

# Aviation Rulemaking Advisory Committee (ARAC) Tasking on § 25.571



Federal Aviation  
Administration

Presented to: Transport Airplane Metallic and Composite Structures  
Working Group and Airworthiness Authorities

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# Overview

- **On January 26, 2015, FAA tasked ARAC to provide recommendations on the damage-tolerance and fatigue requirements of parts 25 and 26 along with the associated guidance information**
- **This briefing—**
  - Provides the regulatory history of the tasking
  - Provides an overview of the tasking
  - Explains how the information from this workshop may be used to address elements of the tasking

# Regulatory History

**Since 1988, the FAA adopted changes to the damage-tolerance (DT) and fatigue evaluation requirements and guidance materials that have primarily addressed the continued airworthiness of metallic structure for transport airplanes.**



# Changes Adopted Since 1988

- **Aging Airplane Safety Program**
  - Supplemental Structural Inspection Program (revised)
  - Mandatory Modification Program
  - Repair Assessment Program
  - Corrosion Prevention and Control Program
  - Aging Airplane Safety Rule
- **Aging Airplane Safety Act, 1991**
- **§ 25.571, Amendment 25-96, 1998**
- **Aging Airplane Safety Rule (AASR), 2005**
- **DT Data for Repairs and Alterations Rule, 2008**
- **Widespread Fatigue Damage (WFD) Rule, 2010**



# Activity Related to Composites

- **FAA revised parts 23, 27, and 29 and related guidance material, including AC 20-107, “Composite Airframe Structure”**
- **In June of 2009, FAA sought public comments on whether future rulemaking is needed to address extensive use of composite materials in transport category airplane construction**
  - Response indicated need for improved guidance material and possible rulemaking



# FAA Assessment

- **Increased use of composite and hybrid structures has driven concerns whether the damage-tolerance (DT) and fatigue airworthiness standards and advisory material are adequate for Transport Airplanes**
  - Rules are metal-centric
  - Rules and ACs should address all structure
  - Composites have been used since 1980s, but today more PSEs are made from composite materials
  - Full-scale testing for composites poses technical and economic concerns



# ARAC Tasking Overview

- **Working group to provide recommendations regarding revision of the DT and fatigue airworthiness standards and development of associated advisory material**
  - Address and provide recommendations on the following:
    - Remaining 2003 General Structures Harmonization Working Group (GSHWG) rulemaking recommendations
    - Increased use of composites by industry
    - Costs and benefits estimates
- **Authorizes two years for activity**



# Task 1

- **Evaluate the DT and fatigue evaluation requirements of parts 23, 25, 26, 27, and 29 and any associated guidance material**
  - Changes to parts 25 and 26 addressed technical issues primarily associated with metallic structure
    - Establishing inspection thresholds
    - Establishing a limit of validity of the engineering data that supports the structural maintenance program (LOV)
    - Developing damage-tolerance data for fatigue critical structure (repairs and alterations)
  - Changes to parts 23, 27, and 29 addressed industry trend to use more composite structures





# Task 2: Advice & Recommendations

- **Based on evaluation under Task 1, provide advice and recommendations on the DT and fatigue evaluation requirements and associated regulatory guidance material**
  - Define short-term and long-term objectives
    - Identify where guidance is needed now to address existing requirements (e.g., full-scale fatigue testing of hybrid structure)
    - Identify whether changes to the requirements and associated regulatory guidance are required
  - Specify requirements that should be in a rule, but do not provide rule text
    - For example, thermal stresses need to be taken into account.



# Considerations

- **The threats associated with fatigue, environmental exposure, and accidental damage that must be addressed per § 25.571 (all sessions)**
  - Large structural damage capability (no requirement, AC 20-107B addresses)
  - Discrete source damage threats
    - For example, address existing policy
  - Other damage threats, such as high-energy wide-area blunt impact
- **Applicability to emerging technology materials (sessions 4, 5, 6, & 7)**

# 2003 GSHWG Recommendations

- **Add or revise requirements and guidance material for § 25.571**
  - Setting inspection thresholds (open)
    - Address whether it is appropriate to require applicants to assume the structure contains an initial flaw of the maximum probable size that could exist as a result of manufacturing or service-induced damage
  - Establishing an LOV (closed, Amdt. 25-132)



# Recommendations (cont.)

- **Add or revise requirements and guidance material for § 25.571 (cont.)**
  - Demonstrating structural damage capability (open)
    - Address whether it is appropriate to add a requirement for showing structural capability in the presence of damage, so that even if the structure fails partially, there will still be enough structure remaining to be safe
- **Harmonize with Joint Airworthiness Authorities (now the European Aviation Safety Agency) regulations and guidance material**

# Additional Considerations

- **For 2015 tasking, also consider any applicable elements of 2003 GSHWG recommendation for composite and hybrid structures (sessions 4, 5, & 6)**
  - Large structural damage capability, including categories of damage identified in AC 20-107B



# Normal Wear/Aging of Composites

- **Address the continued operational safety of composite and hybrid structures as they age, including any airworthiness limitations in the structural maintenance program (sessions 4, 5, & 6)**
  - What are the aging mechanisms for composites that would result in damage similar to metallic structure—e.g., widespread damage (composites) vs. widespread fatigue damage (metallic structure)
  - How should composite and hybrid structures be addressed relative to an airplane's LOV?

# Hybrid Structure Considerations

- **Address the testing of hybrid structure, including, but not limited to—**
  - Thermal effects (e.g., cycle vs. load magnitude trades)
  - Test duration
  - Load and life enhancement factors (LEF)
  - Crack-growth retardation
  - Truncation and clipping
  - The fatigue spectrum and LEF
  - Test evidence and the “building block” approach described in AC 20-107B

**(sessions 4, 5, and 6)**



# Address Repairs and Modifications

- **The bonding or bolting of repairs to metallic, composite, and hybrid structures, addressing—**
  - Composite weak bonds
  - Inspection methods
  - Allowable damage limits
  - Repair size limits
- **The certification of large structural modifications on transport airplanes constructed of composite or hybrid structures**

**(sessions 2 and 7)**





# ARAC and Workshop Common Topics

**Task 2** - Advise and make written recommendations on whether to change 14 CFR part 25, subparts C and E of 14 CFR part 26, and related regulatory guidance material, such as ACs 25.571-1, 20-107, 120-93, and 120-104, to address the use of metallic, composite, and hybrid structures in transport airplanes.

*Provide a list of short-term and long-term deliverables with rationale.*

- ✓ 1. *Provide advice and recommendations on the threats associated with fatigue, environmental exposure, and accidental damage that need to be assessed .*
- ✓ 2. *Provide advice and recommendations on emerging technology materials.*
- ✓ 3. *Provide advice and recommendations related to the 2003 General Structures Harmonization Working Group (GSHWG) report entitled, “Damage Tolerance and Fatigue Evaluation of Structures, FAR/JAR § 25.571.” (Threshold, & LDC, LDC worked by AAWG)*
- ✓ 4. *Provide advice and recommendations on the continued operational safety of composite and hybrid structures as they age and determine whether there are any changes that are necessary to address the airworthiness limitations in the structural maintenance program. (aging mechanisms for composites—e.g., widespread damage & LOV)*
- ✓ 5. *Address the testing of hybrid structure, including, but not limited to, addressing thermal effects, test duration, load enhancement factors, and crack-growth retardation to determine whether any changes are necessary. (Task 2.e.)*
- ✓ 6. *Address the bonding or bolting of repairs to metallic, composite, and hybrid structures to determine whether any changes are necessary.*
- ✓ 7. *Address the certification of large structural modifications on transport airplanes constructed of composite or hybrid structures to determine whether any changes are necessary.*
8. *Address the EASA rulemaking activity on aging aircraft for harmonization purposes.*

**Address any other issues identified under Task 1 Deliverables and Actions**

1. *[e.g., policy PS-ANM100-1993-00041, Compliance with § 25.571(e) Discrete Source Damage (Uncontained Engine Failure) worked by AAWG]*

# Specific ARAC Task 2 Activities

## Top-Level Draft Agenda for 2015 FAA/Bombardier/TCCA/EASA/Industry Composite Transport Damage Tolerance and Maintenance Workshop (Montreal, Quebec)

Revision 4			
	Tuesday, September 15	Wednesday, September 16	Thursday, September 17
1 <sup>st</sup> Hour	<b><i>Bombardier Welcome</i> &amp; Workshop Intro</b> <b>FAA/EASA/TCCA Composite</b> <b><u>Damage Tolerance &amp; Maintenance Initiatives</u></b> Background/Plans/Workshop Objectives Overview of Relevant Technical Issues	<b>Session 3: <u>High Energy, Wide Area, Blunt Impact (HEWABI)</u></b> Industry Experiences and Regulatory Interface FAA/EASA/Industry Research ( <i>even supporting tech.</i> ) <b><u>Recap (30 min):</u></b> Review Industry Experiences and Safety Risk Mitigation Efforts	<b>Session 6</b> <b><u>Damage Tolerance: Part 2B (Special Subjects)</u></b> Hybrid issues for composite & metal assemblies Thermal loads (analysis and sufficient test evidence) Flights with known damage (substantiation) Substantiation of maintenance inspection technologies
2 <sup>nd</sup> Hour		Item #1	<b>Session 4A</b> <b><u>Composite Fatigue and Damage Tolerance</u></b> Aging aircraft (limits of validity, other constraints) Design Criteria & Objectives for Category 2 -4 Large Scale Structural Analysis & Test Protocol
Break (15 min.)	Items #1, 2, 4 & 5		
3 <sup>rd</sup> Hour	<b>Session 1: <u>Sandwich Disbond Assessment/Recap</u></b> Standards and Structural Engineering Methods	<b>Session 4B</b> <b><u>Composite Fatigue and Damage Tolerance</u></b> Repeated Load Tolerance (fatigue & damage tolerance) Design Requirements & Criteria Ongoing Part 25 Fatigue & DT ARAC Efforts	<b>Session 7a: <u>Smarter DT Testing</u></b> Transport "Advanced Analysis" Evaluation Novel Building Block Methods
4 <sup>th</sup> Hour	<b>Session 2A (part 1): <u>Bonded Repair</u></b> Field Experiences Operator Perspectives on Bonded Repairs	Lunch	<b>Session 7b: <u>Use of Probabilistic Methods</u></b> Damage Threat Assessments ( <i>field data</i> ) Combined Structural/Maintenance Safety Analysis
Lunch (45 min.)	Items #1 & 2		
5 <sup>th</sup> Hour	<b>Session 2A (part 2): <u>Bonded Repair</u></b> Field Experiences OEM Perspectives on Bonded Repairs	<b>Session 4B</b> <b><u>Composite Fatigue and Damage Tolerance</u></b> Repeated Load Tolerance (fatigue & damage tolerance) Design Requirements & Criteria Ongoing Part 25 Fatigue & DT ARAC Efforts	<b>Session 7c: <u>Major Structural Modifications, Alterations &amp; Repairs</u></b> Review Industry Experiences & Substantiation Efforts
6 <sup>th</sup> Hour	<b>Session 2B (part 1): <u>Bonded Repair</u></b> Round Robin Test Results/Training Pros and Cons Factors Affecting Bond Quality	Lunch	<b><u>Near-term Emerging Technology Recap</u></b> Review Experiences & Substantiation Efforts for Promising Emerging Technologies (support Sessions 7A, 7B & 7C)
Break (15 min.)	Items #1 & 6		
7 <sup>th</sup> Hour	<b>Session 2B (part 2): <u>Bonded Repair</u></b> Competency for Specific Product Details Bonded Repair Substantiation, Standards	<b>Session 5</b> <b><u>Damage Tolerance: Part 2A (Special Subjects)</u></b> Building Blocks for Analysis Supported by Tests	<b><u>Workshop Recap and Closure</u></b>
8 <sup>th</sup> Hour	<b><u>Bonded Repair Recap</u></b> Review Industry Efforts: CMH-17 Working Groups Best Practices/Case Studies (support Sessions 1 & 2)	<b><u>Fatigue and Damage Tolerance Recap</u></b> Review Industry Experiences & Substantiation Efforts for Fatigue & Damage Tolerance (support Sessions 4A, 4B & 5)	

The above agenda provides a current view of the workshop at a high level. See the detailed agenda for more a specific time allocation within each session.

- Notes:** 1) The last hour of the first 2 days are recap sessions. Participants may leave once they have completed comment forms and have no need to be part of discussions.  
 2) The third day will end 30 to 45 minutes early.

# Summary

- **Workshop provides the ARAC Working Group an opportunity to review existing efforts and identify “best industry practices”**
- **Information gathered may assist in the completion of the ARAC task assignment related to composites**

