

International Maintenance Review Board Policy Board (IMRBPB)

Issue Paper (IP)

IP Number: CIP EASA 2020-05

Initial Date: (DD/MMM/YYYY)

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Retroactivity (Y/N): N

Title:	Analysis of bonding devices in MSG-3
Submitter:	EASA

Applies To:	
MSG-3 Vol 1	X
MSG-3 Vol 2	X
IMPS	

Issue:

Clarification on how to select and analyse bonding devices in MSG-3, highlighting the aspect of redundancy as mitigating aspect typical for those devices.

Problem:

Analysis of bonding devices (e.g. bonding straps, bonding jumpers) in MSG-3 is not harmonized among programmes and often not performed for all devices (e.g. limited to airframe bonding devices, but not for the engine; limited to equipment bonding but not for structures bonding).

In-Service experience (e.g. during Zonal Escalation Exercises, SDR databases) show an enormous number of findings, demonstrating that there is significant *potential for degradation* of such devices. It also demonstrates, that often the Zonal GVI are adequate to find failed bonding devices, but not to find deteriorated bonding devices.

Existing guidance material is inconsistent with respect to bonding devices, for example:

- AC25-27A
22. Lightning/High Intensity Radiated Field (L/HIRF) Protection - The protection of airplane electrical systems and structure from induced voltages or currents by means of shielded wires, raceways, **bonding jumpers**, connectors, composite fairings with conductive mesh, static dischargers, and the inherent conductivity of the structure; may include airplane specific devices, for example, radio frequency (RF) gaskets.

Meaning: Bonding devices are **L/HIRF** (to be covered by MSG-3 L/HIRF analysis)

- 25.1701 Definition.
(a) As used in this chapter, electrical wiring interconnection system (EWIS) means any wire, wiring device, or combination of these, including termination devices, installed in any area of the airplane for the purpose of transmitting electrical energy, including data and signals, between two or more intended termination points. This includes:
(6) Electrical grounding and **bonding devices** and their associated connections.

Meaning: Bonding jumpers are **EWIS** (to be covered by MSG-3 EZAP analysis)

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A DET is an intensive examination of a specific item, installation, or assembly to detect damage, failure, or irregularity. Available lighting is normally supplemented with a direct source of good lighting at an intensity considered appropriate. Inspection aids, such as mirrors, magnifying lenses, or other means, may be necessary. Surface cleaning and elaborate access procedures may be required. A **DET** can be more than just a visual inspection. It may include tactile assessment to check a component or assembly for tightness and security. **Such an inspection may be needed to ensure the continued integrity of installations such as bonding jumpers**, terminal connectors, etc.

Meaning: Bonding devices may **not** be adequately covered by Zonal GVI

- AC25-27A

c. EWIS-Related Guidance for Zonal Inspections. The following EWIS degradation conditions are **typical of what should be detectable and addressed as a result of a zonal inspection** (as well as a stand-alone GVI). Maintenance and training documentation should include these items. This list is not intended to be all-inclusive and may be expanded as appropriate.

(5) **Bonding braid/bonding jumper.**

- Braid broken or disconnected
- Multiple strands corroded
- Multiple strands broken

Meaning: Bonding jumpers should **be** adequately covered by Zonal GVI

In many recent projects, the list of L/HIRF protection components as required by MSG-3 2-6-1.3 Step 1 has been found to be incomplete, many bonding devices have been missed. TCH did claim, that those components were not for lightning or HIRF protection, but for example for protection against static electricity. Often the MSG-3 L/HIRF protection components selection has been limited to those items required for compliance with 25.1317 *Electrical and Electronic System HIRF protection*, and have been limited to the airframe only (e.g. not considering L/HIRF protection components of the engine)

EASA therefore performed a full review of the CS-25 and the related administrative and guidance material for paragraphs mentioning bonding.

Result: Any paragraph of CS-25 which mentions bonding devices is either linked to lightning or HIRF or both. **Any bonding device on a large transport airplane is linked to L/HIRF**, no matter whether it is linked to *Lightning protection (25.581)*, *Electrical bonding (25.899)*, *Fuel System lightning protection (25.954)*, *Electrical and Electronic System lightning protection (25.1316)*, *Electrical and Electronic System HIRF protection (25.1317)*, *Electrical equipment and installation protection (25.1353)* or *Fuel tank flammability design precautions (25.981)*.

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The MSG-3 EZAP analysis focuses on the risk that deteriorated EWIS may cause a fire in combination with the accumulation of combustible materials. For Bonding devices their loss of protective function is the critical issue, not the fact that they could start a fire. The EZAP analysis is not taking into account redundancy, as it focuses on risk, not on loss of function. It also links the required maintenance to the presence of combustible materials, which is totally irrelevant for bonding devices. Therefore, **the EZAP analysis is not adequate to cover such bonding devices.**

MSG-3 already mentions since the 2001 revision in paragraph 2-6.1.b ***bonding jumpers*** as an example for *External On Aircraft L/HIRF Protection Components* to be covered by the L/HIRF logic, it seems from experience with recent projects however to be unclear to which extend all the bonding devices found on the aircraft have to be considered in the LHSI selection.

Recommendation (including Implementation):

All bonding devices should be covered through chapter 2-6-1 of MSG-3 and considered in the LHSI selection, independent of the paragraph of the certification requirements it is linked to.

All bonding devices should be part of the LHSI selection list in accordance with MSG-3 2-6-1.3 Step 1, this should not be limited to the airframe or to electric/electronic systems, but cover the full aircraft including landing gear, engines, propellers, APU etc.

The MSG-3 L/HIRF analysis allows to appropriately group items for analysis, adequately assess the risk of and potential for deterioration of bonding devices, takes into account redundancy, good proven performance, detectability of degradation during Zonal inspections, need for disassembly and allows to select appropriate maintenance tasks and intervals if required.

The aspect of redundancy in the assessment of *unacceptable degradation* (previously covered by the *common mode* aspect in the 2011 L/HIRF logic) should be clearer mentioned. Especially when analysing bonding devices, there is typically multiple redundancy, which is a mitigating factor that allows to accept single obviously failed protection components detectably by zonal GVI which eliminates the need for a dedicated L/HIRF task. Currently MSG-3 is not highlighting this aspect, Step 8 might be understood to address deterioration of single individual protection items and not deterioration of the overall protection provided by multiple protection components.

If there is LHSI redundancy (e.g. one bonding strap per hinge point for a single control surface or door) which allows for a total failure of single components without losing the overall protection, this situation may still be *acceptable* and it may not be required to have a dedicated task to detect degradation, if the total loss of single components would be an obvious failure detectable by the Zonal inspections.

The idea of the CIP is not to create a lot of new tasks, but just to make sure that all L/HIRF protection components are adequately covered in the MRBR.

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Amend MSG-3 2-6-1.3 as follows:

Step 1: Identify L/HIRF Aircraft Protection by location

Using a process acceptable to the certifying authority, OEM Design Engineering specialists will identify and list L/HIRF protection components ~~relating to all systems and structural components required~~ that protect systems or structures from direct or indirect lightning effects and/or from the effects of high intensity radiation fields (HIRF) as addressed by the applicable certification requirements and related guidance material to maintain the inherent safety of the aircraft. Additional protection components can be added to the list at the discretion of the MSG-3 analyst or Working Group, e.g. to cover operational or economic effects. The aircraft protection components shall be identified by location on the aircraft.

Step 8: Assess component degradation modes and mitigations

An assessment process will be developed by the OEM and utilized by the working group to determine if there is a potential for unacceptable degradation of the protection components (including mitigation) due to ED/AD. Such mitigation within the installed environment may eliminate requirement for dedicated maintenance. This assessment may also take into account potential redundancy of multiple, independent protection components which with respect to L/HIRF protection, would make the total loss of single protection components an acceptable degradation detectable by Zonal inspection.

Amend MSG-3 Appendix A as follows:

L/HIRF Significant Item

Lightning/HIRF Significant Items (LHSIs) address L/HIRF protection components determined by the OEM Design Engineering specialists as those that protect systems / structure whose failure would affect the inherent safety levels of the aircraft. The scope of each LHSI is defined by the MSG-3 analyst. LHSIs may also address operational or economic considerations determined significant by the MSG-3 analyst.

LHSIs will include all of these significant aircraft system or structural Lightning/HIRF protection components or groups of components in an installed environment. Components that make up LHSIs are selected using engineering judgement based on the anticipated consequences of the protection component degradation.

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Typical protection components may include bonding jumpers, connectors, and embedded mesh in structural panels.

NOTE:

All L/HIRF protection components that protect systems ~~or~~ structures from direct or indirect lightning effects and/or from the effects of high intensity radiation fields (HIRF) as addressed by the applicable certification requirements to maintain the inherent safety of the aircraft as identified by OEM Design Engineering must be addressed in an LHSI. Other L/HIRF protection components e.g. those installed for economic or operational reasons may be included by the MSG-3 analyst or Working Group as desired and accepted by the ISC.

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IMRBPB Position:	
Date:	
Position:	
Recommendation for Implementation:	

Status of the Issue Paper:	<input type="checkbox"/>	Active
	<input type="checkbox"/>	Incorporated in MSG-3 / IMPS (with details)
	<input type="checkbox"/>	Archived