

# Aviation Rulemaking Advisory Committee Tasking on § 25.571



**Federal Aviation  
Administration**

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# Overview

- **FAA Tasking**
- **Transport Airplane Metallic and Composite Structures Working Group (TAMCSWG)  
Final Report**
- **Summary of Recommendations**
  - Rule and Guidance Changes
  - Costs and Benefits
- **Next Steps**
- **Summary**



# FAA Tasking

- **On January 26, 2015, FAA tasked the TAMCSWG under the Aviation Rulemaking Advisory Committee (ARAC) to—**
  - Provide recommendations on damage-tolerance (DT) and fatigue evaluation requirements and associated guidance materials (primarily 14 CFR 25.571)
  - Estimate the costs and benefits associated with any changes



# TAMCSWG Final Report

- **Approved by ARAC on September 20, 2018**
- **Recommendations align with industry practices and address metal-centric aspect of rule**
- **Industry and regulatory agencies should work together to create educational materials**
- **[https://www.faa.gov/regulations\\_policies/rulemaking/committees/documents/index.cfm/document/information/documentID/3723](https://www.faa.gov/regulations_policies/rulemaking/committees/documents/index.cfm/document/information/documentID/3723)**

# Recommendation for 12 Focus Areas

Rule & Guidance	Guidance Only	No Changes
Threat Assessment	Bonding or Bolted Repairs	Structural Damage Capability (SDC) <sup>^</sup>
Testing of Hybrid Structure	Inspections and the Airworthiness Limitations Section (ALS)	Harmonize European Aviation Safety Agency (EASA) Aging Aircraft Rulemaking
Aging Mechanisms	Emerging Material Technology	
Inspection Thresholds	Rotorburst	
Large Structural Modifications (Part 26)	Cracking During Full-Scale Fatigue Test	

<sup>^</sup> Category 3 expectations (an SDC concept) will remain in AC 20-107B, allowing the desired industry freedom in setting SDC design criteria

# Rule Recommendations Summary

- 1. Generalize environmental damage threat to address others**
- 2. Add manufacturing defects to § 25.571(b)**
- 3. Generalize the DTE requirements related to growth or no growth behavior**
  - a. For metals, generalize the assumptions to be used in threshold determination
  - b. For materials that exhibit growth, continue to allow the repeat interval to be different from the threshold
  - c. For materials that exhibit no growth, continue to allow the repeat interval to be equal to the threshold
- 4. Require the limit of validity (LOV) to be based on the aging space of all structure**
- 5. Include analysis for certain loads to supplement the full-scale fatigue test evidence to show freedom from aging (WFD for metals)**

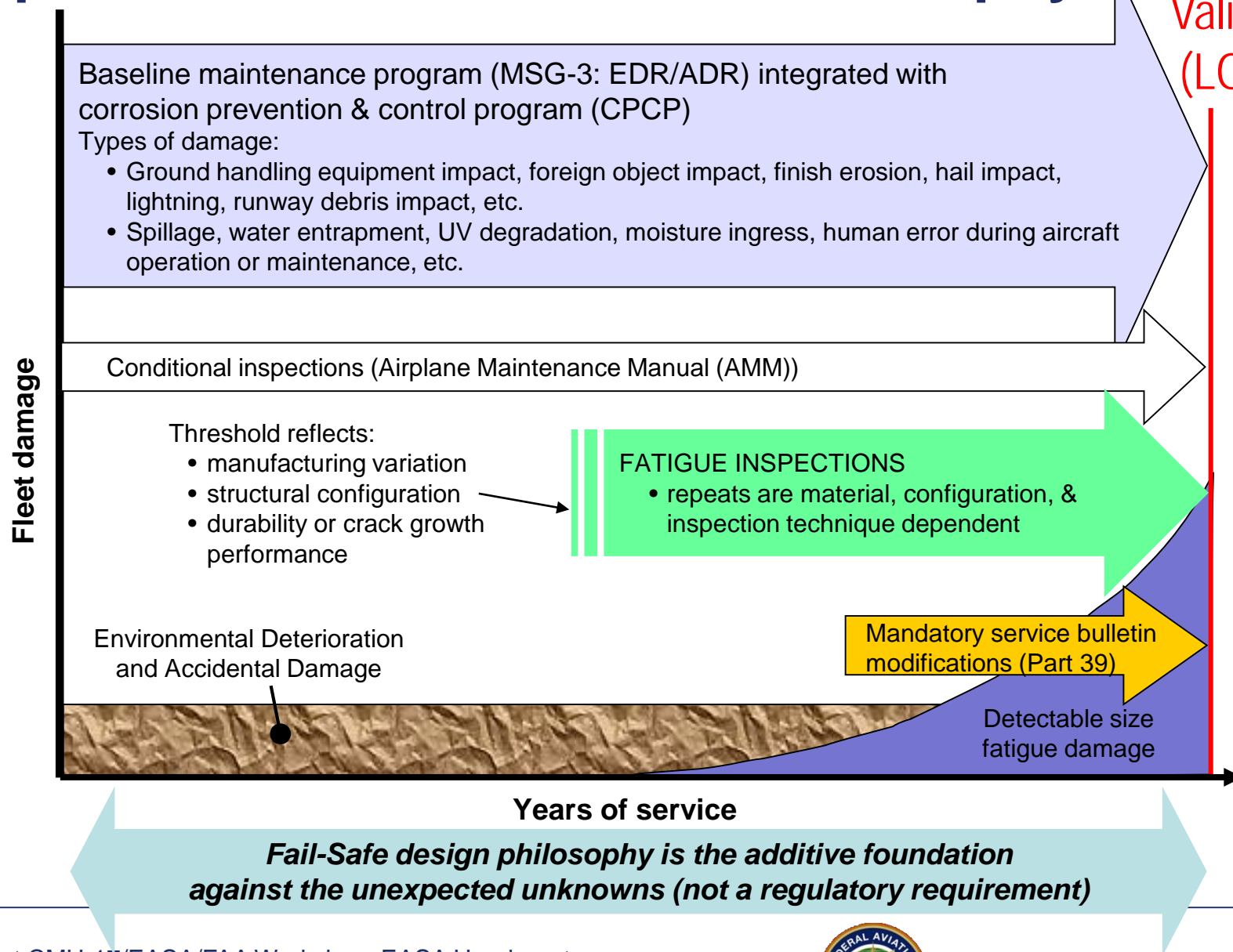


# Guidance Recommendations Summary

- **Revise Advisory Circulars (AC) 25.571-1D and 20-107B as well as FAA policy to align with recommended rule changes by—**
  - Add or revise definitions. e.g.,
    - Manufacturing defect
    - Limit of validity (LOV)
  - Address bonding for both metals and composites
  - Define when to use analysis supported by test evidence to address thermal loads, hybrid structure, and establishing an LOV
  - And more...

# Inspection and Maintenance Philosophy

Limit of  
Validity  
(LOV)





# Inspection and Maintenance Philosophy, *cont.*

- **Ensure Inspection and Maintenance Philosophy Remains Integrated with §25.571 Updates**
  - ***All Damage Threats*** identified in §25.571 need to be practically addressed in maintenance inspections with short and long intervals
  - A thorough ARAC review of the current §25.571 indicates certain areas may require further emphasis
- **Baseline maintenance programs are important to safety**
  - Otherwise, what justifies the shorter inspection interval and no specific threshold for a start
  - Is it possible that those implemented specifically after a detectable fatigue damage threshold may not be complete?
  - May protect best against the unknown, triggering indications to perform the more detailed inspections that are addressed after fatigue damage threshold

# Inspection and Maintenance Philosophy, *cont.*

- **Composites gather damage tolerance field data to ensure inspection intervals for accidental damage have validation**
  - Note engineering assumptions of damage categories →  
Are these sufficient to protect safety?
- **Does the graphic (on chart 8) give too much credit to “failsafe design philosophy”?**
- **What “conditional inspections” require updates to §25.571 to the extent that they must be mentioned within the ICA ALS**
  - e.g., HEWABI that is truly a threat to the next service flight

# Testing of Hybrid Structure and Aging

- **Revise § 25.571(a)(3) to establish a limit of validity (LOV) based on the aging space** (expected environmental exposure and repeated loading environment) **of all structure**
  - Rule change to recognize LOVs may be based on the aging space of materials other than metals (widespread fatigue damage)
  - Retain requirement for full-scale fatigue test *as part of* evidence that widespread fatigue damage will not occur up to the LOV
- **Revise § 25.571(b) to allow analysis supported by test evidence for certain loads, such as thermal loads**
  - Change recognizes that not all loads can be applied to the full-scale fatigue test article

# Inspection Thresholds

- **Generalize the damage-tolerance evaluation requirements related to growth or no growth behavior**
  - For metals, generalize the assumptions to determine threshold
  - For materials that exhibit growth, continue to allow the repeat interval to be different from the threshold
  - For materials that exhibit no growth, continue to allow the repeat interval to be equal to the threshold
- **Replace the prescriptive requirement of § 25.571(a)(3) for setting damage-tolerance inspection thresholds based on crack growth, assuming the structure has an initial flaw, with a performance-based requirement**
  - Address expected range of damage threats
  - Use methods substantiated by representative tests or service data
  - Repeat interval equals threshold unless otherwise substantiated

# Structural Damage Capability (SDC)

- **No rule or guidance changes**
  - TAMCSWG felt SDC was good design practice used as a degree of freedom to help address damage threats without specifying detailed guidelines (e.g., Composite Category 3 damage)
  - Industry standards can document examples and related other considerations leading to SDC for applications
- **Recommend that FAA address single load path structure instead of reintroducing specific structural damage capability (fail-safety) into rule**
- **Although bonding was addressed under threat assessment, the recommendation was effectively a SDC design criteria (structural redundancy) already covered in AC 20-107B**

# Costs and Benefits

- **Rule and guidance material changes would not have any appreciable costs or benefits associated with them**
- **However, rule and guidance material changes would result in cost avoidance or savings**
  - May eliminate or reduce the need for issue papers associated with the Damage Tolerance Evaluation of bonded structure and testing of hybrid structure
  - Would allow flexibility in establishing inspection thresholds

# Next Steps

- **ARAC Extension**
- **Interim activity**
- **Long-term activity**



# ARAC Extension

- **On September 20, 2018, TAMCSWG requested ARAC to extend the tasking in order to provide additional recommendations related to single load path (SLP) structure, bonding, and repeat inspection intervals (crack interaction)**
- **Duration 18 months**





# Single Load Path (SLP) Structure

- **Report describes challenges and issues associated with developing requirements and guidance materials related to SDC**
  - All industry and regulatory participants of the working group believe SDC is important to safety
  - The working group could not agree on a uniform enforceable airworthiness standard and associated regulatory guidance material
- **Report recommends that future efforts focus only on SLP structure, which by definition has no SDC**

# Initial Review of SLP Recommendation

- **Recommendation: Require use of multiple load path structure unless shown impractical**
  - Rule change may not be needed
  - Impractical may be difficult to define
- **Require Development of Process Control and Tracking Documents for SLP**
  - Determine where guidance should go
  - Use existing material from 2003 ARAC report
- **Review Definitions in AC 25.571-1D**
  - Define integrated/monolithic structure

# Bonding

- **TAMCSWG recommends that the FAA revise § 25.571(b) to include manufacturing defects as a damage threat to evaluate**
  - Ensures consistency on damage threats to assess
  - Manufacturing defects to evaluate would include disbonds and weak bonds
- **Bonded structure has links with the “single load path” structure efforts**
  - TAMCSWG moved bonding from SDC to damage threats
  - Bonding really is a SDC issue

# FAA Requested Clarification

- **Weak bonds listed under manufacturing defects is somewhat confusing because, although it is clearly a manufacturing defect, it is unlike any of the other manufacturing defects that are typically listed (i.e., all others are relatively small and either starter flaws for metal fatigue or allowable defects for composites).**
- **Bonding may be acceptable to use if stringent/reliable manufacturing in-process quality control practices are in place to ensure that a weak bond is:**
  - 1) Extremely rare (justifying the size constrained by 2)
  - 2) Localized to a size at or within arresting design features.

# Task Related to Bonding

- **Determine if additional rule changes related to bonding are necessary**
- **Determine if additional guidance material is necessary** (i.e., new guidance or changes to existing guidance)
- **Provide qualitative and quantitative costs and benefits, as necessary**



# Repeat Inspection Intervals

- **TAMCSWG recommends replacing the current metal-centric fracture mechanics requirement with a material-independent performance-based requirement**
- **Working group to review existing guidance to determine if additional guidance is needed**
  - Metal-centric task
  - Investigate crack interaction

# Interim Activity for FAA

- **FAA to consider where new or revised policy is needed to address testing of hybrid structures, rotor burst, bonding, and establishing or extending an LOV**
  - At a minimum, current rule limitations for hybrid composite and metal structure need clarification
- **FAA may develop training/educational material related to policy**
- **CMH-17 efforts to document TAMCSWG report details and related best industry practice**



# Long-Term Activity for FAA

- **Rulemaking is a deliberative process**
  - FAA considers ARAC recommendations as the starting point
  - Publish notice of proposed rulemaking (NPRM) and associated guidance material
  - Publish final rule and guidance material after dispositioning public comments
- **FAA typically develops training/educational material related to final rule and guidance**



# Summary

- **Report published in Fall of 2018**
- **Rule and guidance recommendations are consistent with industry practice**
  - Generalize the environmental damage threat
  - Add manufacturing defects to § 25.571(b)
  - Generalize the DTE requirements related to growth or no growth behavior
  - Require the LOV to be based on the aging space of all structure
  - Include analysis for certain loads to supplement the full-scale fatigue test evidence to show freedom from aging (WFD for metals)
- **Additional effort needed for bonding, single load path structure, and crack interaction**
- **Next steps include policy, rulemaking, and education**

# Extra Slides



# Advisory Circulars

- AC 25.571–1, Damage Tolerance and Fatigue Evaluation of Structure
- AC 20–107, Composite Airframe Structure
- AC 120–93, Damage Tolerance Inspections for Repairs and Alterations
- AC 120–104, Establishing and Implementing Limit of Validity to Prevent Widespread Fatigue Damage
- AC 27-1, Certification of Normal Category Rotorcraft (specifically, Subpart C)
- AC 29-2, Certification of Transport Category Rotorcraft (specifically, Subpart C)



# Policy Issued since 1989

- PS-ANM100-1989-00048, Policy Regarding Impact of Modifications and Repairs on the Damage Tolerance Characteristics of Transport Category Airplanes
- PS-ANM100-1993-00041, Compliance with § 25.571(e) Discrete Source Damage (Uncontained Engine Failure)
- PS-ANM100-1993-00047, Policy Regarding Fail-Safe Structures Designed to the Damage Tolerance Requirements of § 25.571
- PS-ACE100-2001-006, Static Strength Substantiation of Composite Airplane Structure
- PS-ACE100-2005-10038, Bonded Joints and Structures - Technical Issues and Certification



# Policy (cont.)

- **Policy issued since 1989 (cont.)**
  - PS-AIR-20-130-01, Bonded Repair Size Limits
  - PS-ANM-25-20 (date TBD), High-Energy Wide-Area Blunt Impact for Composite Structures
- **Additional Policy to Consider**
  - PS-ANM100-1991-00049, Policy Regarding Material Strength Properties and Design Values, § 25.613
  - PS-AIR-100-120-07, Guidance for Component Contractor Generated Composite Design Values for Composite Structure
  - PS-ACE100-2002-006, Material Qualification and Equivalency for Polymer Matrix Composite Material Systems