



# EASA

European Aviation Safety Agency

# Development of Structural scheduled maintenance requirements

-

# MRB process and Interfaces with Type Certification

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- Interfaces with Type Certification (for Structure)



# Introduction

## Scheduled maintenance:

### ICAO

#### Design (TCH)

##### Annex 8

„Airworthiness of Aircraft“

=> continuing airworthiness  
maintenance information (=ICA)

ICAO 9760 (Airworthiness Manual)

normally issued as MRBR

#### Operation (OPS)

##### Annex 6

“Operation of Aircraft“

=> maintenance program

### EASA

#### Part 21.A.44 & 21.A.61

(=>ICA)

CS 2X.1529

WI.CSERV.00007 Maintenance

Review Board team

MRBR = AMC

#### Part M.A.302

=> Aircraft Maintenance Programme

CS 2X.1529 is used as a  
substitute for CS 25, CS  
23, CS 27 and CS 29



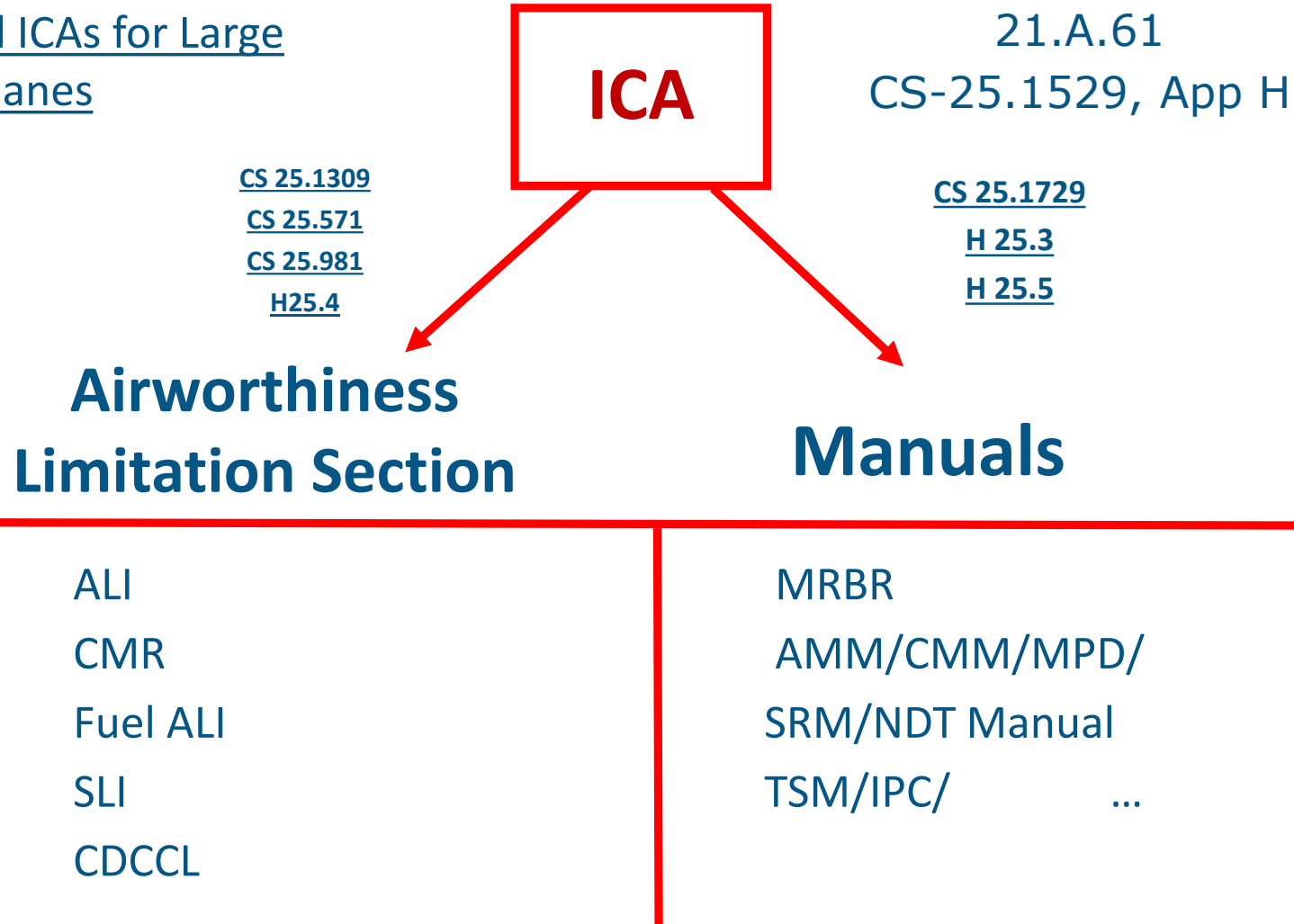
# Instructions for Continued Airworthiness <sup>1/3</sup>

- Instructions for Continued Airworthiness (ICA) ensure the airworthiness of an aircraft over its full life cycle. They comprise:
  - Scheduled information
  - Unscheduled information



# Instructions for Continued Airworthiness <sup>2/3</sup>

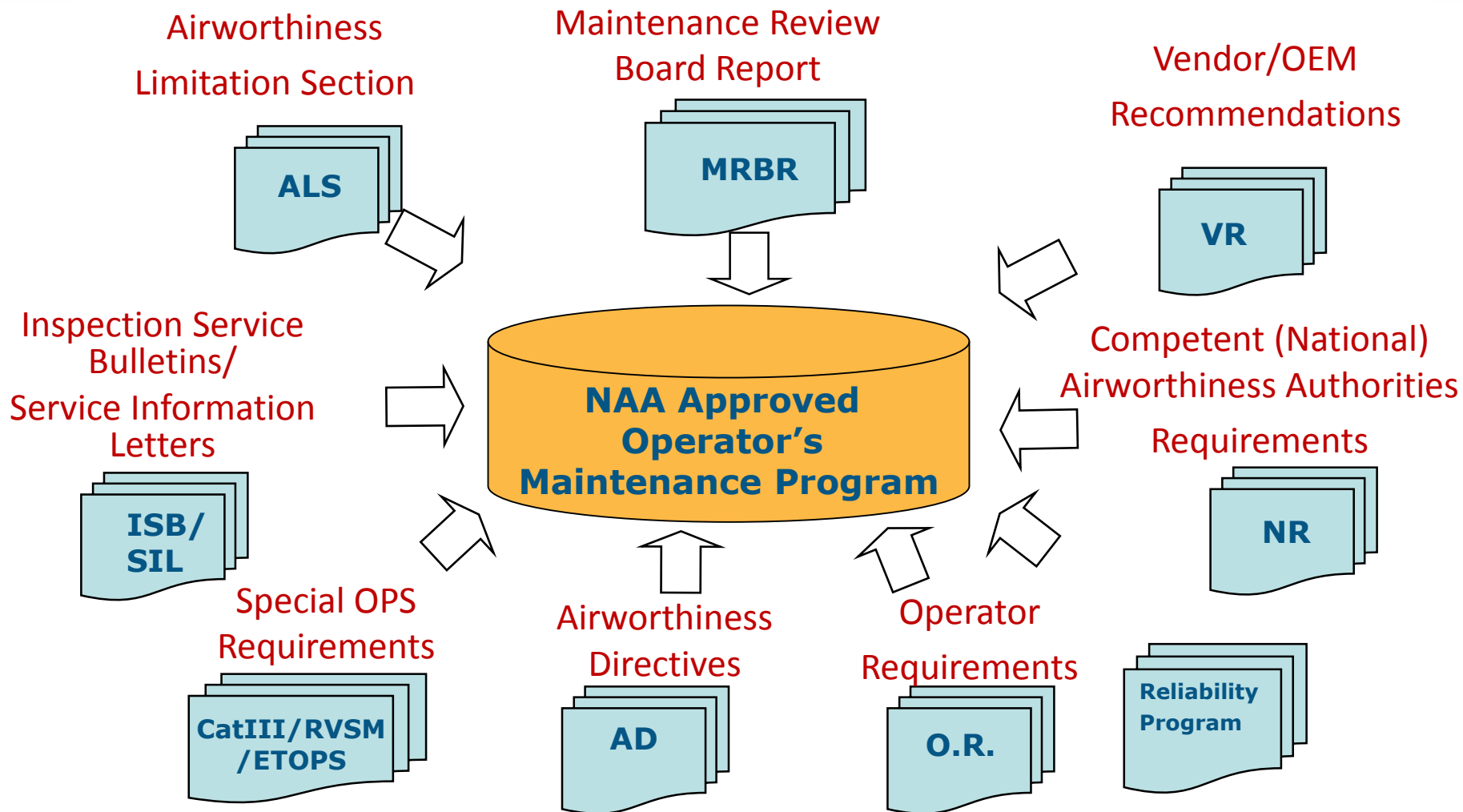
## Typical ICAs for Large Aeroplanes





# Instructions for Continued Airworthiness Aircraft Maintenance Programme

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- The **Maintenance Review Board (MRB) process** (with MSG-3 as a tool) is an acceptable **means of compliance (AMC)** to **develop scheduled maintenance instructions**.
- Further it has a close relationship with other requirements such as CS25.571, 25.1309, 25.1729.
- MRB process and MSG-3 tool are **recognized by major AA** (EASA, FAA, TCCA, CAAC, ANAC,....).
- MSG-3 logic is **owned by A4A**. It is an analytical methodology based on Reliability Centred Maintenance (RCM).
- MRB process and MSG-3 logic are reviewed and updated by a Maintenance Programs Industry Group (MPIG) and approved through the International MRB Policy Board (IMRBPB) (AAs).
  - ensures **standardisation and harmonisation of processes**.



- The MRB process ensures the objectives of an efficient aircraft maintenance program:
  - ➔ To prevent deterioration of the **inherent safety** and **reliability** levels of the aircraft at a **minimum total cost**.
- The MRB process requires a collaborative work, in order to combine knowledge and experience, between :
  - Customer airlines
  - Aircraft manufacturer
  - Airworthiness Authorities
- The final aim is to compile the Initial scheduled maintenance requirements in a document called Maintenance Review Board (MRB) Report draft which is acceptable to the Maintenance Review Board (MRB).





# MRB Process

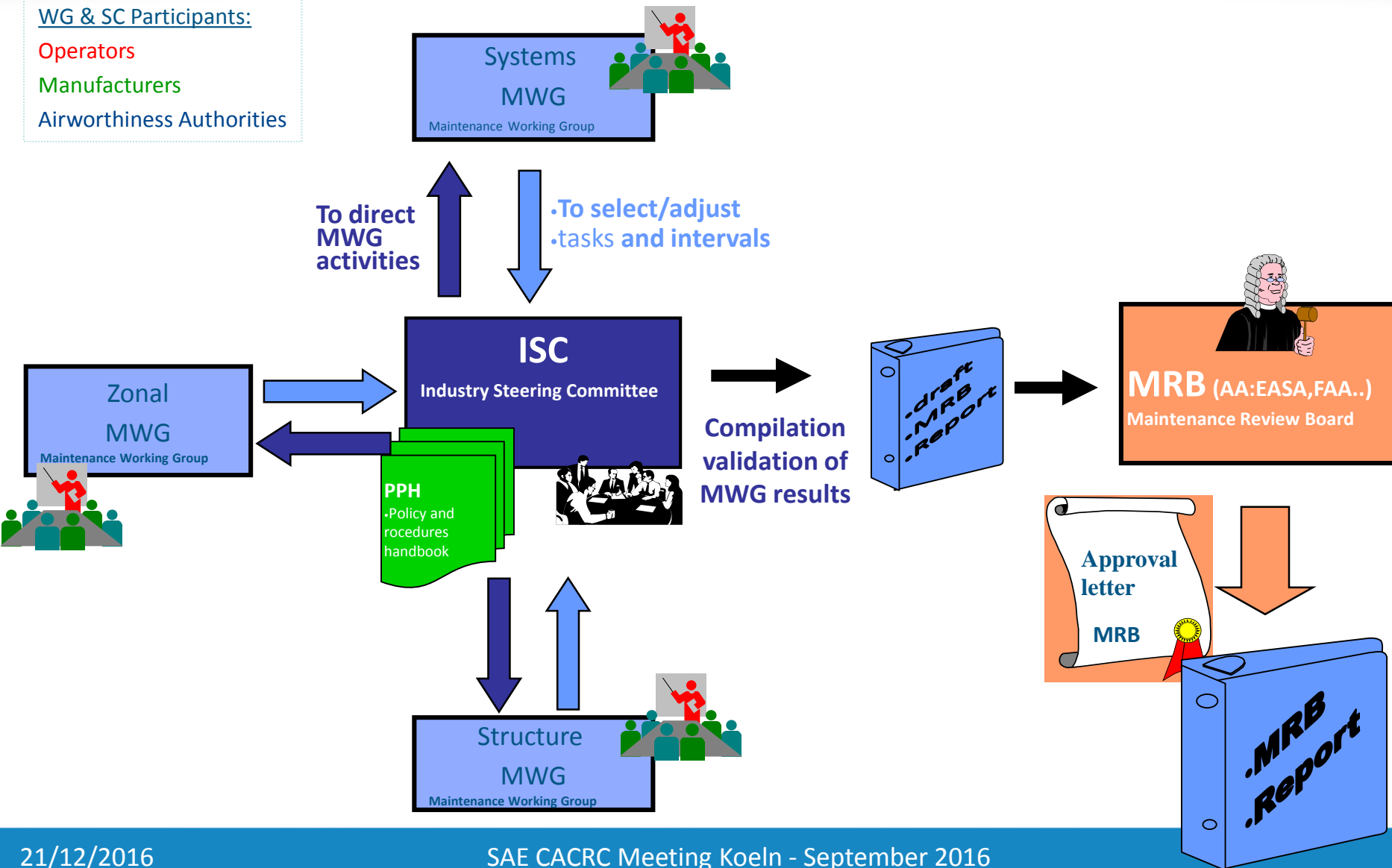
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WG & SC Participants:

Operators

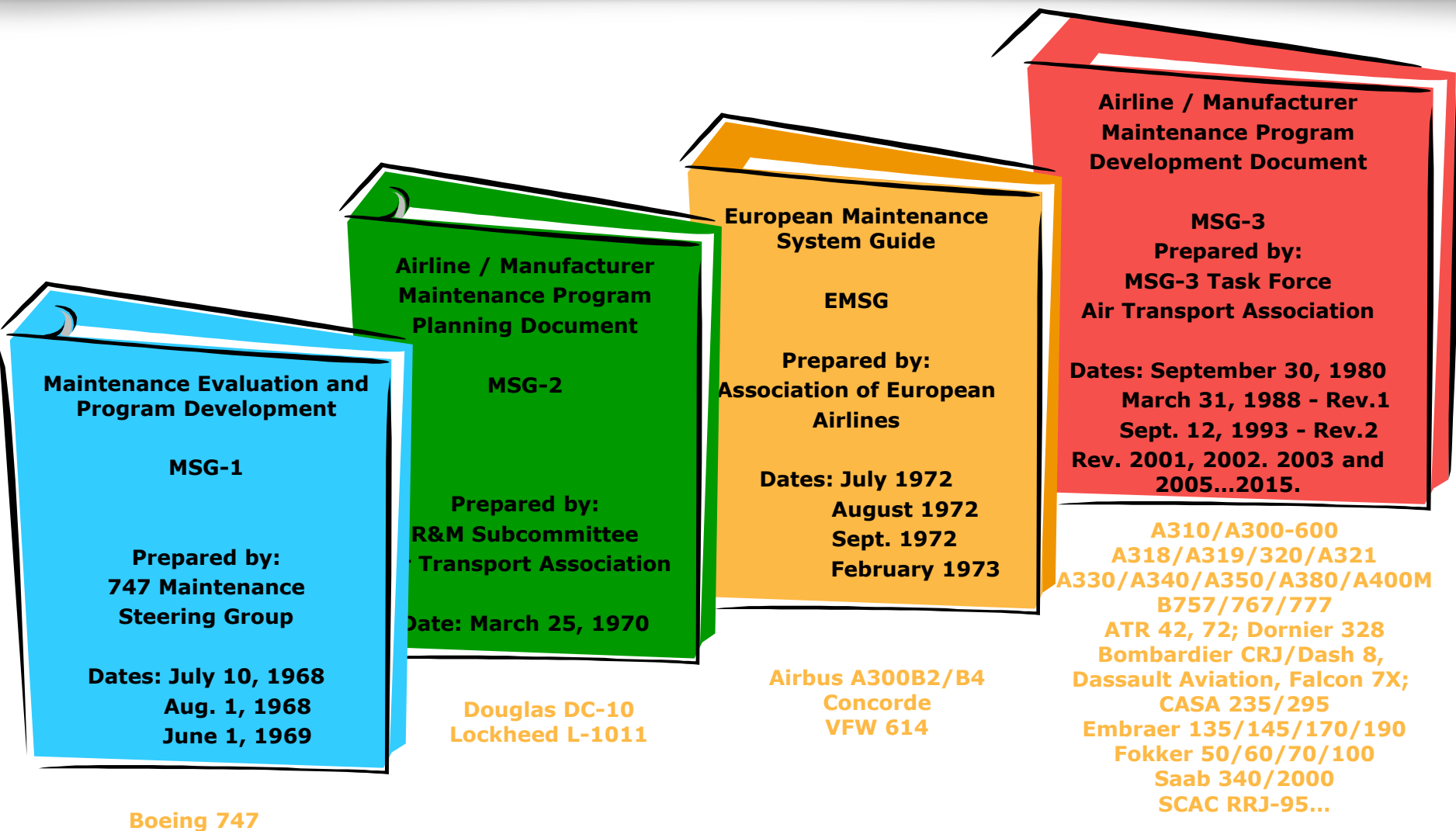
Manufacturers

Airworthiness Authorities





# History of MSG





# MSG-3 Logic

MSG-3 was written by the Maintenance Steering Group 3.

The working portions of the MSG-3 document are contained in four sections. Each of which has its own explanatory material and decision logic.

- ➔ Systems/Engine/APU
- ➔ Structures
- ➔ Zonal & Enhanced zonal
- ➔ L/HIRF

## Zonal Consolidation

For Rotorcraft, a volume 2 of MSG-3 document was introduced with revision 2013.1. This includes a supplemental analysis for Rotor/Drive systems.



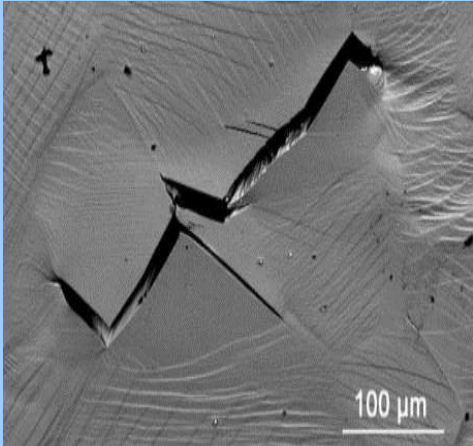
- The Structures Section of the MRB developed using the MSG-3 process contains all tasks needed to maintain the inherent safety and reliability levels of the aircraft structure
- This means timely detection of structural damage



# MSG-3 Logic Structures

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## Certification



Damage not detectable during maintenance

Strength not reduced below certification requirements (demonstrated)

## Maintenance



Damage detectable by visual inspection or non destructive testing (NDT)

Strength reduced, but temporarily acceptable

## Operations



Damage obvious

Airworthiness affected



Damage size





## Aircraft Structure

divided according to  
loads and consequence  
of failure

## PSE

Structure to be maintained to  
meet 25.571 requirement

(certification)

## SSI (Structure Significant Items )

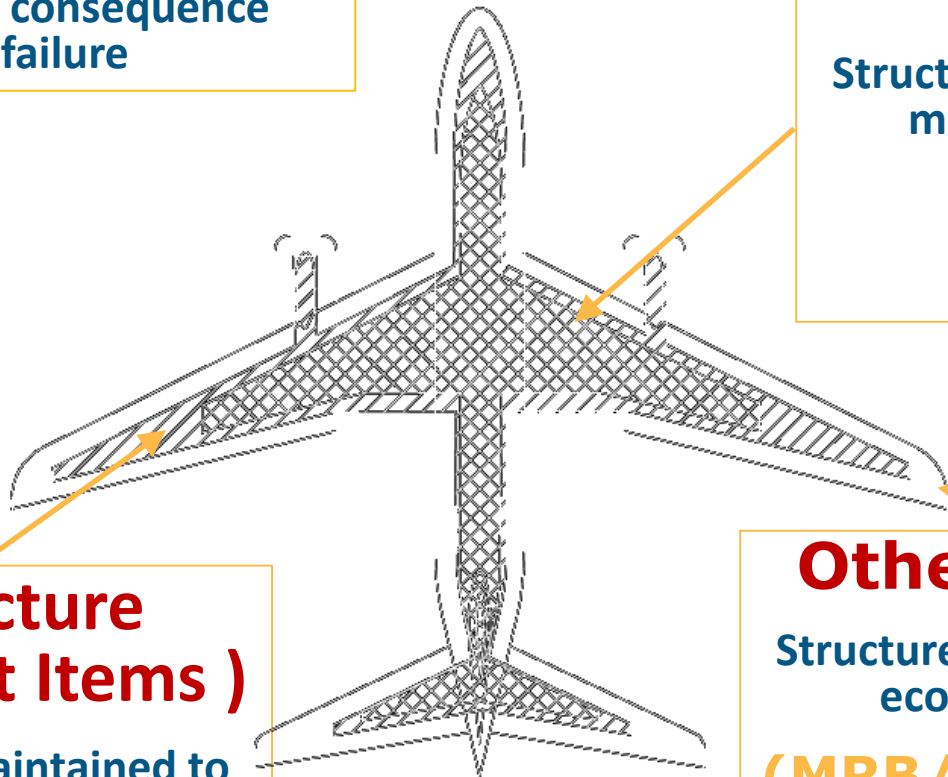
Structure to be maintained to  
ensure safety of the aircraft

(MRB)

## Other Structure

Structure to be maintained for  
economical reason only

(MRB/manufacturer)





## PSE

**Principal Structural Elements** are those which contribute significantly to carrying flight, ground, and pressurisation loads, and **whose failure could result in catastrophic failure of the aeroplane.**

responsibility of the  
certification  
team

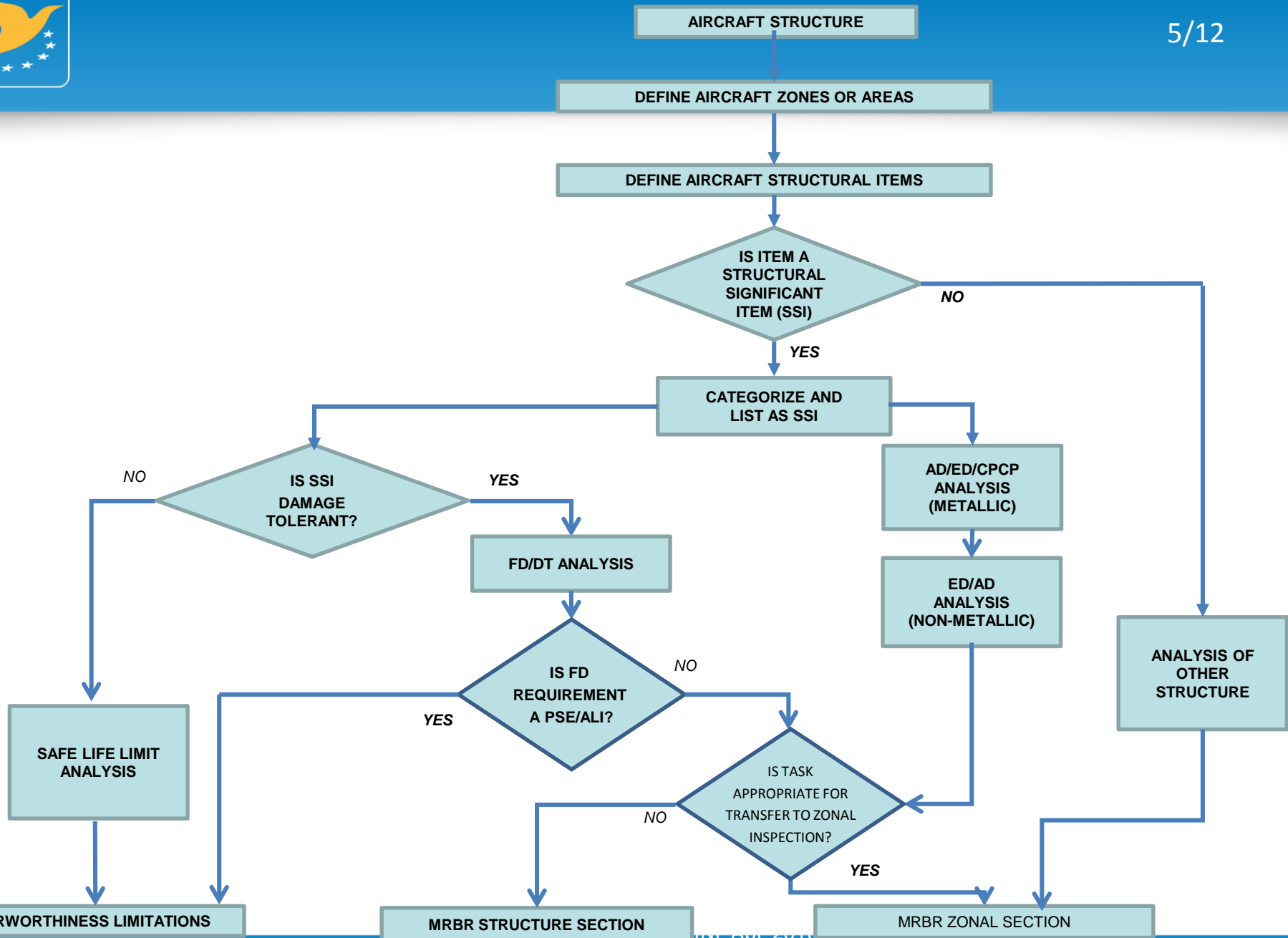
***catastrophic :***  
*failure which would result in multiple fatalities, usually with the loss of the aeroplane.*

## SSI

A **Structural Significant Item** is any detail, element or assembly, which contributes significantly to carrying flight, ground, pressure or control loads, and **whose failure could affect the structural integrity necessary for the safety of the aircraft.**

responsibility of the  
MRB Structures  
Working Group

***Safety*** shall be considered as adversely affected if the consequences of the failure condition would prevent the continued safe flight and landing of the aircraft and/or might cause serious or fatal injury to human occupants.







## Accidental Damage (AD)



Occurrence of a random discrete event which may reduce the inherent level of residual strength.



## Accidental Damage (AD)

- AD assessment of SSI takes into account probability and type of damage, as well as the effect on structural performance.
- AD assessment is carried out differently for
  - Metallic Structure
  - Composite Structure
- For Metallic Structure, the likelihood of AD, SSI visibility during scheduled maintenance, sensitivity to damage growth, estimated residual strength after AD are assessed in order to select the appropriate maintenance requirements. Some TCHs also consider the impact an AD may have on fatigue and surface protection.
- For Composite Structure, AD has an impact on static strength and surface protection.  
An AD inspection task will be developed to timely detect the reduction in inherent structural strength.  
The result of the AD analysis will also be taken into account for the ED task.



## Environmental Deterioration (ED) Metallic Structure



Structural deterioration as a result of a chemical interaction with its climate or environment. (corrosion)



## Environmental Deterioration(ED)

### Metallic structure

- The ED analysis for metallic structure will develop a task to assess the impact of :
  - Corrosion
  - Stress Corrosion
- Corrosion assessment will take into account the susceptibility to various kind of corrosion, material characteristics, surface protection and adverse operational environment.
- Stress Corrosion assessment will take into account also material susceptibility and presence of sustained tensile stress





## Environmental Deterioration (ED) non-metallic Structure



Structural deterioration (e.g. delamination and disbonding)  
due to heat, moisture,  
UV radiation, chemical interaction etc.



## **Environmental Deterioration(ED)** **non-metallic Structure (Aging)**

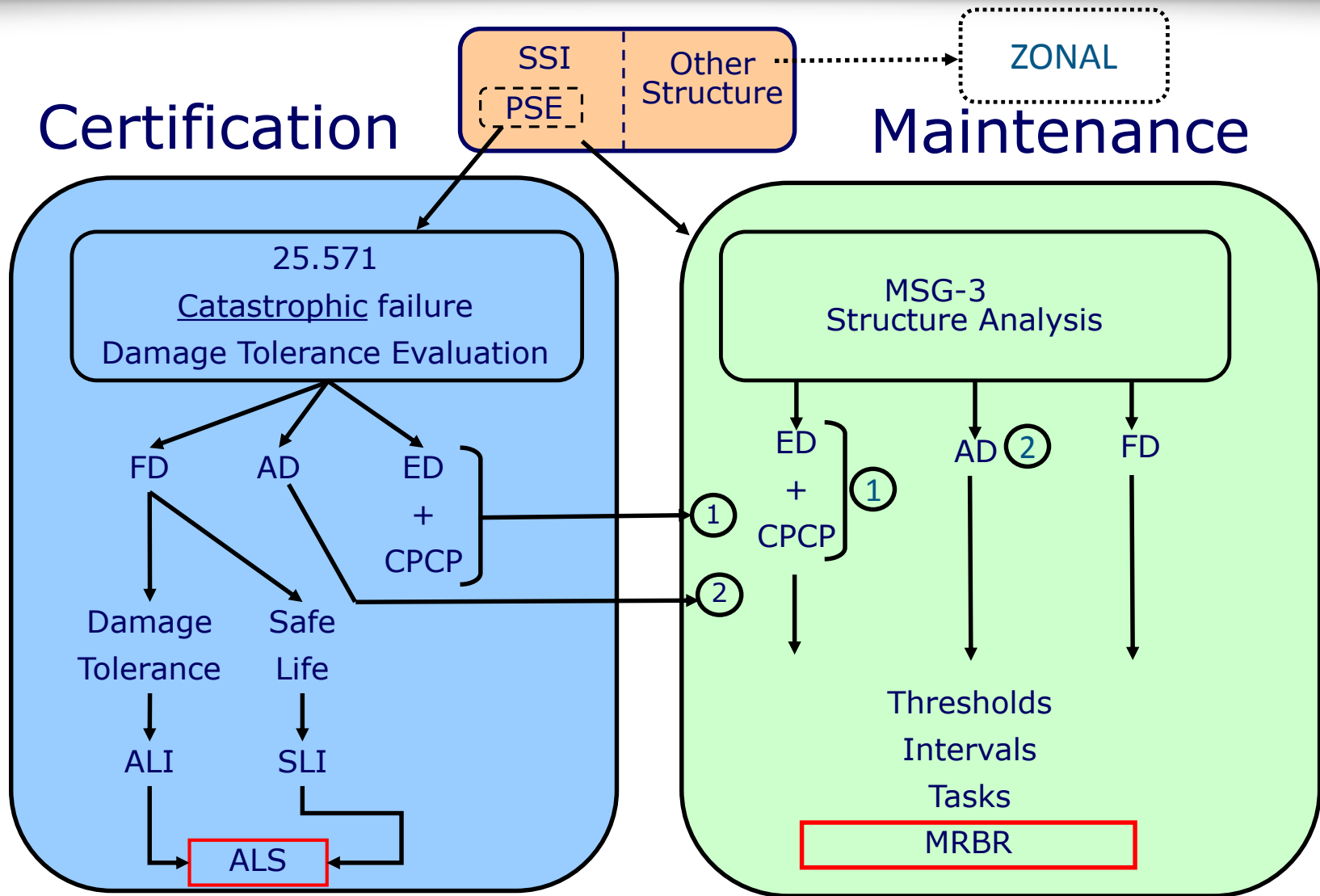
- Typically, composite structures are much more resistant against environmental effects, compared to metal.
- ED characteristics depend strongly on design
  - Sandwich structure
  - Monolithic structure
- Sandwich structure is especially prone to fluid ingress and subsequent disbond, driven by temperature- (freeze-thaw) or pressure-cycling. Such damage is typically not detectable by visual inspections and may cause complete failure of the SSI when grown to a critical size.
- Monolithic structure is much more robust, but ages due to the influence of UV-radiation, heat, moisture and aggressive fluids.



- According to MSG-3, the only maintenance tasks, which can be selected for structure are Inspections :
  - General Visual Inspection
  - Detailed Inspection
  - Special Detailed Inspection e.g. (Penetrants, Eddy Current (HFEC/LFEC), Ultrasonic, Sonic ('Tap Test'), Boroscope
  - Scheduled Structural Health Monitoring (if it satisfies the detection requirements).
  
- If the nature of the deterioration is systematic, structure task's intervals may have an initial threshold and then a different repeat interval when the task should be performed.
  
- If the source for deterioration is random, the interval is applicable from the beginning.



# Interfaces type certification (for Structure)<sub>1/3</sub>







To meet the accidental damage requirement of xx.571 (a)

- TC takes care of small, undetectable damage, which must not reduce structural strength below required limits, and of large damage due to unusual events (birdstrike, uncontained engine failure)
- MRB takes care of detectable damage typically found in service, which does reduce structural strength, and needs to be timely detected



To meet the corrosion requirement of xx.571 (a)

- TC takes care that an appropriate material selection and surface protection has been done
- MRB takes care that integrity of the surface protection is maintained and corrosion is controlled (CPCP)



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**End slide**

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