

# FAA Composite Research Overview

Presented to: AMTAS

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Federal Aviation  
Administration



# Composite Research Topics

- **Under Structural Integrity of Composites, we create top-level research requirements by subject**
- **For FY2019, the subjects are:**
  - SIC.1: Damage Tolerance of Composite Structures
  - SIC.2: Composite Maintenance Practices
  - SIC.3: Crashworthiness Issues Unique to Composite Materials
  - SIC.5: Structural Integrity of Adhesive Joints
  - SIC.12: Continued Operational Safety (COS) and Certification Efficiency (CE) for Emerging Composite Technologies
- **For FY16-FY18, we also had congressionally-mandated additional research funds, and we created a new research line item to manage them, which is also expected to be in the FY19 budget:**
  - SIC.13: Advanced Materials Standardization Development

# FAA Composite Research

- **All of our JAMS research projects are funded through one of those line items**

F&DT	Development and Evaluation of Fracture Mechanics Test Methods for Sandwich Composites - Damage Tolerance Test Method Development	D. Adams
F&DT	Evaluation of Parameters Used in Progressive Damage Models	J. Parmigiani
F&DT	Moisture Diffusion in Sandwich Composites	M. Tuttle
Crash	Development of a Building Block Approach for Crashworthiness Testing	D. Adams
Adhesive	Improving Adhesive Bonding of Composites Through Surface Characterization	B. Flinn
Adhesive	Durability of Adhesively Bonded Joints for Aircraft Structures Project	D. Adams
Adhesive	Effect of Surface Contamination on Composite Bond Integrity and Durability Project	D. McDaniel
Adhesive	Durability of Bonded Aerospace Structures	L. Smith
Maint.	AMTAS Admin Grant	M. Tuttle

# Research Goals

- **Why are we doing research in various subjects?**
- **What are the top-level goals?**
- **Do our current projects adequately support those goals?**
  - What are the limits to FAA sponsored research?
- **What can we do differently to better support the goals?**



# Damage Tolerance of Composite Structures

- **Goals for Industry as a whole:**  
(What knowledge do we want to promote and have available in publications such as CMH-17?)
  1. Methods to predict if and how a specific damage will grow, for both laminate and sandwich structures
  2. Design and substantiation protocol for impact damage that requires maintenance inspection
  3. Design and substantiation protocol for the residual strength of critical damage states
  4. Document mitigating methodologies for damage not detectable by maintenance procedures

# Damage Tolerance of Composite Structures

- **What can we do with FAA research?**
  1. Study critical damage types and potential growth mechanisms
  2. Evaluate the variables from a given impact event that affect damage criticality and detectability
  3. Evaluate analysis methods used in predicting damage growth and residual strength
  4. Document fatigue and damage tolerance certification protocol, including mitigating methodologies for non-detectable damage

# Continued Operational Safety (COS) and Certification Efficiency (CE) for Emerging Composite Technologies

- **This is a series of focused independent projects with separate goals:**
  - Lightning Protection
    1. Understand the physical mechanism of lightning strike on composite structure and develop test methods to lead to better designs and certification procedures
  - Forensic Investigation
    1. Develop protocol to determine whether or not there was a composite structural failure (particularly from a contaminated bondline) after the structure is subjected to a post-impact fire
    2. General update to the composite failure analysis handbook
  - Fiber Quality Control
    1. Better understand the physical behavior of composite materials, and improve testing and certification procedures for the fibers
  - Advanced Fuels
    1. Ensure that the safety of composite structure is not compromised by the introduction of the new fuels



# Crashworthiness Issues Unique to Composite Materials

- **This subject not sponsored in FY20 or FY21**
- **Closing out projects already begun, which had goals to:**
  1. Investigate Unique Reactions of Composite Structures in Crash Events leading to test standards, analysis protocol, industry guidelines and documented best practices to support composite development, certification and substantiation practices



# Structural Integrity of Adhesive Joints

- **Goals:**

1. Define protocols for certifying bonded structural joints and bonded repairs
2. Define protocols for certifying sandwich structure
3. Document lessons learned



# Composite Maintenance Practices

- **This subject is a catch-all for safety management (including workforce education) in addition to actual maintenance practices**
- **Goals:**
  - Workforce Education
    1. Educate FAA certification engineers, manufacturing inspectors and maintenance inspectors to Level 2 “safety awareness”
    2. Expand Level 2 education around the industry
    3. Promote standardized Level 1 training in colleges and universities
  - General
    1. Understand latest technologies and best practices for publication in industry document and FAA guidance



# Advanced Materials Standardization Development

- **Overall goal per congressional mandate is advanced materials and structures standardization**
- **Have sponsored these projects:**
  - Process Definition and Quality Control for CMCs, Polymer AM, Thermoplastic Composite, Repair Materials and Adhesives
    1. Document Kp and Kcc for new materials and processes
    2. Provide guidelines for material and process control of new material forms and processes
  - Engines
    1. Document means of compliance for certifying composite parts (PMC and CMC) in engine applications



# Advanced Materials Standardization Development

- **Have sponsored these projects (continued):**
  - Workforce Education
    1. Update technical content and delivery methods for FAA courses
- **Future efforts will include establishing standards for developing design data and associated limitations – possibly leading to a material TSO**



# Research Goals

- **For each of these goals, the FAA is developing detailed plans to help generate desired knowledge and document best practices**
  - Research will compliment industry standards organizations' activities
- **Future projects will be selected to support these goals**



# Moving Forward

- **Currently around 30 open projects**
- **We expect FY19 dollars to be about the same as FY18, with congress continuing the plus-up process**
  - A sizeable portion of funds will go to AM – both metallic and non-metallic
- **We cannot effectively manage so many small projects**
  - Our plan is to have a fewer number of projects, with higher dollar amounts on each one
  - Projects will directly support a defined research need
  - Grant recipients will be asked to coordinate with other parties, as necessary – including creating research sub-contracts – to reach project goals (*this could include AMTAS/CECAM links*)