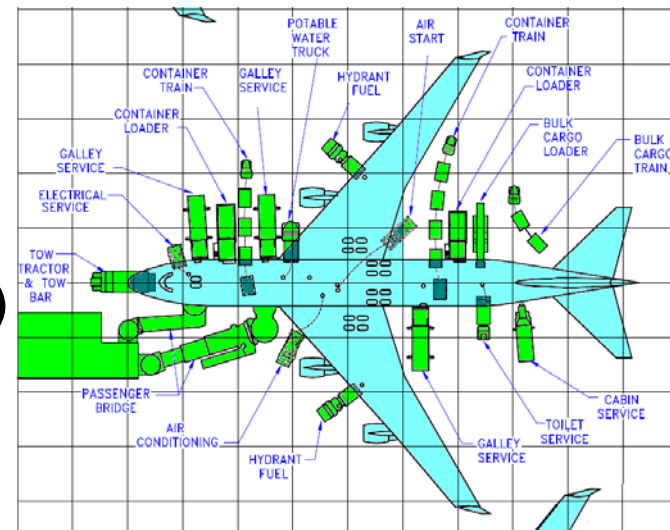
The passenger told security he was the driver, but once they reviewed this footage they saw he clearly wasn't. They were both fired.

<http://www.youtube.com/v/UFcHUJxQKV4>

COS B: HEWABI

Not all damaging events (e.g., severe vehicle collisions) can be covered in design & scheduled maintenance

- Safety must be protected for severe accidental damage outside the scope of design (defined as Category 5 damage) by operations reporting
- Awareness and a “No-Blame” reporting mentality is needed
- Category 5 damage requirements:
 - a) damage is **obvious** (e.g., clearly visual) and **reported** &/or
 - b) damage is **readily detectable** by required pre-flight checks &/or
 - c) the **event** causing the damage is otherwise **self-evident** and **reported**
e.g., obvious, severe impact force felt in a vehicle collision



COS B, HEWABI

- **FAA Deliverables**

- Policy requiring HEWABI evaluation during the certification of aircraft structures FY2016

- Draft Policy on FAA website

- http://www.faa.gov/aircraft/draft_docs/policy/ comment period closed 11/13/15

- **Prerequisite Industry Deliverables and Research**

- FAA has funded research in this area

- Develop a chapter in CMH-17 specific to HEWABI

- 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 (CE) Initiatives

- Certification Efficiency initiatives **capture best industry practices** via regulatory guidance and industry standards documents.
- Goal is to **standardize methods** to certify composite structures and repairs.

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 (Vol 3 Ch 12) 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

ARAC Tasking (per W. Sippel, TAD)

- **Requires working group to address and provide recommendations on the following:**
 - Remaining 2003 GSHWG rulemaking recommendations
 - Increased use of composites by industry
 - Costs and benefits estimates
- **Authorizes two years for activity**
- **Supports AVS Strategic Composite Plan**
- **<https://www.federalregister.gov/articles/2015/01/26/2015-01044/aviation-rulemaking-advisory-committee-new-task#h-14>**

Note that a 2015 Montreal Workshop was organized to address the ARAC needs in benchmarking best industry practices, incl. CMH-17/CACRC content.

Summary and Closure

- **AVS Composite Plan Established to Guide FAA Initiatives**
 - A living document updated annually
- **Continued involvement of industry, other agencies & institutions, and harmonization with foreign regulatory agencies**
- **Three main areas of Continued Operational Safety (COS), Certification Efficiency (CE) and Workforce Education (WE)**
 - Active initiatives for composite guidance/standards
 - Ongoing composite training initiatives