

**RTCA Special Committee 209
ATCRBS / Mode S Transponder MOPS Maintenance
Meeting #7**

In Joint Session with Eurocae WG-49

**Eurocontrol Headquarters, Brussels
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ED-73C Draft Chapter 4 with Honeywell Comments

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SUMMARY

This Working Paper presents the draft Chapter 4 that is submitted by WG-49 and adds comments from Honeywell.

DRAFT

MINIMUM PERFORMANCE SPECIFICATION UNDER ENVIRONMENTAL TEST CONDITIONS

4.1 INTRODUCTION

The environmental test conditions and performance criteria described in this section provide a laboratory means of determining the overall performance characteristics of the equipment under conditions representative of those which may be encountered in actual operation.

Unless otherwise specified in this document or by the approving authority, the test procedures applicable to the determination of equipment performance under environmental test conditions are contained in EUROCAE document ED-14D, "Environmental Conditions and Test Procedures for Airborne Equipment".

These test have been reviewed and aligned with the DO181 requirements. They are summarised and presented on two tables. The first table gives the correspondance between the type of the required environmental condition, the ED14D chapter and a column specifies the relevant group of associated tests. Six group have been identified and are defined in the second table.

The second table gives the reference to the associated requirement, the reference to the associated test procedure, and at last a column gives the test kept for the environmental conditions only.

Some of the environmental tests contained in this section do not have to be performed unless the manufacturer wishes to qualify the equipment for that particular environmental condition; these tests are identified by the phrase "If Required". If the manufacturer wishes to qualify the equipment to these additional environmental conditions, then the "If Required" tests shall be performed.

NOTE: ~~Throughout this chapter there are two columns of references. The first column is a reference to the associated requirement and the second column is a reference to the associated test procedure.~~

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	ENVIRONMENTAL CONDITIONS	ED 14 D/ DO 160 D chapters	ED-73B
4.2 4.2.1 4.2.2	<i>Temperature</i>	4.5	Group 1
4.2.3	<i>Altitude</i>	4.6.1	Group 4
4.2.4	<i>Decompression</i>	4.6.2	If required, Group 4
4.2.5	<i>Overpressure Test</i>	4.6.3	If required, Group 4
4.3	TEMPERATURE VARIATION	5.0	Group 3
4.4	HUMIDITY	6.0	Group 2
4.5 4.5.1	OPERATIONAL SHOCKS		If required Group 2
4.5.2	CRASH SAFETY SHOCKS		Group 6
4.6	Vibration	8.0	Group 3 during the tests And after Group 1
4.7	EXPLOSION PROOFNESS	9.0	if required
4.8	WATER PROOFNESS	10.0	if required, Group 2
4.9	FLUIDS SUSCEPTIBILITY	11.0	if required, Group 2
4.10	SAND AND DUST	12.0	if required, Group 2
4.11	FUNGUS RESISTANCE	13.0	if required, Group 2
4.12	SALT SPRAY	14.0	if required; Group 2

4.13	MAGNETIC EFFECT	15.0	Group 6
4.14	Power Input (Normal / Abnormal Operating Conditions)		Group 2
4.15	Voltage spike conducted test		Group 2
4.16	Audio Frequency Conducted Susceptibility	18.0	Group 1
4.17	INDUCED SIGNAL SUSCEPTIBILITY	19.0	Group 1
4.18	RADIO FREQUENCY SUSCEPTIBILITY (Radiated and Conducted)	20.0	Group 1
4.19	EMISSION OF RADIO FREQUENCY ENERGY	21.0	Group 6
4.20	LIGHTNING INDUCED TRANSIENT SUSCEPTIBILITY	22	Group 5
4.21	LIGHTNING DIRECT EFFECTS	23	Not applicable
4.22	ICING	24	Not applicable
4.23	ELECTROSTATIC DISCHARGE (ESD)	25	Group 1

Comment [SO1]: Power input : group 5. Momentary interruptions/all others : group 3 during/ group 2 after as in DO-181D. It is less stringent than running group 2 during and after.

Comment [AH2]: The Group 5 could be probably limited to Sensitivity tests, power and frequency

Comment [SO3]: DO-181D has a group 5, used in power input test. Please rename it to group 7 or some other number.

Comment [AH4]: Propose to test only Fixed Direct Data, Variable Direct Data since this test seems to support the HMI (injection de static par l'opérateur)

Comment [AH5]: Group 5 in ED 73 B is associated with Lightning induced transient susceptibility. Not yet defined in DO 181D. Group 5 in DO is not used.

Comment [AH6]: It matches with "Receiver Characteristics"

EUROCAE /ED 73B				Required Test Group						
requirementRef Chapter 3	TestRef Chapter 5	Topic	Keep the following tests <u>only for test on environmental conditions</u> :	Honeywell recommendations for environmental tests	1	2	3	4	5	6
3.2.2	5.4.1.2 a	Sensitivity Variation with Frequency	Step 1	Frequency steps not defined. Recommends DO-181D step 1 increments 1029.8, 1030 and 1030.2 MHz to incorporate in ED73C environmental test	✓	✓	✓		✓	

EUROCAE /ED 73B										
3.2.4	5.4.1.2 b through g	Sensitivity and Dynamic Range	Step 2 , Step 3: Take MTL, Medium and -21 DBm Win 2 tests, Step 4, Step 5 , Step 6, Step 7	Step2: Calculate MTL for Mode C/S instead of 4 modes as in ED. Step3: include 2 modes, mode A and mode C/S instead of 4 modes as in ED. Step4: Not needed, since not present in DO-181D 2.3.2.1. Step5: include 2 mode, mode C/S and mode S.	✓	✓	✓			✓
3.3.1	5.4.2.1	Reply Transmission Frequency		To harmonize with DO, measure frequency of mode A, mode A/S reply WITHOUT stub tuner setup during the environmental test. This symplifies test setup with an ATE and reduces test time.	✓	✓	✓	✓	✓	
3.3.3	5.4.2.2	RF Peak Power Output	Step 1 Variation interrogation rate from 100 to the max Proposal: same as the DO 2.3.2.2.2 plus additional modification: Take 1200 interrogations per sec or the Max for which the transponder is designed. Step 2 Idem See new defined steps (3 and 4)	Proposed steps 1 and 2 are identical to DO and they are sufficient for environmental testing. What are the new steps 3 and 4? Can they be added to the ambient test and NOT environmental test?	✓	✓		✓	✓	

EUROCAE /ED 73B											
3.4	5.4.2.5	Reply Rate Capability	Step 1 Interrogation rate at 1200 or the maximum for which the transponder is designed Step 2 Duration 15 Step 3 , Step 4 , Step 5 ,Step 6	Step1: recommend rate of 500 as in DO-181D 2.3.2.2.3 step 1. Step2: Recommend no duration requirement. 15 minutes test duration does not meet any objective. This will expose the UUT to a total of 30 (Gr. 1) X15=450 min. to the environments. Step6: Not needed, since not present in DO-181D 2.3.2.2.3.	✓						
3.5	5.4.3.1	Mode A/C Replies	Keep Step 1 and 2 and measure only the pulse width and position of the first and last pulse	O.K.	✓				✓	✓	
3.6	5.4.3.2	Mode S Replies	Keep Step 1,2, and 3 For Step 2 measure only the first and last short pulse width and the first and last long pulse width.	Steps 1, 2 and 3 mesures preamble/data pulse duration, and amplitude variation. DO-181D 2.3.2.3.2 step 1 and 2 measure mode S replay delay covered by 5.4.3.3/4 below. To harmonize the 2 documents, we recommend removal of ED section 5.4.3.2.					✓	✓	
3.7	5.4.3.3 through 5.4.3.4	Reply Delay and Jitter	In A/C : Keep Step 1 and 2 and make the measurement at MTL+3 dB , -50 and -21 dBm. In Mode S : Keep Step 1 and 2 and make the measurement at MTL+3 dB , -50 and -21 dBm.	O.K.	✓						

Comment [AH7]: It should also include the 5.4.3.4 Mode S Reply rate and Jiter. Those tests are more explicated in ED 73B

EUROCAE /ED 73B					
3.8	5.4.4	Side Lobe Suppression	<p>In Mode A/C: Keep Step 1, 4, 6</p> <p>In Mode S step 1 & 2 . make the test at MTL+3 dB and -21 dBm</p>	<p>In Mode A/C: Step1: Use only one mode, mode A (equivalent to DO-181D 2.3.2.4 step 4).</p> <p>Step 4: Keep P1-P2 spacing fixed, MTL+3 dB, -60, -40, -21 dBm (equivalent to DO-181D 2.3.2.4 step 1, 2).</p> <p>Step 6: Keep P1-P2 spacing fixed (equivalent to DO-181D 2.3.2.4 step 3).</p> <p>In Mode S : proposed test is O.K.</p>	<div style="display: flex; justify-content: space-between;"> <div style="width: 15px; height: 15px; border: 1px solid black; background-color: white; text-align: center; line-height: 15px;">✓</div> <div style="width: 15px; height: 15px; border: 1px solid black; background-color: white; text-align: center; line-height: 15px;">✓</div> <div style="width: 15px; height: 15px; border: 1px solid black; background-color: white;"></div> <div style="width: 15px; height: 15px; border: 1px solid black; background-color: white;"></div> <div style="width: 15px; height: 15px; border: 1px solid black; background-color: yellow; text-align: center; line-height: 15px;">✓</div> </div>

EUROCAE /ED 73B										
3.9	5.4.5	Pulse Decoder Characteristics	<p>Step1&2 make the test at MTL + 10 dB</p> <p>Step3,</p> <p>Step 4 keep only Mode A and make the test at MTL+10 dB only</p> <p>Step 5 make the test at MTL+10 dB only</p> <p>Step7 make the test with amplitude level of MTL , -60 and -45 dBm (P1/P3=0.25 μs)</p> <p>Step8 or 9 : make the test with amplitude level of MTL+3 , -50 and -21 dBm</p>	<p>Step 1: Interrogate Mode A/S All-Call at MTL+10dB. Verify the changeover from ATCRBS to Mode S replies at the relative P4 levels specified in section 3.9.2a. The above comment removes conflicting requirement inserted in the test and harmonizes ED with DO-181D 2.3.2.5 step 1.</p> <p>Step 2: Interrogate Mode A All-Call at MTL+10 dB.</p> <p>Step 3 and 4 : Proposed tests are O.K.</p> <p>Step 5 and 6: Not needed, since not present in DO-181D 2.3.2.5.</p> <p>Step 7,8,9: Proposed tests are O.K.</p>	✓	✓			✓	
3.10	5.4.6	Transponder Desensitisation and Recovery	<p>Step 1 Make the test for 3 and 15 μs only Step 2.,Step 3,Step 4,</p>	<p>Step 1: Set the single pulse power level at MTL+50 dB as in DO-181D 2.3.2.6 step 1.</p> <p>Step 2: Set the ATCRBS Mode A power level at MTL+ 3 dB.</p> <p>Step 3: O.K.</p> <p>Step 4: Keep the test with P1-P2 suppression pair at -35 dBm followed by Mode S only All-Call. Remove the test where mode A/C/S replaces suppression pair.</p>	✓				✓	

EUROCAE /ED 73B										
3.12	5.4.7	Response to Interference	Step 2 Take 3 level -68, -50 and -21 dBm	Step 2: Standard interference pulse test at proposed power levels is O.K. Conduct Mode S SLS at 2 power levels, MTL+3 dB and -21 dBm as in DO-181D 2.3.2.7.	✓					
3.13	5.4.8	Undesired Replies		O.K.	✓		✓		✓	
3.14	5.4.9.1	Self Test and Monitors	Step1	O.K.	✓	✓	✓	✓	✓	
3.14	5.4.9.2	Squitter Monitor	On the discretion of the manufacturer	O.K.	✓	✓	✓	✓	✓	
3.15	5.4.10	Mutual Suppression Capability	No test	O.K.	✓				✓	
3.16	5.4.11	Diversity Operation	Step 1 make the test at MTL+6 dB , -50 and -21dB Step 2 Modify the level difference between the two channels and take it at +6 dB (Harmonized with RTCA requirement) Step 3 Modify the level difference between the two channels and take it at +6 dB (Harmonized with RTCA requirement)	Step1: To harmonize with RTCA, calculate following parameters at proposed power levels, MTL+6 dB, -50 and -21 dBm: 1. Correct reply channel 2. Reply delay for each interrogation type and level 3. Power ratio Step 2: At proposed power levels, MTL and MTL+6 dB for channel A (B) and B (A), include two interrogations, ATCRBS mode C and Mode S UF=4. Step 3: At proposed power levels, MTL+6 dB and -50dBm for channel A (B) and B (A), include two interrogations, ATCRBS mode C and Mode S UF=4.	✓	✓			✓	

Comment [AH8]: This test is more complete in ED 73 B. The DO 181 D equivalent test matches only with the step 1 of ED 73B

Comment [SO9]: ED73B test matches DO-181D ambient test section 2.4.2.7. New tests were added in section 2.4.2.7 in step 5 : CW interference and in step 1: low level interference. However, environmental test section 2.3.2.7 has only standard pulse interference and mode S SLS tests.

Comment [AH10]: This test is being completed by the WG 49

EUROCAE /ED 73B									
3.17.1 a	5.4.12.1	Fixed Direct Data	Step 1 test with AAAAAAA and 55555555 Code Addresses only Step 2 Step 3 Step 4 take only two AC Id LLLLLLLL and 33333333	O.K.	✓	✓			✓
3.17.1 b	5.4.12.2	Variable Direct Data	Step 1 except the invalid altitude, Step 2 Step 3 excepted bullet 7 and invalid altitude Step 4, Step 5	I can't follow comments in step 1, 2 and 3.	✓	✓			✓
3.17.3	5.4.12.3	Standard Transaction Interfaces	Step 1: UF 24 Comm D is missing in ED 73 Step 2: In ED 73 clarify UF 24 for Comm B extraction. Step 3 Remove/Clarify Step 4 from ED 73 Step 5 with All ones only Step 6 Step 7 Ask DO to consider All BDS to be checked.		✓	✓			✓
3.17.4	5.4.12.4	ELM Service Interfaces	Step 1 alignment is necessary Step 3		✓	✓			✓
3.17.2 b	5.4.13	Interface Integrity Testing	On the discretion of the manufacturer		✓	✓			✓
3.24	5.4.14	Power Interruption	Amend PR =0 in ED		✓	✓			✓

Comment [AH11]: Invalid AA is being inserted by WG 49

Comment [AH12]: