



EASA
European Aviation Safety Agency

PED Tolerance Demonstration

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Issue 1

STC WORKSHOP
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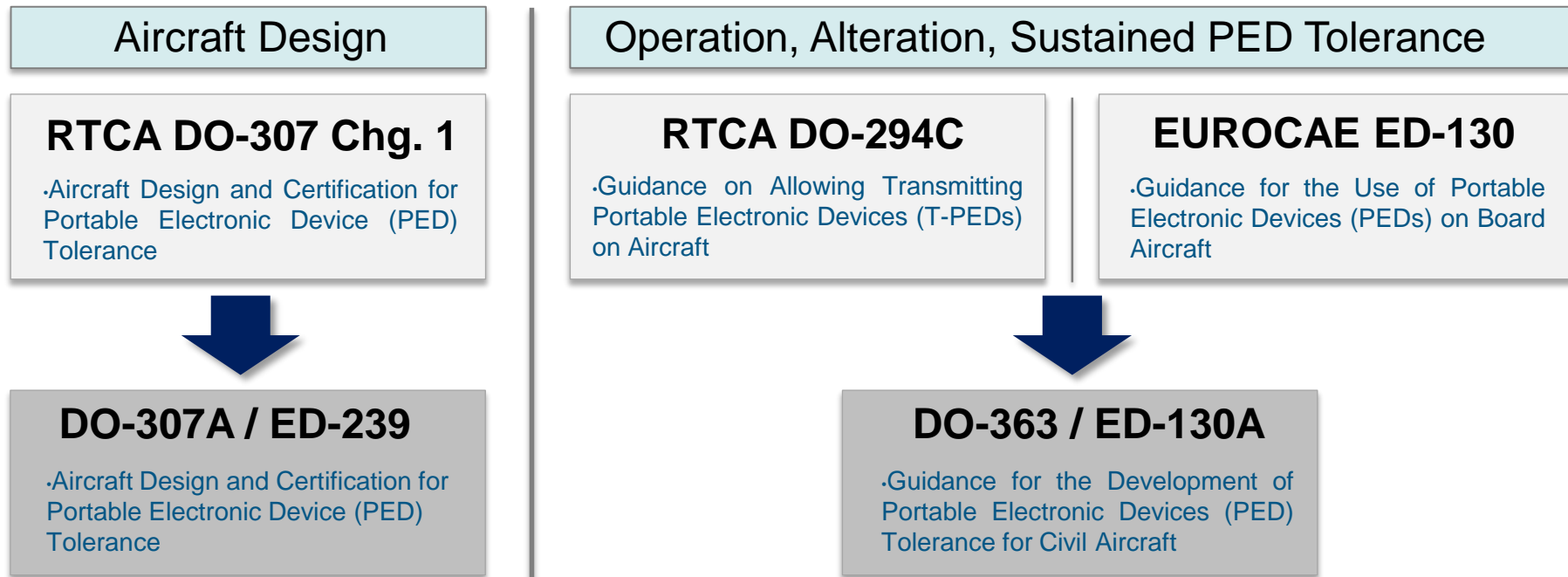
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Introduction

- EUROCAE WG-99/ RTCA SC-234 published on Dec 2016 updated guidelines to demonstrate an aircraft to be PED tolerant



EASA CM ES-003 about to be published endorsing the updated documentation!
AMC1 CAT.GEN.MPA.140 allows to use later revisions for OPS evaluations



Identification of the Issue

RF energy radiated by PEDs may potentially be a source of interference:

- if it induces unwanted responses by direct coupling into an aircraft electronic equipment (back door coupling) – PEDs intended emissions
- if it falls in the frequency range of the communication and navigation systems (front door coupling) – PEDs spurious emissions

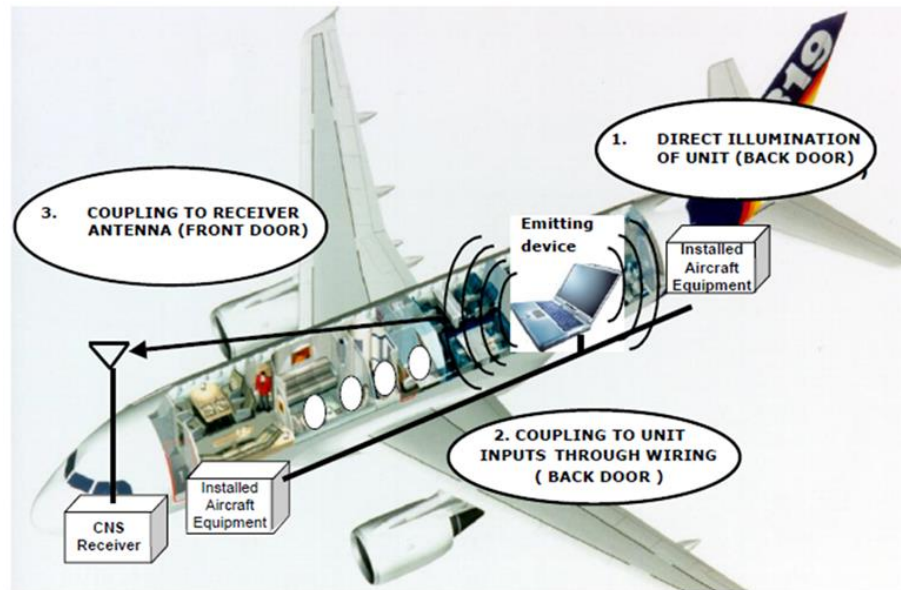


Figure 5-2 Depiction of Front-door and Back-door Coupling

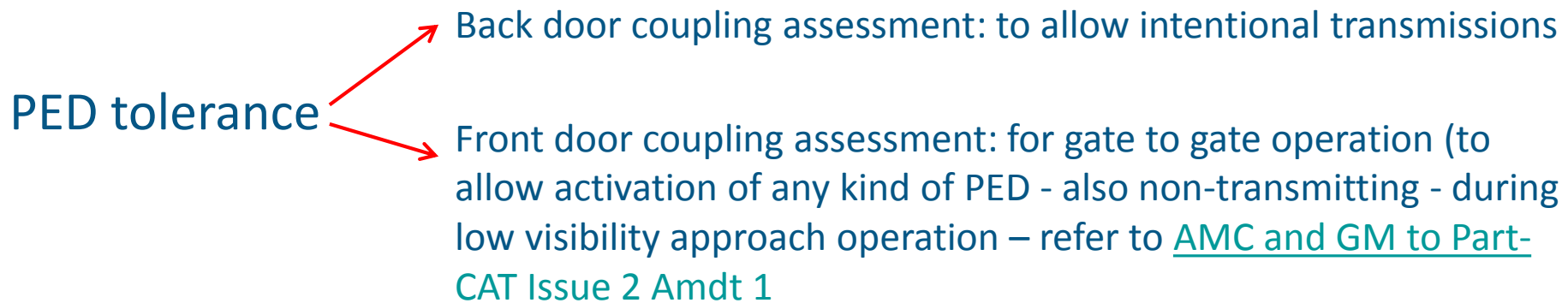


EASA Requirements

STC applicants certifying a WLAN or On Board Mobile Telephone System are required to demonstrate PED tolerance for the wireless technologies that will connect with the system installed – a limitation in the use of other wireless technologies not demonstrated to be compatible is necessary.

If all or part of the wireless system can be active during critical flight phases (such as take-off and landing, etc.), particular attention should be paid to the non-interference demonstration during these phases of flight -> front door coupling required

TC applicants can also certify an aircraft as PED tolerant to help the operators to get the allowance on the use of PEDs on board



Note: Critical phases of flight => low visibility approach operation. The OPS regulation is more precise and the focus is now limited to low visibility approach as the ILS is the most critical system and easy to be disturbed and failures not easy to be detected.



Front Door Coupling Requirements

Front door coupling requirement is for radio receivers that could be susceptible to interference from RF coupling into the radio antennas.

To ensure that the receiver is not susceptible there must be sufficient isolation between the PEDs and the antenna(s) connected to the radio receiver of concern.

Having sufficient isolation will result in the signal from the PEDs to the antenna to be attenuated so that the receiver cannot detect this noise from the PEDs.

The amount of energy lost traveling from the PEDs inside the aircraft to the aircraft radio receiver is the Interference Path Loss (IPL).

Front door coupling assessment is only required if the PEDs want to be switched on in all phases of flight.

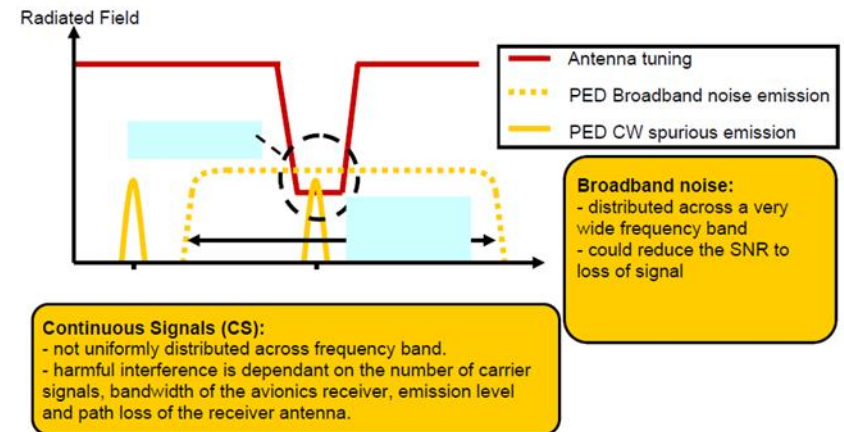


FIGURE 5 : FRONT DOOR COUPLING DUE TO RADIATED SPURIOUS EMISSIONS (NIRA)

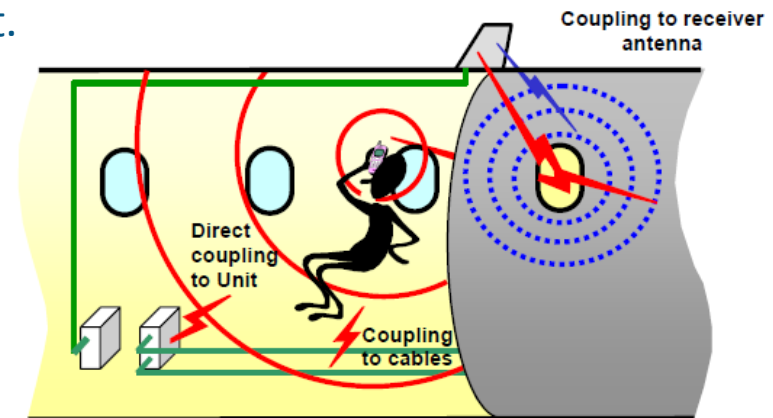


Back Door Coupling

PED radio frequency transmissions that are radiated within the aircraft and received by aircraft electronic systems through their interconnecting wires or electronic equipment enclosures.

PED tolerance needs to be demonstrated for equipment and systems that have failure modes that are classified as Major, Hazardous or Catastrophic, and Flight Data Recorder and Cockpit Voice Recorder.

Equipment that have failure conditions that are classified as Minor and lower does not need to meet the PED tolerance requirement. The failure classifications should be derived from the safety assessment performed for the aircraft.





DO-307 changes / ED-239

Table 3-1 - Aircraft System RF Radiated Susceptibility Test Recommendations

System functional failure condition classification	Distance between T-PED and system LRU ≥ 20 cm	Distance between T-PED and system LRU < 20 cm
Catastrophic	RTCA DO-160E / EUROCAE ED-14E Section 20 Category XR	RTCA DO-160E / EUROCAE ED-14E Section 20 Category XW limited to 8 GHz
Hazardous	RTCA DO-160E / EUROCAE ED-14E Section 20 Category XR	RTCA DO-160E / EUROCAE ED-14E Section 20 Category XR
Major	RTCA DO-160E / EUROCAE ED-14E Section 20 Category XR	RTCA DO-160E / EUROCAE ED-14E Section 20 Category XR
Required by regulation and not covered above	RTCA DO-160E / EUROCAE ED-14E Section 20 Category XR	RTCA DO-160E / EUROCAE ED-14E Section 20 Category XR
Minor and no safety effect and not required by regulation	No requirement	No requirement

PED tolerance test levels are now equivalent to HIRF levels!

TABLE 3-1: AIRCRAFT SYSTEM RF RADIATED SUSCEPTIBILITY TEST RECOMMENDATIONS

System functional failure condition classification	Distance between T-PED and system LRU ≥ 20 cm	Distance between T-PED and system LRU < 20 cm
Catastrophic	ED-14D/DO-160D, change 1 or later issues Section 20 Category XR	ED-14D/DO-160D, change 1 or later issues Section 20 Category XW limited to 8 GHz
Hazardous	ED-14D/DO-160D, change 1 Section 20 Category XR	ED-14D/DO-160D, change 1 Section 20 Category XR
Major	ED-14D/DO-160D, change 1 Section 20 Category XT	ED-14D/DO-160D, change 1 Section 20 Category XT
Cockpit voice recorders and flight data recorders	ED-14D/DO-160D, change 1 Section 20 Category XT	ED-14D/DO-160D, change 1 Section 20 Category XT
Minor and no safety effect and not required by regulation	No requirement	No requirement

NOTES:

- ED-14D/DO-160D, change 1 Section 20 uses two category characters. Conducted susceptibility test levels are designated with the first character, and radiated susceptibility test levels are designated with the second character. The 'X' as the first character in this table means that conducted susceptibility tests are not required to be performed for PED tolerance.
- ED-14D/DO-160D, change 1 or later revisions are acceptable.



PED tolerance vs HIRF certification

- Aircraft are to be classified into three basic categories, describing RF susceptibility sensitivity:

HIRF	Partial HIRF	Non HIRF
Aircraft, that meet FAA HIRF – or EASA/JAA Special Conditions (not introduced until 1987)	Select systems that meet FAA HIRF – or EASA/JAA Special Conditions	Aircraft that don't meet FAA HIRF – or EASA/JAA Special Conditions (initial TC before 1987)
Examples: A320 / A350 / 777 / 787	Examples: 747-8i / 737NG	Examples: A300 / 737CL / 757-200

All CAT, HAZ and Major systems
have been HIRF qualified and are then PED tolerant.
CVR and FDR still need to be checked

A PED tolerance demonstration is
needed for all CAT, HAZ, Major
systems and CVR and FDR

CAT, HAZ and Major systems that have been HIRF qualified are PED tolerant.
The ones not (enough) qualified need to be addressed – test on aircraft needed
CVR and FDR still need to be checked



Back Door Coupling

Low Risk Technologies:

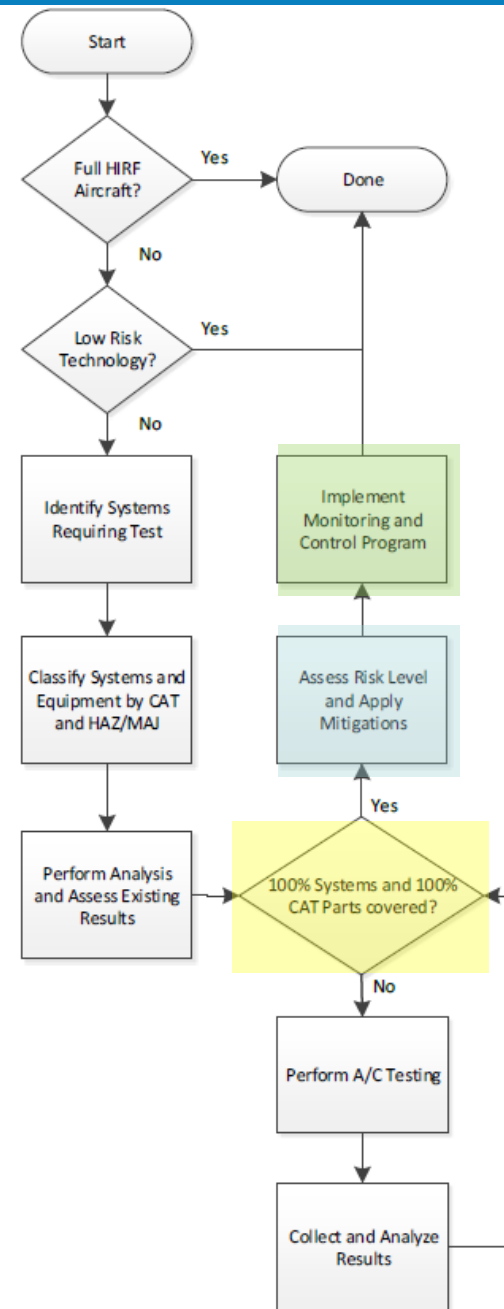
low-power emission limit is 100mW EIRP (equivalent isotropic radiated power). Wireless communication standards which are limited to this level do not need to be analysed for backdoor coupling.

The PED risk is acceptable if the following conditions have been met via test or analysis with positive results:

- 100% of systems supporting functions with Major and/or Hazardous failure conditions

- 100% of systems supporting required voice and data recorders

- 100% of part numbers supporting functions with Catastrophic failure conditions





Risk Based Approach

From CM ES-003:

The back door susceptibility assessment for non-HIRF or partially HIRF certified aircraft relies on a risk based approach, where not all Part Numbers involved in Hazardous or Major failure conditions have been assessed to be PED tolerant to back door coupling.

In order to continuously assess the PED risk, the operators should implement a monitoring a control program to continuously assess the PED risk the AFM needs to include requirements for the operator to systematically monitor and report to the TC or STC holder any interferences caused by the use of PEDs on board.



Methods to prove PED tolerance – back door coupling

Performing initial proof of PED tolerance on non-HIRF and partial-HIRF aircraft and CVR and FDR:

PED-tolerance substantiation according to DO-160 Section 20 on RF susceptibility category tested – HIRF requirements

Onboard PED Testing – no significant differences compared to ED-130 or DO-294C





Test Methods in ED-130A

1. Technology-Specific Demonstration: Perform assessment for only the technologies that will be used on the aircraft, for example, those that will interface with an on-board connectivity system. This method does not establish complete aircraft PED tolerance and the operator will therefore be responsible preventing the on-board use of other technologies.
1. PED Tolerance: Perform assessment to cover the technologies that are widely used by PEDs. This method establishes complete aircraft PED tolerance and testing is conducted using a standardized set of frequency bands, power levels and modulations detailed in section 6.3.2 of ED-130A.

Test Execution Methods:

The Test Execution Method decision determines how the test environment will be applied on the aircraft, leading to tests covering equipment located within areas of the aircraft ('Zonal Testing') or covering specific items of equipment ('Local Testing'):

1. Zonal Testing: Testing is performed to illuminate aircraft zones and cover all parts installed within the zones. Typical zones include the cockpit/flight deck, cargo areas, avionics bays and cabin sections.
2. Local Testing: Part-specific isolation testing with test equipment targeting individual parts installed in the aircraft, similar to ED-14 / DO-160 section 20 test setup, but on the aircraft.



PED tolerance failure

Potential PED non-tolerance findings may require mitigating actions (relevant systems only)

- Interchange of (failing) units to comply with PED-tolerance requirements
- Ban from PEDs in certain areas aboard
- Restricted use aboard (e.g. cruise-flight use only)





Sustaining the PED tolerance

The outcome of the tests and/or analysis is valid only for the approved configuration of the aircraft as tested or for which the analysis was performed against.

Altering the aircraft in any way from the approved configuration in which it was tested or upon which the analysis was done could invalidate the results and therefore making the aircraft no longer PED tolerant.

This also includes the approved interchangeable part numbers listed in the Illustrated Parts Catalogue IPC, that may not be PED tolerant.



Sustaining the PED tolerance

For full HIRF certified aircraft configuration management:

Configuration management of equipment with a Major, Hazardous or Catastrophic failure condition is not required. Maintaining the full HIRF certification of the aircraft will maintain the aircraft PED tolerance.

For partial HIRF or non-HIRF certified aircraft configuration management

Configuration management is needed for all interchangeable P/Ns in systems with CAT FCs.

No configuration management is needed for P/Ns in systems with HAZ or MAJOR FCs, CVR and FDR.

However, equipment with Major, Hazardous or Catastrophic failure conditions or flight data or cockpit voice recorders that were found to have unacceptable adverse effects from PEDs during the initial PED tolerance airplane testing/evaluation need to be tracked and assessed.

Industry and authorities agreed to accept a residual risk for very unlikely MAJ and HAZ system failures after initial substantiation of all MAJ/HAZ/CAT system functionalities

Long term experience and recording of incidences allegedly caused by EMI from PEDs showed a very low number of cases and very limited amount of part numbers affected.



Summary

Initial Certification

HIRF certified aircraft: check only CVR and FDR

Non-HIRF or Partially HIRF certified aircraft:

test to be performed for **ALL** systems involved in CAT, HAZ and MAJOR FC + FDR and CVR.

Sustaining PED tolerance

HIRF certified aircraft: no P/N tracking is needed

Non-HIRF or Partially HIRF certified aircraft:

All interchangeable P/Ns involved in **CAT** FCs need to be assessed and tracked to be TPED tolerant.

Individual P/N assessment and tracking is not necessary for all interchangeable P/Ns involved in HAZ and MAJOR FCs

Approach is Fully Harmonized with FAA and AC 20-164A (draft in consultation)



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