Composite Safety & Certification Initiatives

Presented at 11/10/04 AMTAS Meeting

• Background
  – Approach and teammates
  – FAA Center of Excellence

• Technical status
  – Material and process controls
  – Bonded structure
  – Maintenance training

• Summary
FAA Strategic Plan: Safety Continuum

Safety management system linking certification standards, maintenance and operations

Each function within the continuum is an integral part of Safety Management.

Information and experience derived from each phase is systematically applied to subsequent phases throughout the continuum.

The success of the entire continuum is dependent on effective Safety Management in each and every phase.

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Ongoing Composite Safety & Certification Initiatives*

Objectives

1) Work with industry, other government agencies, and academia to ensure safe and efficient deployment of composite technologies used in existing and future aircraft

2) Update policies, advisory circulars, training, and detailed background used to support standardized composite engineering practices

* Efforts started in 1999 to address issues associated with increasing composite applications
Technical Thrust Areas

Advancements depend on close integration between areas

Material Control, Standardization and Shared Databases

Structural Substantiation
- Advances in analysis & test building blocks
- Environmental effects
- Manufacturing integration

Advanced Material Forms and Processes

Bonded Joint Processing Issues

Damage Tolerance and Maintenance Practices
- Critical defects (impact & mfg.)
- Bonded structure & repair issues
- Fatigue & damage considerations
- Life assessment (tests & analyses)
- Quantitative NDE/Service POD
- Equivalent levels of safety

Flammability & Crashworthiness
Support from cabin safety research groups

Significant progress, which has relevance to all aircraft products, has been gained to date

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FAA Approach to Composite Safety and Certification Initiatives

**Evolving**
- Certification and Service History
- New Technology Considerations
- Internal Policies
- Focused RE&D

**Mature**
- Rules & General Guidance
- FARs
- Advisory Circulars
- Policy Memos
- Training (Workshops, Short Courses, IVTs)
- Detailed Background
- Joint Advanced Materials COE
- Public Documents and Standards (e.g., Mil-Hdbk-17, SAE AMS, Contractor Reports)

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<th>Represented Group</th>
<th>Team Member Name</th>
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CSTA and STS Advisors: Al Broz, Rusty Jones, Robert Eastin, John Howford, Terry Khaled, Steve Soltis, Dave Walen, Chip Queitzsch
Important Teammates

- NASA has been a leader for composite applications
  - Significant research support since 1970/1980s
  - AA587, A300-600 accident investigation

- Partnerships with industry are essential, e.g., Mil-17, SAE P-17, CACRC, ASTM, SAMPE, AGATE, SATS, RITA, SAS/IAB/AACE

- FAA Joint Advanced Materials Center of Excellence (JAMCOE)
  - Univ. of Washington (Edmonds C.C., Washington State Univ., Oregon State Univ.)
  - Wichita State Univ. (Univ. Of Delaware, Tuskegee Univ., UCLA, Northwestern, Purdue)

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Current AMTAS Support to Composite Safety & Certification Initiatives

- Focused research based on identified needs
  - Characterization of bond surface preparation
  - Reliability-based damage tolerance design
  - Aeroservoelasticity of composite structures

- Training development and standardization
  - Industry standards in composite maintenance training to support the needs of expanding applications
  - Practical basis for continuous education, as well as a working knowledge for 2-year, 4-year and graduate degrees
Milestones for Composite Safety and Certification Policy, Guidance and Training

- AGATE Shared Databases
- Initial static strength substantiation
- International M&P specs, database standards and initial environmental effects
- Initial process control, design, manufacturing, structural integrity and repair issues for bonded structures
- National Plan* for aircraft products
- Rotorcraft ARAC for fatigue and damage tolerance
- Initial process control, design, manufacturing, structural integrity and repair issues for bonded structures
- Update process control, design, manufacturing, structural integrity and repair issues for bonded structures
- Update damage tolerance substantiation & maintenance
- Updates for new materials and processes

* International participation in many of the tasks since 2001

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Background in Composite Material Control, Standardization and Shared Databases

- Mil-Handbook-17 has pursued standardization and shared databases for some time - first PMC data set approved in 1990
- NASA/FAA/Industry AGATE efforts accelerated the need for FAA policy on shared material qualification databases
  1. Multi-batch material qualification to generate the database & set specs.
  2. Equivalency (“mini-qualification”) sampling to show new users process the material to fall within the database population (also covers changes)
  3. Apply database to your product and continuously control the material
- Mil-Handbook-17 initiatives and AGATE experiences led to a need for FAA guidance on M&P specs – AC in 2003
  - Linked with material control and shared databases
  - SAE P-17 is developing AMS for composite prepreg
- WSU NIAR is developing related composite training

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FAA Research at UCSB*: Bonding Surfaces Previously Subjected to Removable Layers

- Improper use of removable layers led to Airworthiness Directives
- Removable plies or layers that leave chemical contamination on bonding surfaces include release fabrics and release films
  - Surface abrasion (grit blasting) will not guarantee the elimination of contaminates and potential, undesirable adhesion (interfacial) failures
  - Ongoing efforts to establish standard terminology for removable plies and update product labels & technical literature to warn of potential bonding problems
- UCSB tests to evaluate bond integrity

Ref. Hart-Smith, Brown, Wong

* University of California at Santa Barbara (Bardis and Kedward)

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2004 Bonded Structure Initiative

Objectives for Workshops & Follow-on Report(s)

Primary objective

Collect & document technical details that need to be addressed for bonded structures, including critical safety issues and certification considerations

Secondary objectives

1) Give examples of proven engineering practices
2) Identify needs for engineering guidelines, shared databases and standard tests & specs
3) Provide directions for research and development

Presentations at http://www.niar.wichita.edu/faa/
Technical Scope of the Bonded Structures Workshops

Regulatory Considerations
- Proof of structure: static strength
- Fatigue and damage tolerance
- Design and construction
- Materials and workmanship
- Durability
- Material strength properties & design values
- Production quality control
- Instructions for continued airworthiness
- Maintenance and repair

Material & Process Qualification and Control

Design Development and Structural Substantiation

Bonding applications where at least one side of the joint is metal or pre-cured composite

Manufacturing Implementation and Experience

General aviation, rotorcraft and transport aircraft

Commercial and military applications were reviewed

Repair Implementation and Experience

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2004 and 2005 Composite Maintenance Training Initiatives

Starting with a Series of Workshops to Bring Industry & Regulators Together on the Issues

• FAA/NRC Workshop in Wash. DC (May 18 & 19, 2004)
  Executive review of systematic, repair, NDI & training issues

• Kickoff meeting for FAA research at Edmonds C.C. to evaluate training needs (Nov. 30 – Dec. 2, 2004)
  Continuous education (web-based training and short courses for technicians, inspectors and engineers) and 2 to 4 year programs

• FAA Workshop (tentatively set for Chicago in Sept., 2005)
  To review Edmonds C.C. efforts in studying available training resources versus the expanding needs and an introductory short course for technicians, inspectors and engineers

Presented at 11/10/04 AMTAS Meeting
2004 and 2005 Composite Maintenance Training Initiatives

• FAA JAMCOE research in 2004/2005 (*Edmonds C.C. with help from Univ. of Washington and Wichita State Univ.*)
  – Details to be coordinated with the CACRC and industry
  – Study to evaluate training needs and available resources
  – Create practical short intro course (with OEM & maintenance expert insights) for technicians, inspectors and engineers
  – Documented study and course materials publicly available

• Edmonds C.C. study and intro course will be reviewed at the 2005 FAA Workshop

• Future activities will expand into specialty areas and standardize composite maintenance training
Summary

A multi-year plan has been developed and implemented

• Will be continuously reviewed and updated in public forum (e.g., Mil-17, CACRC, national conferences, “town meetings” and FAA seminars & workshops – your input is requested)

• New FAA Joint Advanced Materials Center of Excellence will support research, standardization and training

Milestones achieved to date and future plans

• FAA guidance, workshops and detailed engineering practices for material & process specs and shared databases

• 2004 survey, workshop and guidance for bonded structures

• 2005 initiative for composite maintenance training

• AMTAS research started for bonding and damage considerations