Limit of Validity, Repairs, Modifications, Composites, and the Aviation Advisory Rulemaking Committee

Presented to: Composite Modifications Workshop

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Purpose of Briefing

– Provide an overview on
  • Regulatory changes related to limit of validity of the engineering data that supports the structural maintenance program (hereafter referred to as LOV)
  • The widespread fatigue damage (WFD) rule
– Explain how repairs, alterations/modifications, and composites impact LOV
– Provide an overview on the current Aviation Rulemaking Advisory Committee activity related to damage-tolerance and fatigue evaluation requirements for Transport Category Airplanes
DT and Fatigue Requirements

- Changes adopted since 1988 primarily addressed metallic structure
  - 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 Rule (AASR), 2005
      - DT Data for Repairs and Alterations Rule, 2008
      - Widespread Fatigue Damage (WFD) Rule, 2011
What is the WFD Rule?

- The WFD Rule is about:
  - Establishing LOVs
  - Incorporating LOVs
  - Addressing aging airplane structures susceptible to WFD (i.e., fatigue damage of large areas of metallic structure)
    - Multiple site damage: A source of WFD characterized by the simultaneous presence of fatigue cracks in the same structural element
    - Multiple element damage: A source of WFD characterized by the simultaneous presence of fatigue cracks in adjacent structural elements
Limit of Validity (LOV)

- Is how far out you can validate what the proper maintenance is to preclude WFD
- Applies to an airplane model
- Requires an evaluation of fatigue data
- Is a limit beyond which airplane can’t be operated
- Can be escalated with additional fatigue data
LOV, Per Rule Preamble & AC

Limit of Validity (of the engineering data that supports the maintenance program) is the period of time (in flight cycles, flight hours, or both), up to which it has been demonstrated by test evidence, analysis and, if available, service experience and teardown inspection results of high time airplanes that widespread fatigue damage will not occur in the airplane.
Composites & LOV

• FAA adopted the WFD rule to address aging concerns in metallic structures
  – LOV is tied to WFD—i.e., the aging of metals
  – Composite structures wear or age differently than metallic structures
  – Composite structural maintenance programs appear to be adequate up to LOV based on fleet experience
  – Composite structures may affect the durability of metallic structures (e.g., thermal stresses)
  – Composite structures affect testing and test results for metallic structures
What impact do repairs and modifications have on the LOV?

- A change to the airplane’s LOV is not likely
  - There may be exceptions, such as design changes that increase the airplane’s gross weight or cabin pressure

- A change to the structural maintenance program is more likely
  - Since the FAA will mandate WFD-related maintenance actions by airworthiness directives, alternative methods of compliance may be needed
  - You may need new or revised DT-based inspections or other procedures
What’s required?

- Under § 26.21 and § 26.23, repairs are not required to be evaluated except for those requiring modifications or replacements that are mandated by airworthiness directives.

- Under § 26.21, certain modifications are required to be evaluated:
  - Alterations, including STCs, that increase or decrease the maximum takeoff gross weight (MTGW) of the airplane:
    - §§ 26.21(c)(5) and (c)(6) address increases.
    - § 26.21(c)(7) addresses decreases.
  - Amended type certificates applied for after the effective date of the rule.

STCs Projects

• Apply § 21.101 to determine the applicable amendment level for § 25.571 and other applicable requirements

• For large external modifications on transport category airplanes, the FAA would apply an issue paper
  – Identifies the applicable structural requirements
  – Provides a medium by which the compliance to the structural requirements is documented
Salvaging Parts

• What parts, if any, from an airplane that reached its LOV, can be installed on other transport category airplanes?
  – Parts may be installed on other airplanes
    • Installation must meet FAA installation requirements (e.g., part 43)
    • Installation must meet requirements for repair approvals, changes in type design approvals, or any applicable airworthiness directives
  – LOV is an airplane-level number
  – LOV does NOT apply to individual parts
Rules Related to Composites

• Increased use of composite and hybrid structures has driven concerns whether the damage-tolerance (DT) and fatigue airworthiness standards 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
Aviation Rulemaking Advisory Committee (ARAC) Tasking

• FAA tasked ARAC on January 26, 2015, to provide recommendations on DT and fatigue evaluation requirements for transport category airplanes
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

- Authorization until January 2018
Items to Consider

• Threat Assessment
• Emerging material technology – for example, additive manufacturing
• Inspection Thresholds
• Structural damage capability – reintroduce “fail-safe” requirement
• Aging of composites
• Testing of hybrid structure – address thermal effects, test duration, etc.
Items to Consider (cont.)

- Bonding and bolting of repairs
- Certification of large structural modifications
- EASA aging aircraft rulemaking and harmonization
- Rotor burst
- Disposition of cracking during full-scale fatigue testing
- Accidental damage inspections included in the airworthiness limitations section vs. Maintenance Steering Group (MSG) -3 program
Summary

• **LOV applies to metallic structures**
  – LOV is how far out you can validate what proper maintenance is to preclude WFD
  – Repairs and modifications most likely affect the structural maintenance program rather than the LOV

• **Composite structures may affect**—
  – The durability of metallic structures
  – How testing is performed and test results for metallic structures

• **Parts from an airplane that has reached its LOV can be installed on other airplanes if FAA installation requirements are met**

• **FAA tasked ARAC in January 2015 to provide recommendations related to composites**