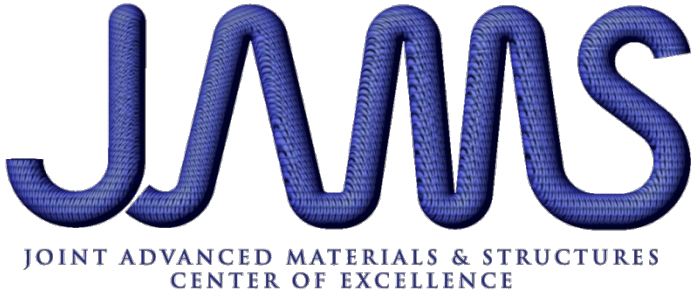

AMTAS Structural Bonding – Industry Feedback

November 12, 2014 AMTAS Review

Adhesive Bonding Industry Working Group Progress Update

- Monthly working group meetings (telecons)
  - Discuss progress on bonding projects R&D
  - Topical discussions
- Bonded Structures Technical Interchange Meeting (Salt Lake City, UT)
  - FAA AVS Composite Plan
  - Bonding Initiatives
  - Benchmark current industry practices
  - Research: Durability and Test Methods
  - Future FAA Bonding Research
- Interaction with Industry groups
  - CMH-17, ASTM, SAE, CACRC

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Current Working Group Projects - Feedback

- **Improving Adhesive Bonding of Composites Through Surface Characterization**
  - **Brian Flinn-University of Washington**
- **Test Method Development for Environmental Durability of Composite Bonded Joints**
  - **Dan Adams-University of Utah**
- **Effect of Surface Contamination on Composite Bond Integrity**
  - **Dwayne McDaniel-Florida International University**
- **Durability of Bonded Aerospace Structures**
  - **Lloyd Smith-Washington State University**

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Bonded Structure - Discussion Questions

- What areas need to be addressed with targeted R&D that will improve the safety and reliability of bonded aircraft structures?
- What holes exist in the standardization of processes and testing protocols for composite bonded structures?
- What are some of the unique challenges of composite bonding over metal bonding?
- What approaches should we be considering to evaluate fracture toughness and adhesion in bonded laminates and sandwich structures?
- How do we want to expand the use of adhesive materials properties into bonded joint analyses and what are approaches on measuring adhesive properties?

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Thank you!

Questions and comments welcome.

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Adhesive Bonding Working Group Team Membership

Team Members:

- Univ of Washington
- Univ of Utah
- Washington State Univ
- FIU/University of Miami
- Boeing
- Cessna
- Lockheed
- NIAR/Wichita State
- FAA
- NRC-CNRC
- AFRL
- NAVAIR
- NASA

Scope:

- Monthly Working Group Meetings
  - 1st Thursdays @10:00
- Review progress on AMTAS tasks
- Topic presentations on bonding
- Brainstorm collaborative R&D ideas

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Future Adhesive Bonding Working Group Collaboration Areas

Building Block Approach to Certification of Adhesively Bonded Structures	Quality Assurance of Adhesively Bonded Structures	CMH-17 Adhesive Bonded Structures Guidance
Better understand empirical observations of multiple failure modes in bonded DCB specimens and their applicability to more complex configured bonded structures. More simply: why don't cracks jump into less-tough adherend in DCB tests as they do in lap shear. Perform multi-material orthotropic fracture mechanics analysis that describes the phenomenon, observed in bonded DCB specimens, of plane strain crack growth (i.e. center of the specimen) growing cohesively in a tough adhesive material while crack turns into less tough adherend at free edges (plane stress state).	Updated metal wedge test standard/criteria	Guidelines for composite bonding: M&P qualification procedures, Best practices for manufacturing and maintenance, Best practices for structural substantiation
Develop a test specimen for composites to enable parallelized, fatigue testing with accelerated aging in moisture or aircraft fluids	Sandwich disbond initiatives : Best practices to mitigate the risk of sandwich disbonds, Engineering analyses and tests to evaluate sandwich disbonds	Updates to composite bonding modules for all safety awareness courses
Updated metal wedge test standard/criteria	Reliable composite durability test: Practical and valid for M&P qualification & QC, Considers effects of environment and service fluids, Evaluates cleavage loading, Success criteria checks for adhesion failures	
Reliable composite durability test: Practical and valid for M&P qualification & QC, Considers effects of environment and service fluids, Evaluates cleavage loading, Success criteria checks for adhesion failures	Correlate process parameters to in-line QC: Contact angle, FTIR, IGC	
Correlate process parameters to in-line QC: Contact angle, FTIR, IGC	Mature test method for extended durability of commposite substrates: Accelerated durability test, DCB vs wedge crack	
Develop methodologies that enable precision controlled surface treatment and bonding processes	Effects of cyclic loading to simulate service environment: Moisture and fluids, Rates of absorption/desorption changes,	
How does each level of the building block approach support determination of safe structure (conceptual)?	Maturation of NDI to detect weak bonds: LBID and other techniques	
Develop an empirical understanding of the contributions of each test in assessing final product safety	Develop methodologies that enable precision controlled surface treatment and bonding processes	
Predictive assessment of final product capabilities based on the lower levels of the building block approach	Bondline variations versus static and fatigue properties	
Bondline variations versus static and fatigue properties	Develop monitoring techniques to enable in-situ detection of water/aircraft fluid ingression into adhesively bonded assemblies	
Baseline materials aging study on adhesive bonds: Extend existing work on composite systems		

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