

Services & Support

EMBRAER Perspective on SHM Introduction into Commercial Aviation Programs

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Service & Support Development



Agenda



Introduction

- EMBRAER
- SHM applications on maintenance programs

Maintenance Program Development

Status of SHM on the MSG-3 Methodology

SHM Introduction into Scheduled Maintenance Programs

- MRB process / MSG-3 Methodology Familiarization
- Scheduled SHM (S-SHM) applications
- S-SHM Ground Support Equipment
- S-SHM as provisions for initial Automated SHM applications

Embraer – Business Areas



Defense Systems



Executive Aviation Market



Commercial Aviation Market

Introduction - Embraer Defense Systems

Super Tucano



AMX/A-1M



KC-390



EMB 145 Multi Intel
Airborne Ground Surveillance and
Strategic Intelligence

EMB 145 MP
Maritime Patrol

EMB 145 AEW&C
Airborne Early Warning & Control

Introduction - Embraer Executive Aviation

Phenom 100



Phenom 300



Legacy 450/500



Legacy 600/650



Lineage 1000



Introduction - Embraer Commercial Aircraft



ERJ 145 Family
(37 to 50 Pax)



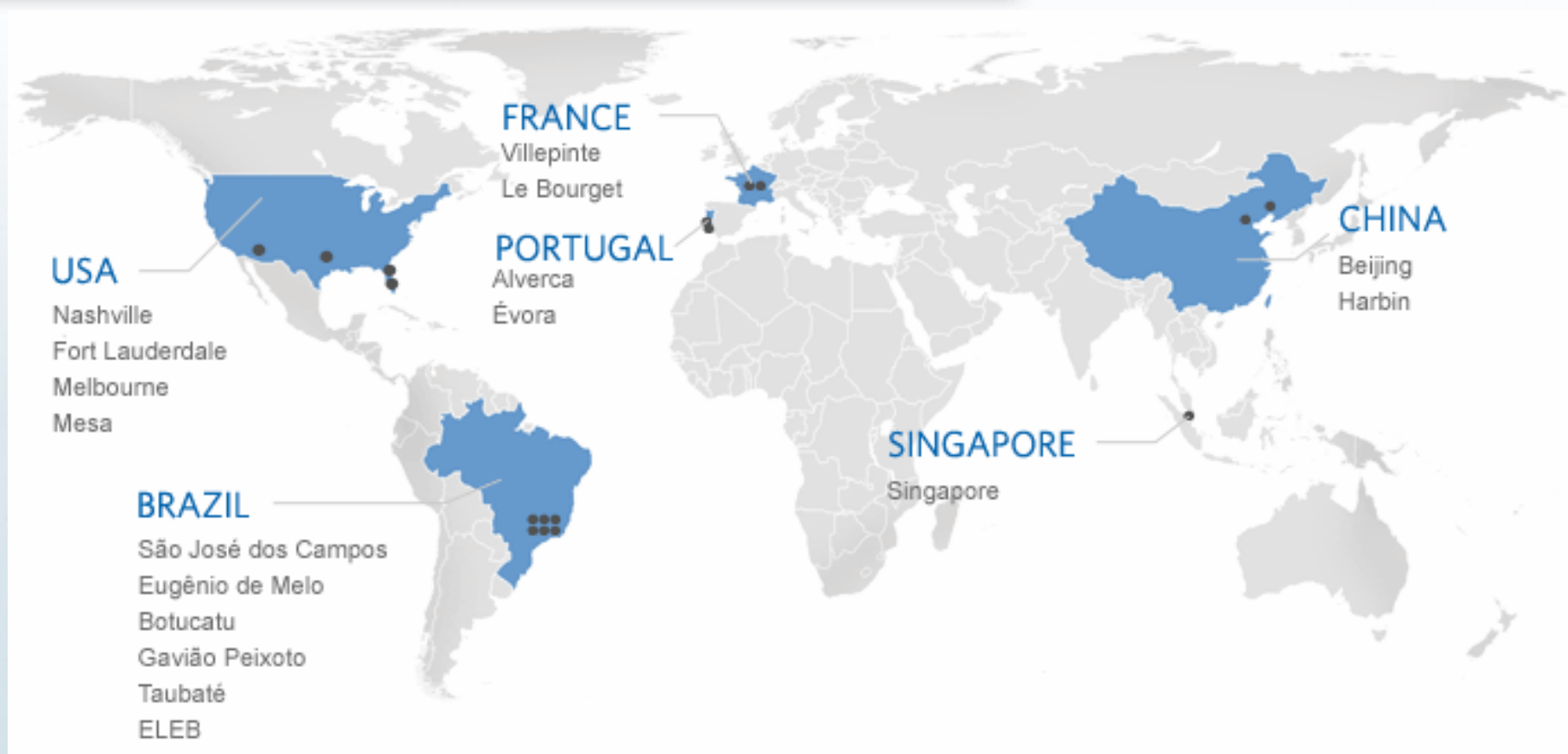
E-Jets Family
(70 to 122 Pax)

Introduction - Embraer

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Commercial Aviation

Introduction - Embraer

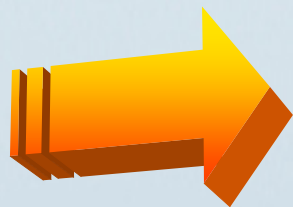


Commercial Aviation Backlog	Firm Orders	Options	Total	Deliveries	Firm Backlog
ERJ 145 Family	890	-	890	890	-
EMBRAER 170	190	32	222	182	8
EMBRAER 175	189	285	474	136	53
EMBRAER 190	519	305	824	349	170
EMBRAER 195	105	36	141	75	30
E-JETS Family	1.003	658	1.661	742	261
TOTAL	1.893	658	2.551	1.632	261

Introduction

2009 FAA & EASA accepted
SHM into Commercial
Aviation Maintenance Programs

2011



?

WHAT DO WE NEED?

Technical Feasibility

Consistent Business Case

Approved in a Certification Process

**Compatible with Continued
Airworthiness Requirements**

Acceptability by Operators



SUCCESSFUL

SHM

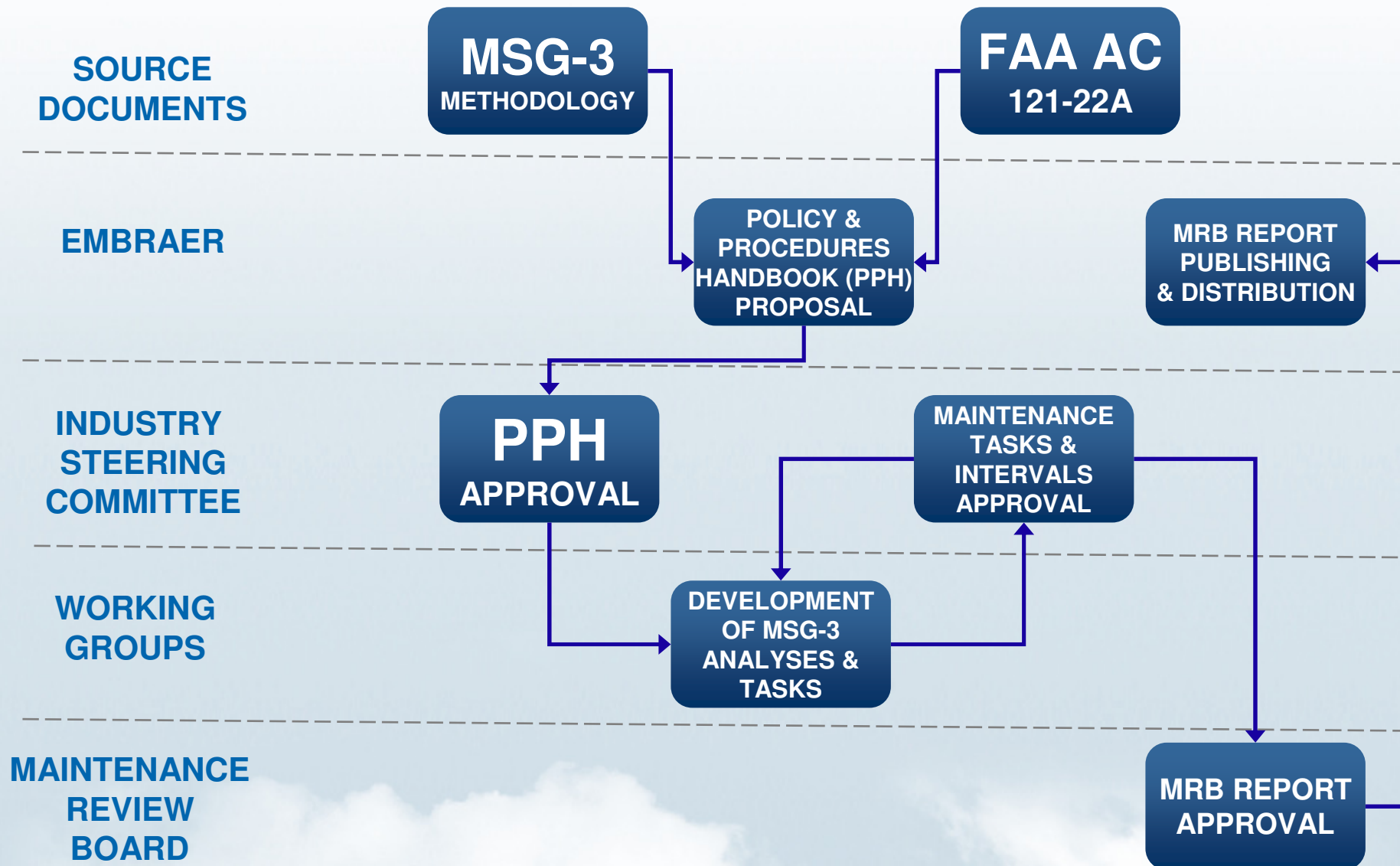
SOLUTION



[1] Derriso, M.M., S.E. Olson, M.P. DeSimio, D.H. Pratt, "Why are there few fielded SHM for Structural. Health Monitoring" 6th International Workshop on Structural Health Monitoring, Stanford CA, Sept 11, p55, 2007

[2] Munns, Thomas E., R.E. Beard, A.M. culp, D.A. Murphy, R.M. Kent, 2000. Analysis of Regulatory Guidance for Health Monitoring. NASA / CR-2000-210643, 6: 56.

Maintenance Program Development

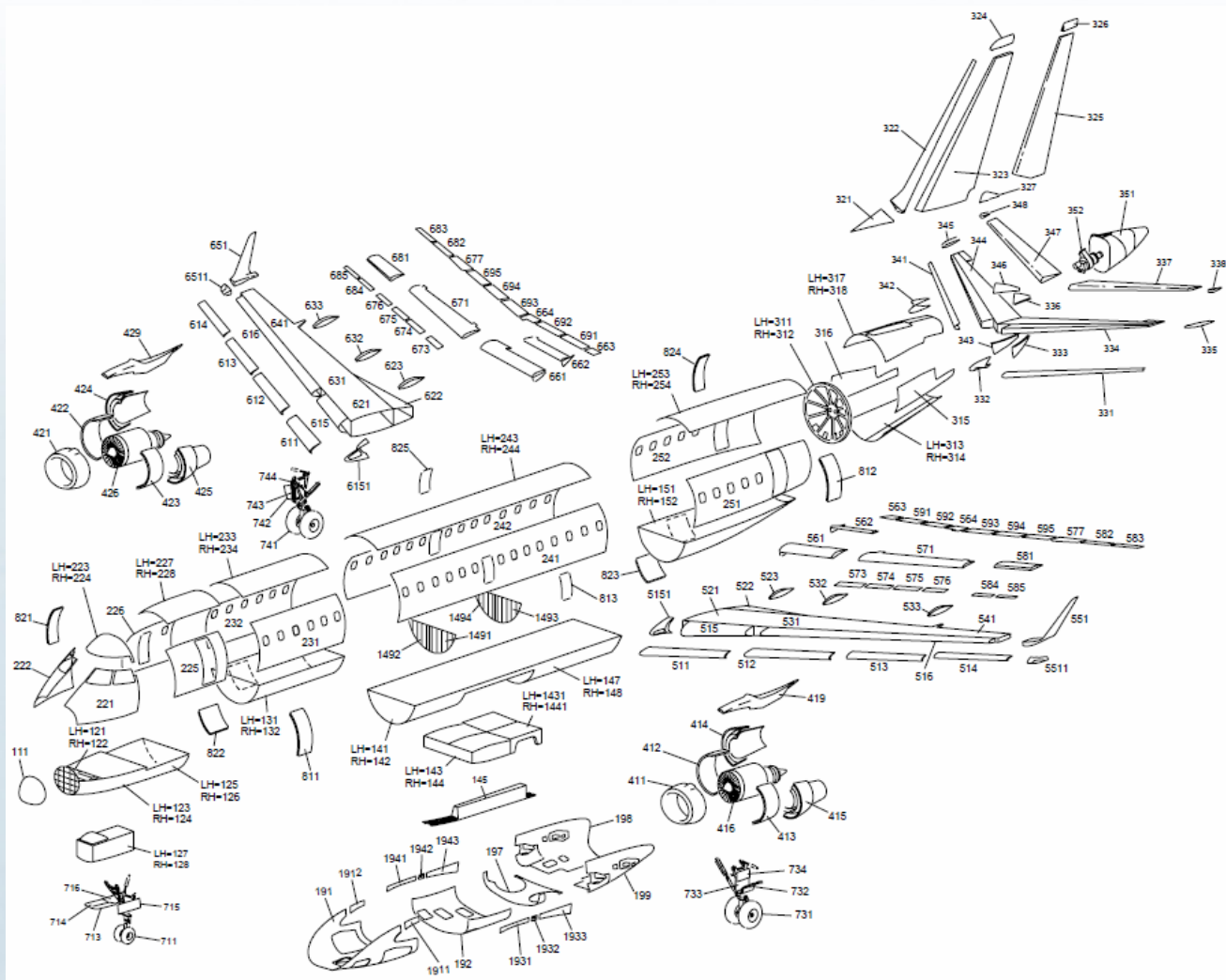


Maintenance Program Development

Section 1
System &
Powerplant
Mainten.
Requirem.

Section 2
Structural
Mainten.
Requirem.

Section 3
Zonal
Mainten.
Requirem.

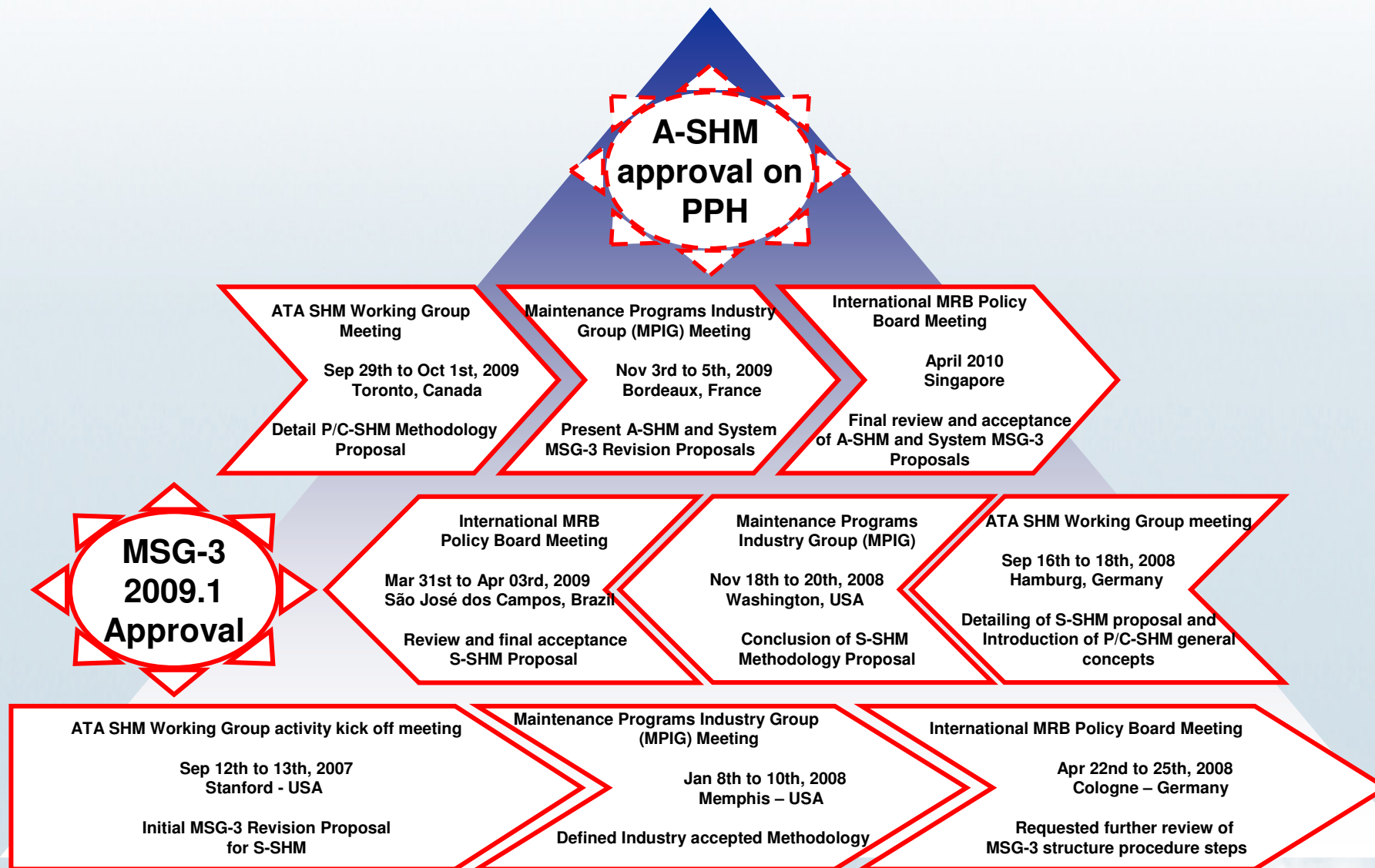


Section 4
Corrosion
Prev. &
Control
Mtx Req.

Appendix 2
Airworth.
Limitation
Items (ALI)

**Other
Sections
&
Appendixes**

Status of SHM on the MSG-3 Methodology



Status of SHM on the MSG-3 Methodology

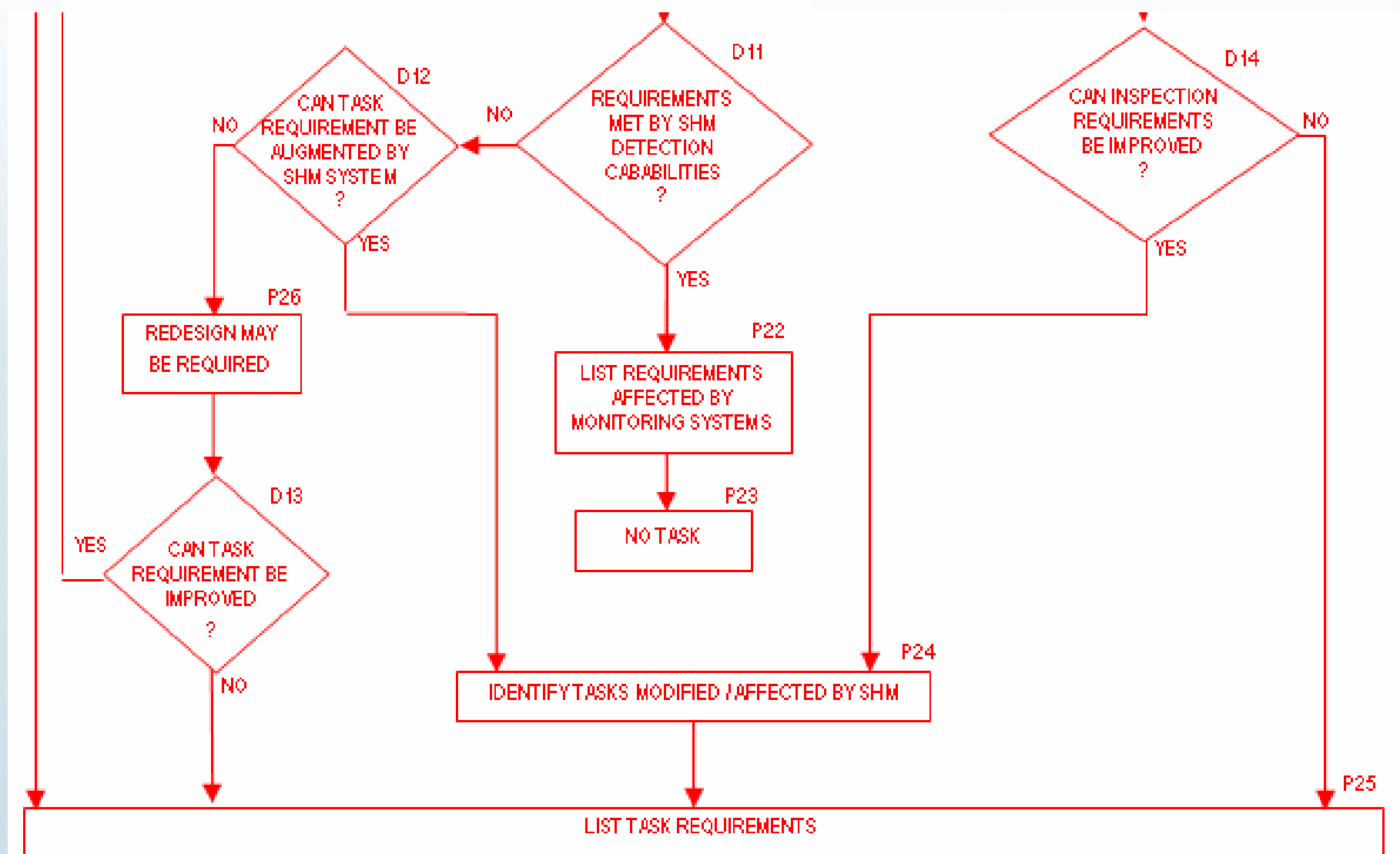
MSG-3 Methodology Revision 2009.1 (current)

- Scheduled SHM (S-SHM) - “the act to use/run/read out a SHM device at an interval set at a fixed schedule”.
- S-SHM as new maintenance task category: alternative for current inspections

International MRB Police Board Issue Paper 105

- Automated SHM (A-SHM) - any SHM technology, which does not have a pre-determined interval at which maintenance action much takes place, but instead relies on the system to inform maintenance personnel that action must take place.
- SHM technology types
 - i. Damage Monitoring System – It uses sensors to directly monitor the structure for deterioration conditions.
 - ii. Operation Monitoring System - It uses sensors, which do not directly check the structure for damage, but instead correlate various measurements (e.g. environment conditions, loads) to make an inference to the probability or likelihood of damage.
- Once a SHM system design is demonstrated to be applicable and effective, it may be used to ensure inherent airworthiness of the item being monitored and traditional inspection task selection may not be appropriate.
- When an A-SHM system is used to monitor structure which has maintenance/inspection requirements, appropriate transfer policies should be used to show that the intent of the damage detection (ED/AD/FD) requirement is being satisfied by the monitoring system. This process takes place after the development of the Structures Requirements described previously in this section.

Status of SHM on the MSG-3 Methodology



Introduction of SHM on Scheduled Maintenance



EMBRAER 190

MAINTENANCE REVIEW BOARD REPORT

MRBR Task Number	Zones	Type Category	Title Description Note Access Panels	Applicability	Interval (I: Interval, T: Threshold)
55-20-001-0407	337 347	S-SHM	ELEVATOR STRUCTURE - INTERNAL <i>Inspection of Elevator Structure, LH/RH, by using Structures Health Monitoring equipment – Internal Side of Elevator</i>	ALL	T: XX MO I: YY MO
55-20-002-1000	337 347	DET	ELEVATOR HINGE AND ACTUATOR FITTINGS - INTERNAL <i>Detailed Inspection of Elevator Hinge and Actuator Fittings, LH/RH - Internal Side at Rear Spar and Elevator Area.</i>	ALL	T: FC I: FC
55-20-004-0406	337 347	GVI	ELEVATOR FRONT SPAR FORWARD FACE, LH/RH - INTERNAL <i>General Visual Inspection of Elevator Front Spar Forward Face, LH/RH - Internal</i>	ALL	T: FC I: FC

Introduction of SHM on Scheduled Maintenance - Example 1

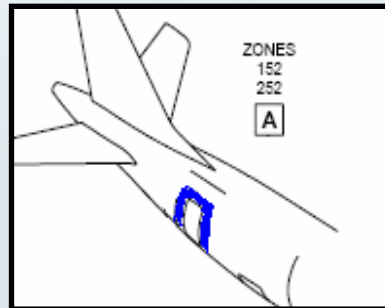
Internal Visual Inspections of rear passenger and service doors cutout structures

What is the issue with current maintenance requirements for this region?

Galley, Lavatory and linings removal

Current Mtx Requirement

To inspect every 5000 FC for fatigue damage (threshold of 20000 FC) & every 12000 FC for corrosion



With SHM (fatigue)

To inspect every 12000 FC for corrosion

BENEFITS

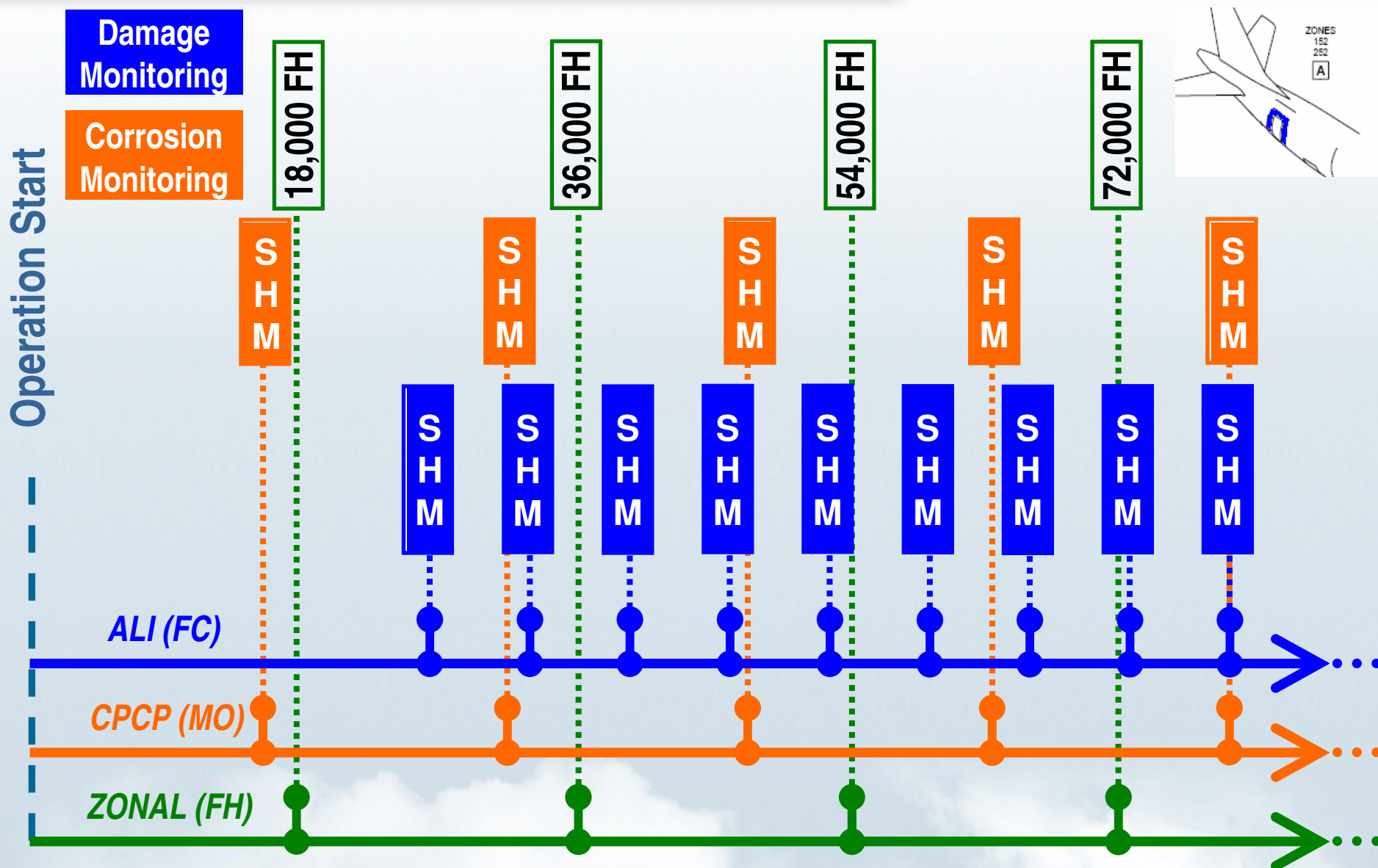
Reduction of 120 Man-hours (MH) every 12000 FC

If SHM also covers corrosion, MH reduction every 12000 FC would be >250 hours

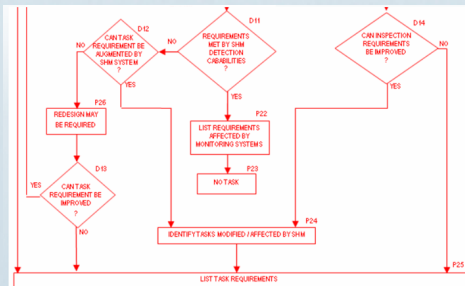
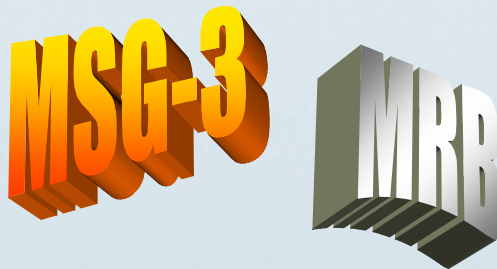
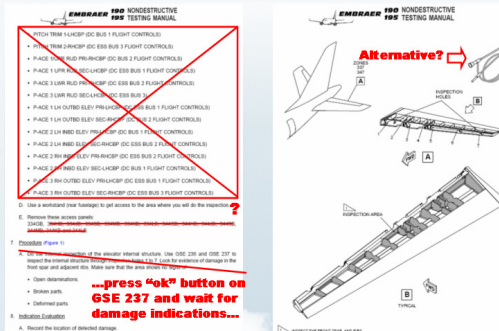
Elimination of maintenance induced problems

Higher aircraft availability (lower downtime means more revenue flights)

Introduction of SHM on Scheduled Maintenance - Example 1



SHM Introduction into Scheduled Maintenance Programs



A blue graphic with white text and stars. At the top, three small tabs are visible: "SOURCE DOCUMENTS", "MSG-3 METHODOLOGY", and "FAA AC 121-22A". The main text reads "FAMILIARIZE YOURSELF WITH MSG-3 MRB MAINTENANCE RULES" in large, bold, white capital letters. The text is flanked by four white stars on each side.

SHM Introduction into Scheduled Maintenance Programs



★ ★ ★ ★

START WITH
SIMPLE
S-SHM
SOLUTIONS

★ ★ ★ ★

SHM Introduction into Scheduled Maintenance Programs



FRAGILE



**HEAVY
DUTY**

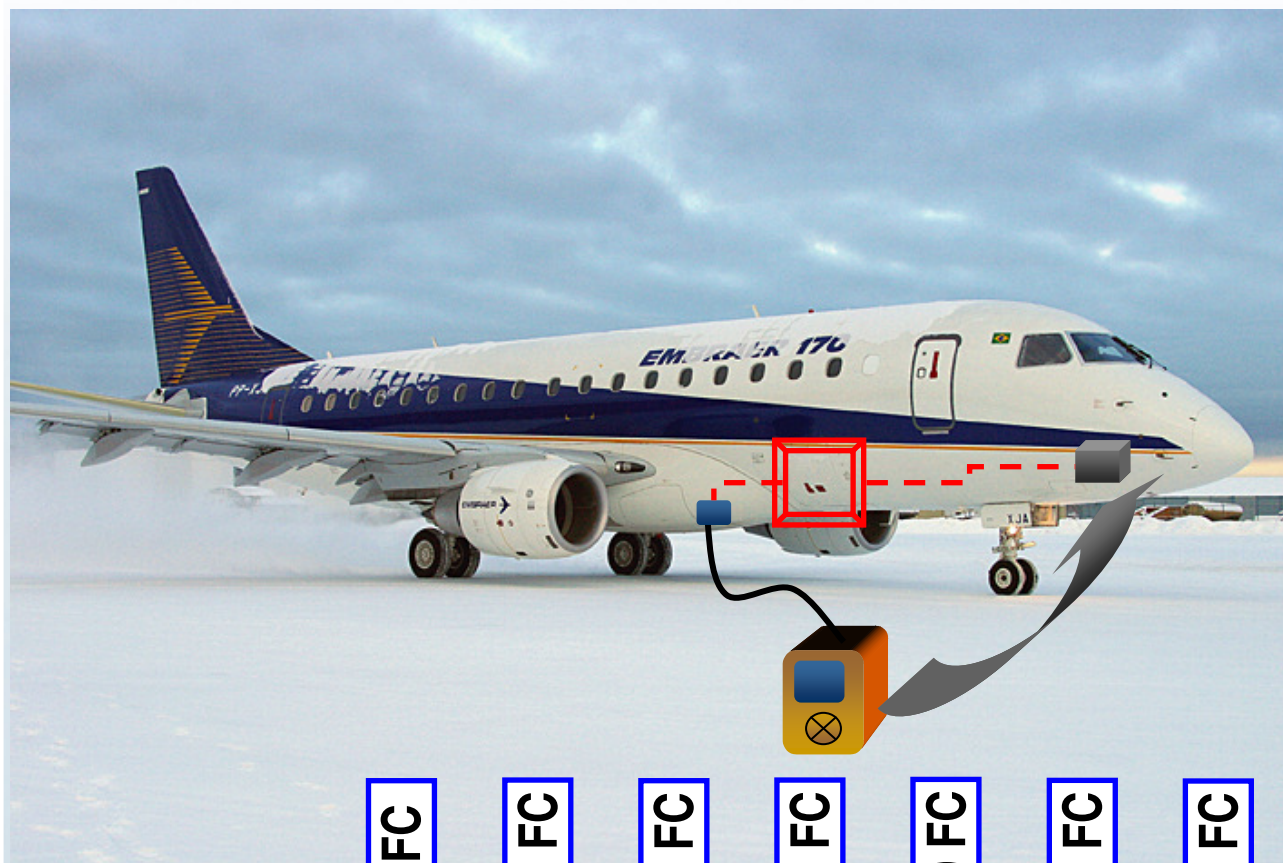


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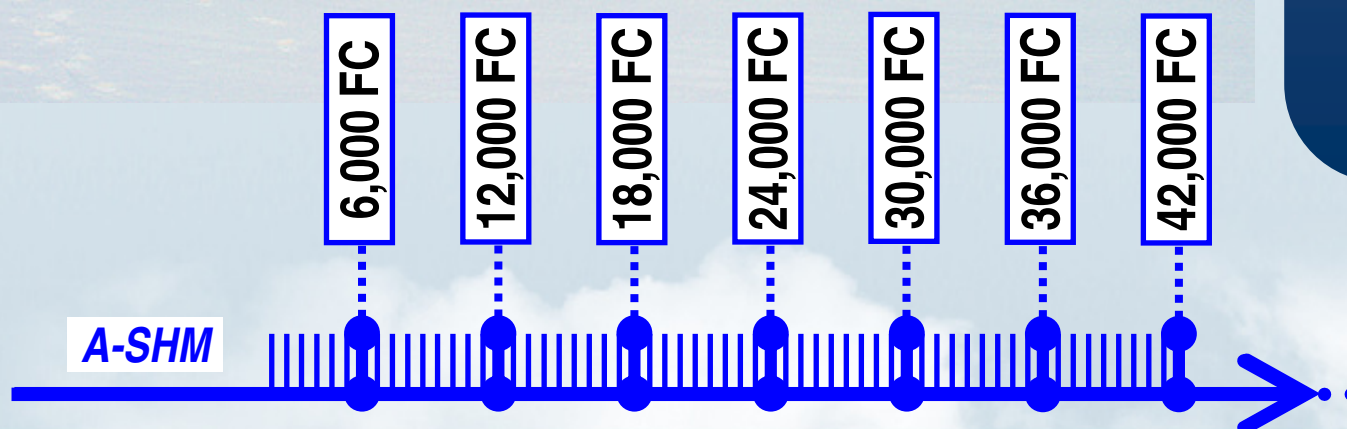
**AFFORDABLE
LIGHT
RESISTENT
SIMPLE
GSE**

★ ★ ★ ★

SHM Introduction into Scheduled Maintenance Programs



★★★★
S-SHM
AS
PROVISIONS
FOR INITIAL
A-SHM
★★★★



Thank You

