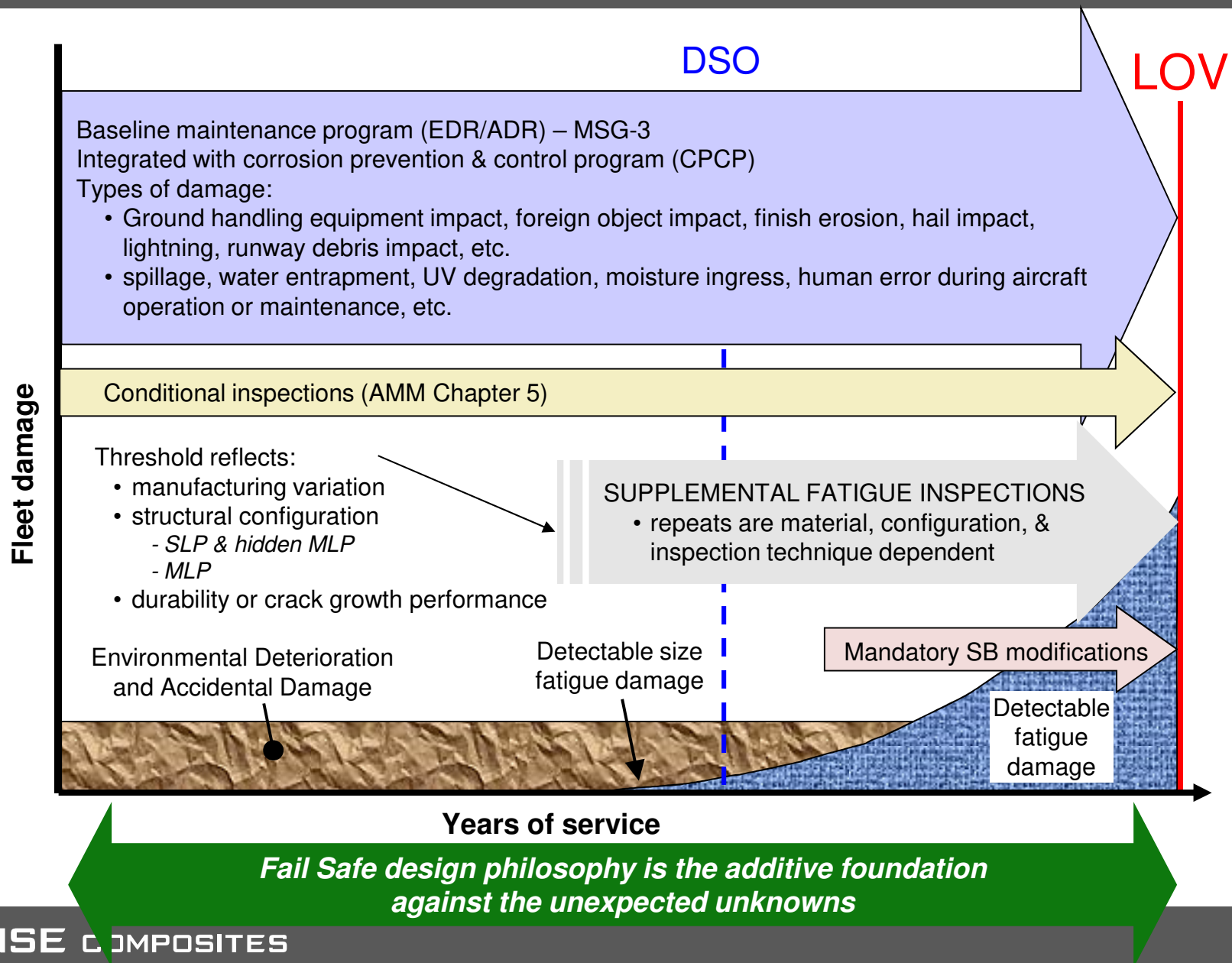


Outline



Maintenance Inspection Technology

Inspection and Maintenance Philosophy



Inspection Protocol (1 of 2)

- Describe inspection protocols driven by ALS, MSG-3 and other inspections.
 - Protocol for Instructions for Continued Airworthiness (ICA) as applied to scheduled composite maintenance.
 - Both ALS and MSG-3 promote essential inspections that avoid catastrophic failure and the former is being linked to those inspections that require specific DTE-driven inspection definitions (thresholds, repeat intervals, critical damage locations and inspection procedures).
 - *MSG-3 inspections are equally important and in many cases help detect critical but rare damage states that cannot be assumed to be safely detected from DTE-driven engineering efforts.*
 - *Conditional inspections can also not be predetermined but specific “triggers” are needed to ensure they are performed (i.e., hard landing, flight overload, or severe service vehicle collision).*
 - All of these may be considered somewhat unbounded and very difficult to define.
 - The lower end of these threats may require conservative design criteria, e.g., SDC in order to ensure safety.

Inspection Protocol (2 of 2)

- Through NPA 2013-07 and ARAC/Working Group/Workshop presentations EASA has indicated a number of important considerations regarding aging of composite structures.
 - Emphasis is placed on the importance of ensuring that the damage assumptions made remain conservative after entry into service, and that the certification assumptions that form the basis of the maintenance program remain valid through the operational life of the aircraft.
 - Uncertainty associated with the AD and ED performance of a completely new structure may warrant specific inspections in the ALS.
 - *Depending on specific engineering assumptions used in DTE to cover the two classes of damage/degradation.*
 - Importance is given to explaining “...to operators the link between the AD and ED inspection programmes and CS 25.571 and CS 25.1529 compliance.”

- Inspection Protocol (Fawcett/Davis)

Include these OEM best practices
in new CMH-17 content?

F&DT Best Industry Practice for CMH-17 *Inspection protocol*

1. Inspections identified by ALS are inspections established using engineering data.
 1. ALS is FAA approved **and mandates** the procedures necessary to accomplish Supplemental Structural Fatigue Inspections which are post fatigue threshold.
 2. ALS can also contain temporary operating limits until all engineering data is in place.
 3. Engineering assumptions, methods and allowables are continually updated based on fleet experience
2. MSG-3 ED / AD inspections are based on OEM knowledge of structure sensitivity to environmental and accidental damage and operator service experience. Operator has greatest say in MSG-3 process.
 1. Inspections typically are visually based (**occasionally special detail**) and are the predominate planned inspections used before the fatigue threshold where they continue on along with the supplemental inspections.
 2. Applicant test program must address sensitivity to accidental damage.
 3. New materials should be screened for sensitivity to environmental degradation and aging (viscoelastic effects).
3. Findings in service are all reported via COS program.
 1. OEMs evaluate the in service events to ensure the inspections in place adequately capture damage and maintain regulatory residual strength capability.
 2. Service bulletins are used (modifying inspections and possibly requiring terminating action) when the existing inspections are inadequate

Maintenance Inspection Technology

■ Key Aspects From Industry/Regulatory Working Group

- Demonstration maintenance inspection technology details related to F&DT

- *Guidelines for MSG-3 (accidental and environmental damage threats)*
- *Validation of inspection methods used for detection (Category 1 - 3 damages), including the minimum number of inspection cycles*
- *Validation of full extent/characterization of damage as related to allowable damage limits and repair size limits (e.g., BRSL criteria)*

- ***Protocol for ICA as applied to scheduled composite maintenance***



Under Discussion

- ***Conditional inspection details for HEWABI and other Category 5 damage types***



In-Work

Maintenance Inspection Technology – Rev. H Needed Content

- **Rev. H – Needed Content?**

- Protocol for Instructions for Continued Airworthiness (ICA) as applied to scheduled composite maintenance?
- Conditional inspection details for HEWABI and other Category 5 damage types?

Rev. G: Some content on MSG-3 and EDR/ADR, and on using POD studies to validate inspection methods.

Inspection Thresholds – ARAC DRAFT Final Report

Inputs (1 of 4)

■ Inspection Thresholds (from Executive Summary)

- “Both rule and guidance changes are recommended by the WG in order to move toward material-independent performance based requirements.
 - *The current rule is prescriptive in that only a material (metal) centric fracture mechanics approach “must be used” per the rule to establish inspection thresholds for SLP & hidden multi-load path (MLP) structure.”*
- “The WG also recommends that the FAA update the current guidance material to describe an acceptable means of compliance that aligns with the recommended material-independent and non-method specific rule recommendation.”

Inspection Thresholds – ARAC DRAFT Final Report

Inputs (2 of 4)

■ Section 3.4 – Inspection Thresholds

- “For situations where propagation is shown to be unlikely, such as with composites, the focus is on the static performance following any accidental damage. Given that accidental damage can occur at any time in the life of an airplane, there is no latency period and the concept of an inspection threshold does not apply.”
- “The WG considered product variation, and agreed that the expected variation of production quality can leave undetected defects that may impact the durability of the structure and thus it needs to be considered in the establishment of inspection thresholds regardless of the analytical method used.”
- “An undetectable defect that falls outside of expected manufacturing variation is fortunately rare given today’s mature manufacturing controls.
 - *In the rare event such an escape were to occur robust designs such as those with redundant load paths or integral with effective crack retarding features tend to drive latent defects to become obvious damage and detected prior to catastrophic failure.*”

Inspection Thresholds – ARAC DRAFT Final Report

Inputs (3 of 4)

■ Section 3.4.1 – Rule Change

- “It is understood that there is no evidence that either analytical method (fracture mechanics or damage accumulation) used to establish the point at which inspections need to start is inherently more accurate than the other.”
- New Rule Text
 - *“When inspections are required to prevent catastrophic failure, inspection thresholds must be established to ensure that damage in a PSE will be detected before it results in a catastrophic failure. The inspection thresholds must account for the expected range of damage threats to the structure and use methods substantiated by representative tests or in service data.”*

Inspection Thresholds – ARAC DRAFT Final Report

Inputs (4 of 4)

■ Section 3.4.2 – Guidance Change

- “Replace the current initial flaw only verbiage in AC 25.571-1D with provisions for use of either a damage accumulation or fracture based method.
- Improve on the 2003 recommendation of defining thresholds as an arbitrary percentage of DSG with linkage to redundancy and inspectability.
- Clarification relative to inspection thresholds for both metals and composites exposed to accidental and environmental damage is included in the recommendation, **defining the threshold at the first repeat interval. ???**
- How to address quality escapements vs. the range of “normal production quality”?
- Ensure continued use of historically accepted assumed initial flaws.”