

FAA Composite Plan and Planned Sandwich Structure Advisory Circular (AC)

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**Federal Aviation
Administration**



Overview

- **FAA Composite Plan Overview**
- **Planned Sandwich AC**
 - Background
 - Draft Outline

NOTE:

**This presentation discusses possible future actions.
These plans are current at this time, but subject to change.**



FAA Composite Plan Overview

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



CE E, Bonded Structure Guidance

- **Background**

- An existing part 23 policy memo covers bonded structure material and process, control, design, analysis, testing, manufacturing, and repair techniques.
- The policy will be expanded into an AC for all product types and there will be a companion AC for sandwich structure.

- **Deliverables**

- AC for Bonded Structure that includes Bonded Repair Best Practices FY2020 (Note this is the same deliverable as COS Initiative A)
- AC for Sandwich Structure FY2020 (Note this is the same deliverable as COS Initiative A)
- Other FAA guidance will be reviewed to determine effects from loss of prescriptive rule 23.573 in the part 23 rewrite



COS A, Bonded Structure

- **Initiative encompasses three distinct sub-topics:**
 - Bonded Repairs
 - Metal Bond Quality Control
 - **Sandwich Disbond Growth**
- **Deliverables**
 - 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
 - AC for Bonded Structure that includes Bonded Repair Best Practices – FY2020
 - **AC for Sandwich Structure – FY2020**



Bonded Structure

- **FAA's efforts are linked to research and industry deliverables.**
 - Numerous FAA research projects on bonded and sandwich structure are underway and planned for the next few years.
 - FAA is also researching current maintenance instruction practices
 - Publication of the ACs 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),
 - CMH-17 Risk Mitigation Guidelines (CMH-17 Rev H)
 - Standards for Metal Bond Process QC (ASTM D3762)
 - Test Standards for Disbond Growth (ASTM)



Background – Sandwich AC

- **FAA Advisory Circular (AC) on Sandwich Structure**
 - Guidance material giving means of compliance to relevant regulations in 14 CFR Parts 23, 25, 27, 29
 - Expected release date 2020
(Coincides with CMH-17 Rev H)



Background – Sandwich AC

- **Intent is to focus on factors that are unique to sandwich structure.**
- **Reference, rather than replicate, relevant content available elsewhere.**
 - AC 20-107B Composite Aircraft Structure
 - AC 20-xx Bonded Structure
 - CMH-17 Volume 6 Structural Sandwich Composites
 - CMH-17 Volume 3 Polymer Matrix Composites: Materials Usage, Design and Analysis



Major AC Sections

- **Sandwich Design, M&P Selection**
- **Certification Means of Compliance**
- **Manufacturing Implementation**
- **Repair**
- **Inspection**



Sandwich Design, Material and Process Selection

- **Background on choice of materials**
(point to Volume 6 Chapter 3 for details).
- **Processing options: cocure, cobond, bond**
- **Discussion of key design details**
 - Ramps, attachment points, etc.
- **Holistic view of sandwich structure:**
 - What do I have to control to ensure my process is repeatable?
 - How do I control the various materials vs. controlling the sandwich?



Certification Means of Compliance

- **Material qualification & allowables (2x.603, .613)**
 - Sandwich as a whole
 - Facesheets (*CMH-17, MMPDS*)
 - Caveats about laminate vs facesheet properties
 - Adhesives (*Planned FAA Bonding AC*)
 - Core
 - Unchanged by sandwich processing
 - Changed by sandwich processing
 - Core allowables
 - Other: core splice, potting compound, septumized core, etc.



Certification Means of Compliance

- **Process Control (2x.605)**
 - Volume 6 Chapter 5 has a good discussion of processing of sandwich structure.
 - Summarize key topics and point to that document.

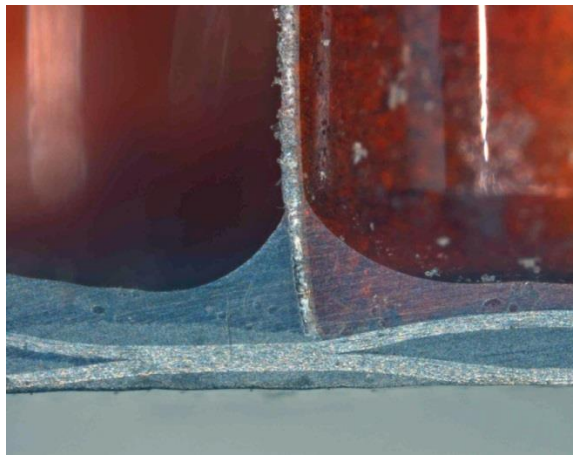


Fig. 5.3.3.3(c) A well formed fillet.

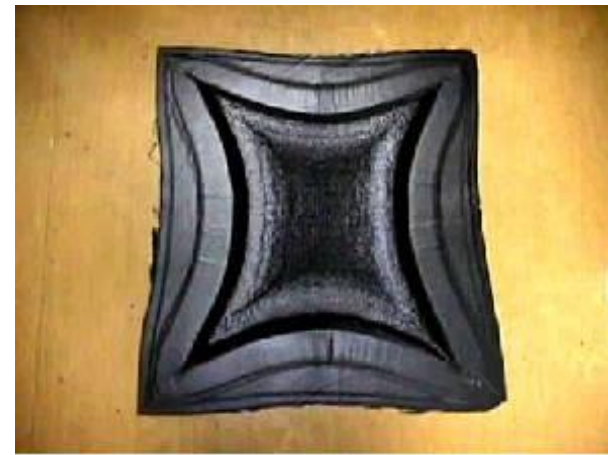


Fig. 5.4.1(c) Panel exhibiting substantial core crush

Certification Means of Compliance

- **Protection of Structure (2x.609)**
 - Regulation requires suitable protection against deterioration or loss of strength due to any cause, including weathering, corrosion, abrasion, etc.
 - Moisture ingress may be a particular concern with thin facesheets.
 - Discuss appropriate means of protection.



Certification Means of Compliance

- **Static Strength Substantiation (2x.305, .307, etc.)**
 - Building block approach as applied to sandwich structure.
 - Volume 6 Chapter 2 lists test methods, mostly at coupon level.
 - Environmental and variability factors –
Determined at sandwich level, at constituent level?
 - Different failure modes that need to be considered.
 - Point to Volume 6 Chapter 4 for appropriate equations and analysis methods.
 - Volume 6 Chapter 4 has a lengthy discussion (>100 pages) of design and analysis methods for sandwich structure.



Certification Means of Compliance

- **Damage Tolerance (2x.571, .573)**
 - Defect and damage threat assessments
 - Fatigue and damage tolerance testing
 - Coordinate content of AC with ongoing work to improve coverage of damage tolerance in Volume 6.



Manufacturing Implementation

- **Process Control**
 - Environmental control
 - Control and handling of materials
 - Design scale up issues
- **Tooling**
- **Process Verification**
 - Cure cycle verification
 - Inspections (destructive and NDI)



Repair

- **Types of Repair Designs**
 - Volume 6 Chapter 7
- **Process Control**
 - Including importance of drying core prior to elevated-temperature cure

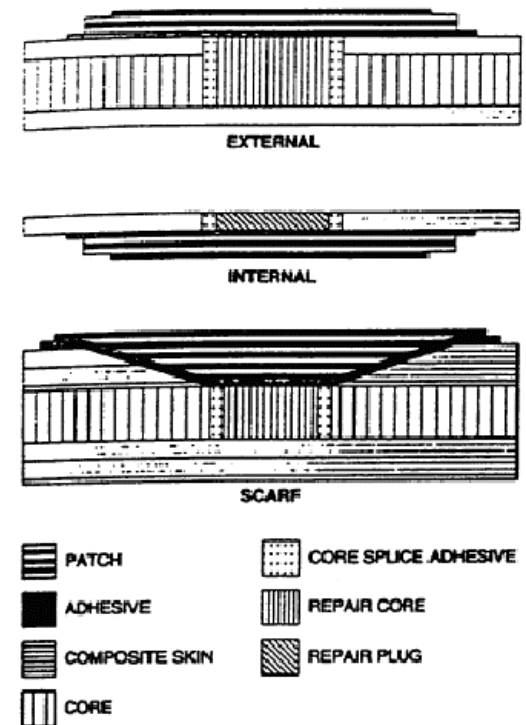
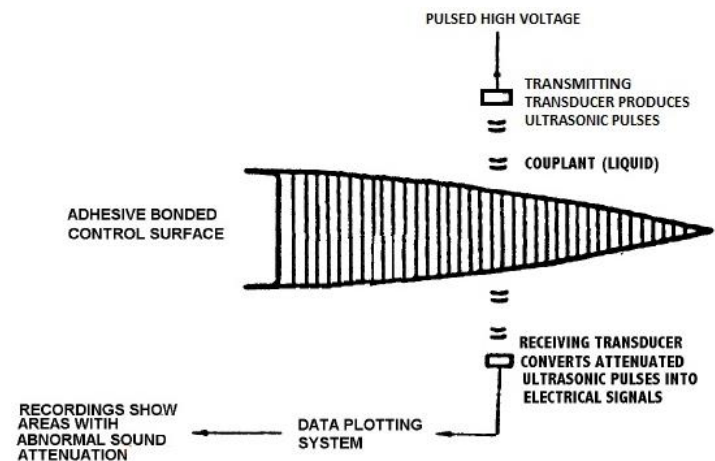


Fig. 7.3.4.2 Basic bonded repairs

Inspection

- Related to process control, damage tolerance, repair
- Summary of applicable methods and what defects / damage can be found with each
 - Point to Volume 6 Chapter 6 and Volume 3 Chapter 13 for details



Vol. 3 Fig. 13.2.1.3 Through Transmission

Conclusion

- **The FAA Composite Plan includes an Advisory Circular (AC) on sandwich structure, with expected release in 2020.**
- **We welcome your comments on the content of the AC.**

