RTCA SC-209, Working Group #1, Meeting #4

Post___Cologne

4 – 6 December 2007

Alignment of ED-73C Section 5.4 With DO-181D Section 2.3 for Environmental Test Procedure Purposes

Version 6.0 (e.g., WG49N12-11e)
December 4-6, 2007

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SUMMARY

The original version of this document presented differences and proposed changes for consideration in achieving agreement between ED-73C and DO-181D in regards to Test Procedures to be performed under Environmental Conditions. Version 1 of this document (WG49N12-11a) was updated real time during WG49N12 with changes as necessary and agreement noted appropriately. Version 2 (WG49N12-11b) was updated post WG49N12 and reviewed at the RTCA SC-209 WG-1 Meeting 03 in Washington, D.C., during the week of October 1, 2007. Version 3 was updated and reviewed at the WG-49 meeting in Cologne, Germany during the week of November 5, 2007. Version 4 incorporated changes and finalized the document subsequent to the WG-49 Cologne Meeting. Version 5 was intended for strong review and approval at the December 4-6, 2007 SC-209 meeting in DCA. Version 6 was the result of edits during the SC-209 meeting and will be the result entered into the next draft of DO-181D as specified herein.

Introduction:

Original Version for WG49N12:

The following table has been developed in response to action items arising at the SC-209 / WG-49 meeting in Brussels in August, 2007. The table is intended to address differences in environmental test procedures provided in Eurocae ED-73C Section 5.4 and those provided in RTCA DO-181D Section 2.3. As such, the first two columns detail the procedures as provided in ED-73C. The third and fourth columns detail the procedures as provided in DO-181D. The fifth column provides commentary, notes, rationale, etc., as necessary to describe minor changes made in the previous columns to either ED-73C and DO-181D. The changes made are suggested in the interest of aligning ED-73C section 5.4 with DO-181D section 2.3. For the most part alignment was reasonably achieved with minimal change. However, two areas of concern still exist with those being (a) Reply Rate Capability in ED-73C section 5.4.2.5 and (b) Extended Squitter testing in ED-73C section 5.4.3.2. Appropriate commentary on both issues is provided in the table.

All are invited to review the table input and respond as deemed necessary.

Version 2 (Sept. 27, 2007_RHS) for SC-209 WG-1 Meeting 3, October, 2007:

The document has been updated with real time changes during the WG49N12 meeting and with additional changes made since that time. During review of the document, specific attention should be drawn to the following areas:

a. Column 2:

Normal Black text provides test procedures as they currently exist in ED-73C.

Green text (normally underlined) provides text as entered into ED-73C prior to beginning the alignment of environmental test procedures performed in this document. That is, text inserted in the document prior to WG49N12.

Text in Red and inBrackets [ ] is text that needs to be added to ED-73C section 5.4 to provide information on what tests or portions of tests need not be performed during environmental testing.

b. Column 3:

Text in **Blue** and **Bold** provides indication of where agreement was reached with WG-49 in regards to reducing or modifying the test procedures provided in Column 2.

c. Column 4:

Normal Black text provides test procedures as they currently exit in DO-181D.

Green text (normally underlined) provides text as entered into DO-181D prior to beginning the alignment of environmental test procedures performed in this document. That is, text inserted in the document prior to WG49N12.

d. Column 5:

Red Text provides rationale for changes made to either column 2 (ED-73C) or column 4 (DO-181D).

Blue Text normally provides notes, commentary, or other information.

e. Special Text Areas:

(1). Blue Highlighted text in section 5.4.3.2 (inclusive) represents area that must be readdressed in order to clarify Mode-S Reply testing requirements.

(2). Special Note Text in Magenta or Red (section 5.4.3.2 inclusive for example) represents area that must be readdressed.

Primary Areas of Concern Remain:

Section 5.4.3.2	Mode-S Testing
Section 5.4.3.2.2	Squitter Testing
Section 5.4.4.1.2	Step 5, Short Duration P2 Testing
Section 5.4.6.2	Step 7, Addition of "0607" Recovery Testing added to ED-73C and DO-181D
Section 5.4.9.2.2	Squitter Monitor Question

Version 3 – October 31, 2007:

This version updates the document as needed after review during SC-209 October, 2007, meeting in Washington, D.C.

Most areas that need to be discussed and yet resolved are highlighted in green.

Version 4 – November 16, 2007:

This version updates the document as needed after review during WG-49 November, 2007, meeting in Cologne, Germany.

Most areas that need to be discussed are highlighted in yellow.

Most unnecessary text has been removed as the document has been scrubbed.

Particular attention should be paid the changes made that involve extended squitter testing as it is pointed out that the original procedures provided in ED-73C section 5.4.3.2.3 cannot be used for environmental testing and that the procedures are not consistent with extended squitter requirements provided in ED-73C or DO-181D.

As far as environmental testing is concerned, the author of this document considers that the procedures given below bring ED-73C and DO-181D into alignment. The remaining tasks are:

1. WG-49 to update procedure for reply rate capability in section 5.4.2.5.2.a.
2. WG-49 to update/add/modify procedures in ED-73C as indicated in the following tables.
3. SC-209 to update/add/modify procedures in DO-181D as indicated in the following tables.

Note in particular that this version solves the problem with ED-73C section 5.4.7.2.e (Interference Testing) as discussed at length at the WG-49 Cologne Meeting.

ENVIRONMENTAL TEST PROCEDURE COMPARISON AND ALIGNMENT				
EUROCAE ED-73B/C		**RTCA DO-181D**		**COMMENT**
5.1	**GENERAL**	**2.3**	**Equipment Performance – Environmental Conditions**	
5.1.1	**Power Input Voltage** Unless otherwise specified, all tests shall be conducted with the power input voltage adjusted to design voltage ±2%. The input voltage shall be measured at the equipment input terminals.		The environmental tests and performance requirements described in this subsection provide a laboratory means of determining the overall performance characteristics of the equipment under conditions representative of those that may be encountered in actual aeronautical operations. Some of the environmental tests contained in this subsection need not be performed unless the manufacturer wishes to qualify the equipment for that particular environmental condition. These tests are identified by the phrase "When Required." If the manufacturer wishes to qualify the equipment to these additional environmental conditions, then these "when required" tests shall be performed. The test procedures applicable to a determination of equipment performance under environmental test conditions are contained in RTCA Document DO-160D, *Environmental Conditions and Test Procedures for Airborne Equipment,* July 1997. Some of the performance requirements in Subsections 2.1 and 2.2 are not tested by the test procedures herein. Moreover, not all tests are required to be done at each of the environmental conditions in RTCA/DO-160D. Judgment and experience have indicated that these particular performance parameters are not susceptible to certain environmental conditions and that the level of performance specified in Subsections 2.1 and 2.2 will not be measurably degraded by exposure to these environmental conditions. The specified performance tests cover all classes of Mode S transponders. Only those tests that are applicable to the class of transponder being qualified need be done. Additional tests may have to be performed in order to determine performance of particular design requirements that are not specified in this document. It is the responsibility of the manufacturer to determine appropriate tests for these functions. Specific transponder performance tests have been included in this section for use in conjunction with the environmental procedures of DO- 160D. These tests have been judiciously chosen as a subset of the transponder performance tests of Subsection 2.4. Normally, a MOPS document does not provide specific equipment performance tests to be used in conjunction with the environmental procedures of DO-160D. However, there is a sufficiently large number of transponder performance tests in Subsection 2.4 that it would be impractical to repeat all of those tests in conjunction with all of the appropriate environmental procedures.	**Note:** Information provided in ED-73C Section 5.1 –through- Section 5.3. is equivalently provided in DO-181D Section 2.4.1. This is because DO-181D Section 2.4 is basically equivalent in intent to ED-73C in providing Equipment Test Procedures under ambient conditions.
5.1.2	**Power Input Frequency** a. In the case of equipment designed for operation from an AC power source of essentially constant frequency (eg, 400 Hz), the input frequency shall be adjusted to design frequency ±2%. b. In the case of equipment designed for operation from an AC power source of variable frequency, (eg, 300 to 1 000 Hz), unless otherwise specified, tests shall be conducted with the input frequency adjusted to within 5% of a declared frequency within the range for which the equipment is designed.			
5.1.3	**Adjustment of Equipment** The circuits of the equipment under test shall be properly aligned and adjusted in accordance with the manufacturer's recommended practice prior to application of the specified tests. Unless otherwise specified, adjustments may not be made once the test procedure has started.			
5.1.4	**Test Instrument Precautions** a. Precautions shall be taken during conduct of the tests to prevent the introduction of errors resulting from the connexion of test instruments across the input and output impedances of the equipment under test. b. Throughout this chapter, the accuracy of the test equipment is not addressed in detail, but rather is left to the calibration process prescribed by the agency which certifies the testing facility.			
5.1.5	**Ambient Conditions** All tests shall be conducted under conditions of ambient room temperature, pressure and humidity, as defined in ED-14D, paragraph 3.4.			

EUROCAE ED-73B/C		RTCA DO-181D		COMMENT
5.1.6	**Connected Loads** Unless otherwise specified, all tests shall be performed with the equipment connected to loads having the impedance values for which it is designed.	**2.3.1**	**Environmental Test Conditions**	
5.1.7	**Recording of Test Results** When test results are being recorded for incorporation in the type test report, it is not sufficient to note merely that the specified performance was achieved. Except where tests are obviously GO/NO GO in character (eg the determination of whether or not mechanical devices function correctly) the actual numerical values obtained for each of the parameters tested shall be recorded to enable verification of the statement of compliance with the relevant performance specifications of Chapter 3.		Table 2.3.1.1 lists all of the environmental conditions and test procedures (hereafter referred to as environmental procedures) that are documented in DO-160D. Table 2.3.1.2 lists the 13 sets of transponder performance tests that are specified in detail in this section and which are intended to be run subject to the various environmental procedures of DO-160D. In order to simplify the process of relating the environmental procedures to the transponder performance tests, Table 2.3.1.1 divides the environmental procedures into groups. All of the procedures in a given group are carried out in conjunction with the same set of transponder performance tests. Using this approach, the environmental procedures fall into six groups. The environmental procedures that apply to all of the sets of transponder performance tests fall into group 1. Group 2 procedures apply to 8 of the sets of transponder performance tests. Groups 3, 4, and 5 apply to 4, 3 and 3 of the sets of transponder performance tests, respectively. (Group 6, which applies to none of the transponder performance tests, includes only environmental procedures that are intended to determine the effect of the transponder on rack mounting hardware, compass needles, explosive gasses, and other RF hardware.) Table 2.3.1.2 indicates which of the groups of environmental procedures is related to each set of transponder performance tests. Each transponder performance test shall be validated under all of the environmental procedures in the groups required for that test as indicated in Table 2.3.1.2. **Refer directly to DO-181D for Table 2.3.1.1 and 2.3.1.2.**	
5.1.8	**Test Procedures** a. The following test procedures are considered to be a satisfactory means of establishing compliance with the performance specifications of Chapters 2 and 3. b. Alternative procedures which provide equivalent information may be used. In such cases, the procedures described in this chapter shall be used as one criterion in evaluating the acceptability of the alternative procedures.			
5.2	**STANDARD INTERROGATION TEST SIGNALS** Unless otherwise specified, all test interrogation signals shall be as defined below. The signal measurement convention shall be as specified in paragraph 1.5.4.			

EUROCAE ED-73B/C		RTCA DO-181D		COMMENT
5.2.1	**General Characteristics** a. Radio Frequency The carrier frequency of the signal generator for Mode A/C and Mode A/C/S All-Call interrogation shall be 1 030 ±0.1 MHz. Mode S interrogation signals shall have a carrier frequency of 1 030 ±0.01 MHz. b. CW Output The CW output between pulses shall be at least 50 dB below the peak level of the pulse. c. Pulse Rise and Decay Time Rise and fall times shall be as specified in paragraphs 1.6.3 and 1.6.4. ***NOTE:*** *Unless otherwise indicated, interval measurements are measured between half voltage points of the respective pulses as detected by a linear detector.* d. Pulse Top Ripple The instantaneous amplitude of the pulses shall not fall more than 1 dB below the maximum value between the 90% voltage amplitude points on the leading and trailing edges of the pulse. e. Signal Level Unless otherwise noted in the Test Procedure, the signal level shall be -60 dBm, ±3 dB. f. Interrogation Repetition Standard Rate Unless otherwise noted in the Test Procedure, interrogation rates shall be 450 ±25 Hz for Mode A/C interrogations and 45 ±5 Hz for All-Call and Mode S interrogation. g. Mode S Interrogation Address. Unless otherwise noted in the Test Procedure, the aircraft 24-bit address encoded in a Mode S interrogation shall be : AA AA AA {HEX}, (i.e. binary 1010 1010 1010 1010 1010 1010).	**2.3.2**	**Detailed Environmental Test Procedures** The test procedures set forth below are considered satisfactory for use in determining equipment performance under environmental conditions. Although specific test procedures are cited, it is recognized that other methods may be preferred. These alternative procedures may be used if the manufacturer can show that they provide at least equivalent information. In such cases, the procedures cited herein should be used as one criterion in evaluating the acceptability of the alternative procedures. These transponder performance tests do not include specific pass fail criteria. It is intended that those criteria be obtained from the transponder performance requirements presented in the referenced paragraphs in Subsection 2.2.	

EUROCAE ED-73B/C		RTCA DO-181D		COMMENT
5.2.2	**Mode A/C, Mode A/C/S All-Call and Mode A/C-Only All-Call Interrogations** The nominal characteristics shall be as specified in paragraph 1.6. In addition, in order to prohibit any reply inhibition, the "on-the-ground" report (VS or FS field) shall not indicate the on-the-ground condition but the airborne condition unless otherwise noted in the test procedure.			
5.2.3	**Mode S Interrogations** The nominal characteristics shall be as specified in paragraph 1.6.			
5.2.3.1	**Mode S-Only All-Call Interrogation.** Mode S-Only All-Call interrogation is defined as a Mode S interrogation of Uplink Format 11 (UF=11), with the value of PR being 8, the value of IC and CL being 0. The "on-the-ground" report (VS or FS field) in the transponder should indicate the "airborne" condition. An address of 24 ONEs is used in generation of the AP field.			
5.2.3.2	**Mode S Surveillance - Altitude Interrogation** Mode S Surveillance Altitude Interrogation is defined as a Mode S interrogation of Uplink Format 4 (UF=4), with the following mission field values: PC=0 RR=0 DI=0 SD=0			
5.2.3.3	**Mode S Surveillance - Identity Interrogation** Mode S Surveillance - Identity Interrogation is defined as a Mode S interrogation of Uplink Format 5 (UF=5) with the following mission field values: PC=0 RR=0 DI=0 SD=0			

EUROCAE ED-73B/C		RTCA DO-181D		COMMENT
5.2.3.4	**Comm-A - Altitude Interrogation.** Comm-A - Altitude Interrogation is defined as a Mode S interrogation of Uplink Format 20 (UF=20) with the following mission field values: PC=0 RR=20 DI=0 SD=all ONEs MA= 'AA AAAA AAAA AAAA' {HEX}			
5.3	**TRANSPONDER TEST SET** The test procedures in this chapter call for one or more Transponder Test Sets, at least one of which must have all of the following capabilities: a. A means of varying: (1) the RF frequency by 60 MHz from the centre frequency, (2) the amplitude of the interrogating signal level from -21 to -85 dBm, (3) the amplitude of either P2, P3 or P4 with respect to P1, (4) the interval spacings between the following pairs of pulses, P1-P2, P1-P3 and P3-P4. b. A means of independently varying the durations of P1, P2, P3 and P4. c. A means of counting the number of correct replies transmitted in response to valid interrogations. d. A means of selecting: (1) Mode A, Mode C, Mode A/C/S All-Call, Mode A/C-Only All-Call or Mode S interrogation formats, (2) the data which will modulate the P6 pulse. e. A means of providing carrier phase modulation of the P6 pulse. f. A means of displaying the downlink reply bit pattern generated by the unit under test in response to a Mode S or All-Call interrogation. g. A means of adding a train of: (1) single 0.8 ± 0.1 µs wide pulses or 0.8 ± 0.1 µs pulse pairs spaced 2.0 ± 0.15 µs apart, with level adjustable from 12 dB below P1 to equal with P1 at a carrier frequency of 1 030.0 ±0.2 MHz, incoherent with the Mode S signal frequency, and with the following			

	characteristics: - Repetition frequencies variable up to 10 000 Hz ; - Positionable anywhere from the first pulse coincident with P1 to the second pulse coincident with the end of P6. (2) single 6.4 ±0.5 µs pulses or 3.5 ±0.5 µs pulse pairs spaced either 12 ±0.5 µs or 30 ±0.5 µs apart. The level shall be set at -30 dBm at a carrier frequency variable from 962 to 1 213 MHz. The repetition rate on the pulse pairs shall be variable up to 3 600 Hz and that of the single pulses variable up to 2 000 Hz. h. A means of synchronising interrogation sequences repetitions with a similar test set. i. A means of rapidly changing between two interrogation rates. j. A means of moving the sync phase reversal position in P6 over a ±200 nanosecond range from assigned position. k. A means of encoding Mode S interrogations with proper parity check sequence. l. A means of decoding Mode S replies using proper parity check sequence. m. A means of interlacing Mode A/C and Mode S interrogations. n. A means of generating Mode A/C and Mode S interrogation bursts at rates which test compliance with paragraph 3.4. o. A means of displaying the output of the detected video of the replies from the unit under test. p. A means of measuring the transmission frequency of the transponder. q. A means of loading test patterns into one or more of the transponder GICB registers 05 to FF {HEX} via the data link interface r. A means of inputting avionics data to the transponder on one or more channels. e.g. A Transponder control unit and/or a generator of control words, altitude, ground speed, etc. s. A means for analysing the statistic properties of squitters.			

EUROCAE ED-73B/C		RTCA DO-181D		COMMENT
5.4	**TEST PROCEDURES RELATED TO RECEIVER AND TRANSMITTER** The tests in paragraphs 5.4.1 through to 5.4.14 verify transponder performance as a receiver and transmitter of signals. The tests in 5.5 test the transponder processing functions. ***NOTE 1:*** *Means are required to provide the control functions specified in paragraph 2.5 .* ***NOTE 2:*** *The nature of the processing tests is such that some means of automatically controlling, sequencing and evaluating of tests is necessary*			
5.4.1	**Receiver Characteristics** (paragraph 3.2)	**2.3.2.1**	**Receiver Characteristics (Paragraph 2.2.2)**	
5.4.1.1	**Test Equipment** Transponder Test Set			
5.4.1.2	**Test Procedure** Connect the equipment as shown in Figure 5-1. Follow steps 1 through 7, below: a. STEP 1 - Sensitivity Variation with Frequency (Paragraph 3.2.2) Interrogate the transponder with a Mode A interrogation. Vary the RF signal frequency over the range 1 029.8 to 1 030.2 MHz. Record the minimum and maximum RF signal levels required to produce 90% transponder reply efficiency. [Under environmental conditions, it is sufficient to record only the maximum RF signal level required to establish 90% reply efficiency at frequencies of 1029.8, 1030.0, and 1030.2 MHz.]	**Agreed**	Step 1 Sensitivity Variation with Frequency (§2.2.2.2) Using a standard Mode A interrogation, interrogate the transponder at RF signal frequencies of 1029.8, 1030.0 and 1030.2 MHz. Determine the required maximum RF signal level at each frequency required to produce 90% reply efficiency.	
	b. STEP 2 - Sensitivity (Paragraph 3.2.4 a and e) Interrogate the transponder with a Mode A interrogation. Record the minimum RF signal level required to produce 90% transponder reply efficiency. Repeat the procedure using : - a Mode C interrogation, - a Mode A/Mode S All-Call interrogation and - a Mode C/Mode S All-Call interrogation. This determines the MTL for these interrogations. [Under environment conditions, it is sufficient to perform this test using only a Mode C/Mode S All-Call	**Agreed**	Step 2 Sensitivity (§2.2.2.4 a.) Interrogate the transponder with a standard Mode C ATCRBS/Mode S All-Call interrogation. Determine the minimum RF signal level required to produce 90% transponder reply efficiency.	

	interrogation.] c. STEP 3 - Mode A/C and Mode A/C/S All-Call Dynamic Range (Paragraph 3.2.4f) Interrogate the transponder with a Mode A interrogation. Vary the RF level in 5 approximately equal steps between MTL and -21 dBm. Record the reply ratio at each step. Repeat the procedure using : - a Mode A/Mode S All-Call interrogation and - a Mode C/Mode S All-Call interrogation. [Under environmental conditions, it is sufficient to perform the above test using approximately 5 equal steps between MTL + 3 dB and -21 dBm with Mode A interrogations and Mode C/Mode S All-Call interrogations.] d. STEP 4 - Bandwidth (Paragraph 3.2.3) Interrogate the transponder with a Mode A interrogation. Adjust the RF signal level to 60 dB above MTL. Record the frequencies above and below 1 030 MHz at which 90% transponder reply efficiency is obtained. ***NOTE:*** *Care must be taken to avoid high signal levels at or near the centre frequency.* [This test step is not required under environmental conditions.] e. STEP 5 - Mode A/C Mode A/C/S All-Call and Mode S-Only All-Call Low-Level Reply Ratio (Paragraph 3.2.4 d) With a RF signal level of -81 dBm, interrogate the transponder with: - a Mode A interrogation, - a Mode A/Mode S All-Call interrogation, - a Mode C/Mode S All-Call interrogation, and - a Mode S-Only All-Call interrogation with PR = 0. In each case record the reply ratio. [Under environmental conditions, it is sufficient to perform this test using only Mode C/Mode S All-Call interrogations.] f. STEP 6 - Mode S Sensitivity (Paragraph 3.2.4 b) Interrogate the transponder with a Mode-S Only All-Call interrogation with PR=0. Record the minimum RF level to produce 90% reply efficiency. This is the MTL for this interrogation. g. STEP 7 - Mode S Dynamic Range (Paragraph 3.2.4 c) Interrogate the transponder with a Mode-S Only All-Call interrogation with PR=0.	**Agreed** **Agreed** **Agreed**	Step 3 ATCRBS and ATCRBS/Mode S All-Call Dynamic Range §2.2.2.4f.) Interrogate the transponder with a standard Mode A interrogation at RF levels from MTL +3 dB to -21 dBm in approximately 5 equal steps. Determine reply ratio. Repeat for a standard Mode C ATCRBS/Mode S All-Call. Step 4 ATCRBS/Mode S All-Call Low-Level Reply Ratio (§2.2.2.4 d.) Interrogate the transponder with a standard Mode C ATCRBS/Mode S All-Call at an RF level of -81 dBm. Determine reply ratio. Step 5 Mode S Sensitivity (§2.2.2.4 b.) Interrogate the transponder with a Mode S Only All-Call interrogation at a standard rate with PR=0. Determine the minimum RF level to produce 90% proper reply efficiency. Step 6 Mode S Dynamic Range (§2.2.2.4 c.) Using the signal specified in Step 5, determine the reply efficiency for RF levels of MTL +3 dB, -50 dBm and -21	.

	Record the reply ratio at RF levels of MTL+3dB, -50 and -21 dBm. h. Step 8 Mode S Low-Level Reply Ratio (§2.2.2.4 d.) Using the signal specified in Step 6, determine reply efficiency for an RF level of -81 dBm.	**Agreed**	dBm. Step 7 Mode S Low-Level Reply Ratio (§2.2.2.4 d.) Using the signal specified in Step 5, determine reply efficiency for an RF level of -81 dBm.	
5.4.2	**Transmitter Characteristics** (Paragraph 3.3)	**2.3.2.2**	**Transmitter Characteristics (§ 2.2.3.1)**	
5.4.2.1	**Reply Transmission Frequency** (Paragraph 3.3.1)	**2.3.2.2.1**	**Reply Transmission Frequency (§ 2.2.3.1)**	
5.4.2.1.1	Test Equipment a. Transponder Test Set b. Stub Tuner. c. Variable Air Line (Line Stretcher) d Slotted Line			
5.4.2.1.2	Test Procedure Connect the equipment as shown in Figure 5-2. Adjust the stub to establish a 1.5:1 VSWR at the antenna end of the coaxial line specified by the manufacturer. - If the transponder requires a minimum length of a specified cable type, attenuation equal to the loss of the minimum amount of cable may be placed between the 1.5:1 VSWR point and the transponder antenna jack. - Alternatively, a length of cable equal to the specified minimum length and cable type may be used in lieu of the attenuator. Set the transponder for a 14 pulse reply (Mode-A code 7777). Interrogate the transponder with a Mode A interrogation and adjust the line stretcher for maximum transmitter frequency shift above or below 1 090 MHz. Record the frequency shift in each case. Repeat the above procedure with a Mode A/Mode S All-Call. [Implementation of the Stub Tuner is not required under environmental conditions.]	**Agreed**		
5.4.2.2	**RF Peak Power Output** (Paragraph 3.3.3)			
5.4.2.2.1	Test Equipment a. Transponder Test Set b. Wide Band Dual Channel Oscilloscope			

EUROCAE ED-73B/C		RTCA DO-181D		COMMENT
5.4.2.2.2	5.4.2.2.2 Test Procedure Connect the equipment as shown in Figure 5-3. a. STEP 1 - Mode A/C Power Output (Paragraph 3.3.3) Set the transponder for a 14 pulse reply (Mode-A code 7777). Interrogate the transponder with a Mode A interrogation and record the peak power level of the single reply pulse having the least RF power level. While varying the interrogation rate from 100 interrogations per second to the maximum interrogation rate specified for the transponder, record the variation in peak power level of the single reply pulse having the least RF power level. Repeat the procedure, recording the level and variation in peak power level of the single reply pulse having the highest RF power level. [Under environmental conditions, it is sufficient to perform this test step while measuring only the single pulse having the least RF power level.] b. STEP 2 – Short Mode S Power Output (Paragraph 3.3.3) Repeat STEP 1 with a Mode A/Mode S All-Call interrogation at standard rate only. c. STEP 3 – Long Mode S Power Output For transponders with long reply capability (Level 2 or above) repeat STEP 1 with sixteen Mode S interrogations per second using any format and coding for which a long reply is required. If the transponder is also Extended Squitter capable, configure the transponder, so that the transponder is transmitting the extended squitters (or an equivalent number of long replies) in addition to the sixteen replies. d. STEP 4 – Extended Long Mode S Power Output For transponders with extended reply capability (Level 4 or above) repeat STEP 3 stimulating the maximum rate of long replies for which the transponder is designed.	**2.3.2.2.2** **Agreed**	**RF Peak Power Output (§ 2.2.3.2)** Step 1 ATCRBS Power Output (§ 2.2.3.2) Connect the equipment as shown in Figure 2-26. Set the transponder for a 14-pulse (7777) reply. Interrogate the transponder with a standard Mode A interrogation at 1200 interrogations per second or the maximum for which the transponder is designed and measure the single pulse having the least RF power output. Determine that the power output meets the requirements of §2.2.3.2. Step 2 Short Mode S Power Output (§2.2.3.2) Repeat Step 1 with a standard Mode A ATCRBS/Mode S All-Call interrogation at the standard rate. Step 3 Long Mode S Power Output For transponders with long reply capability (Level 2 or above), repeat Step 1 with sixteen Mode S interrogations per second using any format and coding for which a long reply is required. If the transponder is also Extended Squitter capable, then configure the transponder so that the transponder is transmitting the Extended Squitters (or an equivalent number of long replies) in addition to the sixteen replies. Step 4 Extended Long Mode S Power Output For transponders with extended reply capability (Level 4 or above), repeat Step 3, stimulating the maximum rate of long replies for which the transponder is designed.	

EUROCAE ED-73B/C		RTCA DO-181D		COMMENT
5.4.2.3	**Transmitter Spectrum** (Paragraph 3.3.2) [This procedure is not required under environmental conditions.]	**Agreed**		
5.4.2.3.1	Test Equipment a. Transponder Test Set. b. Spectrum Analyser. c. Directional Coupler.			
5.4.2.3.2	Test Procedure Connect the equipment as shown in Figure 5-4. a. STEP 1 - Mode A/C Set the transponder for a 14 pulse reply (Mode-A code 7777). Interrogate on Mode A at 500 interrogations per second, and verify that the reply efficiency exceeds 90%. Measure and record the spectrum of RF emission at the antenna terminal of the transponder over the range 150 kHz to 10 GHz. b. STEP 2 - Mode S Repeat Step 1 with Mode S "All-Call interrogation". Record the maximum response in each frequency band as a ratio expressed in dB relative to the centre band peak level.			
5.4.2.4	**Residual Power Output** (Paragraph 3.3.4) [This procedure is not required under environmental conditions.]	**Agreed**		
5.4.2.4.1	Test Equipment a. Transponder Test Set. b. Spectrum Analyser. c. Directional Coupler.			
5.4.2.4.2	Test Procedure Connect the equipment as shown in Figure 5-4. Either disable the transponder transmission modulation or inhibit squitter transmissions. Do not interrogate the transponder. Record the maximum power output, in the range of 1 090 ±3 MHz, with the transponder in the inactive state.			

EUROCAE ED-73B/C		RTCA DO-181D		COMMENT
5.4.2.5	**Reply Rate Capability** (Paragraph 3.4)	**2.3.2.2.3**	**Reply Rate Capability**	
5.4.2.5.1	Test Equipment Transponder Test Set			
5.4.2.5.2	Test Procedure a. STEP 1 - Continuous Reply Rate Capability (Mode A/C) (Paragraph 3.4.1) Set the transponder for a 15-pulse reply (Mode A with SPI) and set the reply rate limit control to maximum. Interrogate the transponder on Mode A at 500 interrogations per second. Gradually increase the interrogation rate while observing the reply count over 1-second intervals. Verify that the maximum reply rate is at least 1 200 replies per second for Class 1 transponders, and 1 000 replies per second for Class 2 transponders. [Under environmental conditions, it is sufficient to perform this test while interrogating the transponder at a constant rate of 500 Mode A interrogations per second plus 50 Mode S interrogations (with short replies) per second. While performing the rate test, measure the output power and frequency.] b. STEP 2 - Continuous Reply Rate Capability (Mode S) (Paragraph 3.4.2) (1) If the transponder has only short reply capability Set the transponder for a 15-pulse reply (Mode A with SPI). Interrogate the transponder at a constant rate of 500 Mode A interrogations per second, plus 50 Mode S interrogations (for short replies) per second. For at least 15 minutes verify that the transponder replies at the specified rates. [Under environment conditions, it is not necessary to monitor the reply rate for 15 minutes.] (2) If the transponder has long reply capability but no Downlink ELM capability Perform the test listed in (1) using 16 of the 50 Mode S interrogations requiring long replies. (3) If the transponder has Level 4 capability Perform the test listed in (1) using 16 of the 50 Mode	**Agreed.** Mod in ED73 is necessary. **Agreed**	Step 1 ATCRBS Reply Rate Capability (§2.2.3.4.1 a and 2.2.3.4.2) Set the transponder for a 15-pulse ATCRBS reply. Interrogate the transponder at a constant rate of 500 ATCRBS interrogations per second plus 50 Mode S interrogations (with short replies) per second. Measure the output power and frequency. If the transponder is equipped for long Mode S reply formats, repeat the test with 16 (24 if also equipped with the enhanced data link protocols) of the 50 Mode S interrogations requiring long replies. Step 2 Continuous Reply Rate Capability (§2.2.3.4.1a and 2.2.3.4.2) Set the transponder for a 14 pulse plus SPI-pulse ATCRBS reply. Interrogate the transponder at a constant rate of 500 ATCRBS interrogations per second plus 50 Mode S interrogations (with short replies) per second. If the transponder is equipped for long Mode S reply formats, have 16 (24 if also equipped with the enhanced data link protocols) of the 50 Mode S interrogations requiring long replies. Determine reply ratio for each type of interrogation.	**Note 1:** In regards to Step 1, WG-49 has agreed to the 500 per second limit and the text written in RED. WG-49 needs to **re-write** the Yellow highlighted text to be consistent with that provided in Step 1 of DO-181D.

	S interrogations requiring long replies. Additionally generate Downlink ELMs at the rate specified in Step 6 below. (4) If the transponder has Level 5 capability Perform the test listed in (1) using 24 of the 50 Mode S interrogations requiring long replies. Additionally generate Downlink ELMs at the rate specified in Step 6 below. c. <u>STEP 3 - 100 Milliseconds Peak Reply Rate Capability (Mode S)</u> (Paragraph 3.4.2) Set the transponder for a 15-pulse reply (Mode A with SPI). Interrogate the transponder with periodic bursts of Mode A and Mode S interrogations as follows: (1) 120 Mode A interrogations (100 for Class 2 equipment), plus 18 Mode S interrogations (with short replies), each type of interrogation approximately uniformly spaced within a single 0.1-second interval, followed by (2) a 0.9-second interval with no interrogations. Verify that the transponder replies at the specified rate. If the transponder has long reply capability, repeat the test using 6 of the 18 Mode S interrogations requiring long replies. d. <u>STEP 4 - 25 Millisecond Peak Reply Rate Capability (Mode S)</u> (Paragraph3.4.2) Set the transponder for a 15-pulse reply (Mode A with SPI). Interrogate the transponder with periodic bursts of Mode A and Mode S interrogations as follows : (1) 30 Mode A interrogations (25 for Class 2 equipment) plus 8 Mode S interrogations (requiring short replies), each type of interrogation burst approximately uniformly spaced within a single 25-millisecond interval, followed by (2) a 975-millisecond interval without interrogations. In each case, verify that the transponder replies at the specified rate. If the transponder has long reply capability, repeat the test using 4 of the 8 Mode S interrogations requiring long replies. e. <u>STEP 5 - 1.6 Milliseconds Peak Reply Rate Capability (Mode S)</u> (Paragraph 3.4.2) Set the transponder for a 15-pulse reply (Mode A with	**Agreed** **Agreed**	Step 3 <u>100 Milliseconds Peak Reply Rate Capability (§2.2.3.4.1.b & c and 2.2.3.4.2)</u> Set the transponder for a 14 pulse plus SPI-pulse ATCRBS reply. Interrogate the transponder with periodic bursts of ATCRBS and Mode S interrogations as follows: 120 ATCRBS interrogations (100 if the equipment is intended for installation in aircraft that operate at altitudes not exceeding 15,000 feet) plus 18 Mode S interrogations (with short replies), each type of interrogation approximately uniformly spaced within a single 0.1-second interval, followed by a 0.9-second interval with no interrogations. If the transponder is equipped for long Mode S reply formats, have 6 (9 if also equipped with the enhanced data link protocols) of the 18 Mode S interrogations requiring long replies. Determine reply ratio for each type of interrogation. Step 4 <u>25 Millisecond Peak Reply Rate Capability (§ 2.2.3.4.2)</u> Set the transponder for a 14 pulse plus SPI-pulse ATCRBS reply. Interrogate the transponder with periodic bursts of ATCRBS and Mode S interrogations as follows: 30 ATCRBS interrogations (25 if the equipment is intended for installation in aircraft that operate at altitudes not exceeding 15,000 feet) plus 8 Mode S interrogations (requiring short replies), each type of interrogation burst approximately uniformly spaced within a single 25-millisecond interval, followed by a 975-millisecond interval without interrogations. If the transponder is equipped for long Mode S reply formats, have 4 (6 if also equipped with the enhanced data link protocols) of the 8 Mode S interrogations requiring long replies. Determine reply ratio for each type of interrogation.	

	SPI). Interrogate the transponder with two Mode A interrogations plus four Mode S interrogations (with short replies), each type of interrogation approximately uniformly spaced within a single 1.6-millisecond interval, followed by a 998.4-millisecond interval with no interrogation. Verify that the transponder replies at the specified rate. If the transponder has long reply capability, repeat the test for two additional Mode S interrogations with long replies. f. STEP 6 - Mode S Peak Reply Rate (Paragraph 3.4.3) ***NOTE:*** *This test need not to be repeated if it has already been performed as part of Step 2* Obtain the maximum number of segments (n) the transponder is declared to be capable of delivering. Calculate the additional number of segments (a) that the transponder is required to handle in a 25-millisecond interval each second as follows: a = n/4 (Rounded up) Load the transponder with a Downlink ELM with (n) segments. At Time = 0: Interrogate the transponder to extract (n) segments (i.e. the complete Downlink ELM). At Time = 24 milliseconds: Interrogate to extract (a) segments again (any segments of the downlink ELM can be chosen), then closeout the Downlink ELM Verify that all the segments were extracted correctly. Repeat the test once per second for 1 minute and verify that all the extractions were successful. [This procedure step is not required under environmental conditions.]	**Agreed**	Step 5 1.6 Milliseconds Peak Reply Rate Capability (§2.2.3.4.1 and 2.2.3.4.2) Repeat Step 3 with the following modification: Use two ATCRBS interrogations plus four Mode S interrogations (with short replies), each type of interrogation approximately uniformly spaced within a single 1.6-millisecond interval, followed by a 998.4-millisecond interval with no interrogation. If the transponder is so equipped, two of the Mode S interrogations require long replies instead of all short replies. Determine reply ratio for each type of interrogation.	
5.4.2.6	**Reply Rate Limiting** (Paragraph 3.11) [This procedure is not required under environmental conditions.]	**Agreed**		
5.4.2.6.1	Test Equipment a. 2 Transponder Test Sets. b. Wide Band Dual Channel Oscilloscope			
5.4.2.6.2	Test Procedure Connect the equipment as shown in Figures 5-5 and 5-6. a. STEP 1 - Determination of Mode A/C Reply Rate Limit With the Mode A code set to 0000, interrogate the transponder on Mode A at a rate greater than 2 000			

	interrogations per second. Record the reply rate at the maximum and minimum settings of the reply rate limit control. Set the reply rate limit control to 1 200 replies/sec or the maximum rate below 1 200 replies/sec for Class 2 transponders. b. STEP 2 - Mode S Reply Rate limiting (Paragraph 3.11) ***NOTE:*** *This test only needs to be performed if a reply rate limiting device is provided.* Interrogate the transponder with standard UF=4 interrogation requiring a long reply at a rate equal to 1.5-times the Mode S reply rate limit. Record the squitter reply rate. For a transponder equipped with the optional long air-air formats, interrogate the transponder as above and with interrogations requiring a DF=16 reply at a rate of 10 interrogations per second and record the DF=16 reply rate. c. STEP 3 - Sensitivity Reduction Set the transponder Mode C code to 0000 and the Mode A code to any value other than 0000. Interrogate the transponder with : (1) Mode C interrogations at MTL+20dB at a continuous rate of 1 200 interrogations/sec, and (2) unsynchronised Mode A interrogations at MTL+3dB, at a continuous rate of 600 interrogations/sec Verify that the transponder replies to at least 90% of the Mode C interrogations at the signal level of MTL+20dB, and that it does not reply to more than 10% of the Mode A interrogations.			
5.4.3	**Reply Characteristics**	**2.3.2.3**	**Reply Pulse Characteristic**	
5.4.3.1	**Mode A/C Replies** (Paragraph 3.5)	**2.3.2.3.1**	**ATCRBS Reply Pulse Characteristics (§2.2.4.1)**	
5.4.3.1.1	Test Equipment a. Transponder Test Set. b. Wide Band Dual Channel Oscilloscope.			
5.4.3.1.2	Test Procedures Connect the equipment as shown in Figure 5-3. a. STEP 1 - Mode A/C Reply Pulse Spacing (Paragraphs 3.5.1, 3.5.2, 3.5.5) Set a transponder for a 15-pulse reply (Mode A code 7777 with SPI pulse). Interrogate the transponder on Mode A and display the	**Agreed**	Step 1 ATCRBS Reply Pulse Spacing and Width (§2.2.4.1) Interrogate with a standard Mode A interrogation. Use a 15-pulse reply group (7777 **with SPI**) and measure the time between the first and last framing pulses. This time	**Note:** DO-181D Step 1 is effectively the same as ED-73D Step 1 and 2 in regard to validating ATCRBS Reply Pulse characteristics with

	reply pulses on the wide band oscilloscope. Record the spacing of each reply pulse with respect to the first framing pulse and the spacing between information pulses. b. STEP 2 - Mode A/C Reply Pulse Shape (Paragraph 3.5.4) Set the transponder for a 15-pulse reply (Mode A with SPI). Interrogate the transponder on Mode A. Record the duration of each reply pulse. Record the rise and decay times of each pulse. Record the pulse amplitude variations of each pulse with respect to all other pulses in the reply train. ***CAUTION:*** *If the detector is not known to be linear, checks should be made to determine what amplitude points on the detected pulse correspond to the 10% and 90% amplitude points of the RF pulses. In addition, checks should be made to determine the rise time of the detector.* [Under environmental conditions, it is sufficient to perform only the pulse duration measurement specified above.] c. STEP 3 - SPI Pulse (Paragraph 3.5.3 and 3.5.5) Interrogate with Mode A interrogations. Activate the SPI pulse control. Record the position of the SPI pulse with respect to the last framing pulse and the time the pulse remains in the reply train. [This procedure step is not required under environmental conditions.] d. STEP 4 - SPI Pulse with Mode C Interrogations (Paragraph 3.5.3) Interrogate with Mode C interrogations. Activate the SPI pulse control and verify that the SPI pulse is not transmitted. [This procedure step is not required under environmental conditions.]	**Agreed** **Agreed**	shall be 20.30 ±0.10 microseconds. Measure the width of the first and last pulses. This width shall be 0.45 ±0.10 microseconds. Observe that all code pulses are of equal width and stable in position with respect to the first pulse.	the exception of the SPI pulse. Therefore DO-181D is modified to include the SPI pulse. Once this is done, then there is no need for ED-73D Step 3 and 4 to be performed during environmental conditions as the SPI has already been checked. NEEDS TO BE RE-NEGOTIATED

EUROCAE ED-73B/C		RTCA DO-181D		COMMENT
5.4.3.2	**Mode S Replies, Acquisition and Extended Squitter Transmissions** (Paragraph 3.6)			
5.4.3.2.1	Test Equipment a. Transponder Test Set b. Wide Band Dual Channel Oscilloscope.	**2.3.2.3.2**	**Mode S Replies (§2.2.4.2)**	
5.4.3.2.2	Test Procedure (Mode S Replies) Connect the equipment as shown in Figure 5-3. Interrogate the transponder with a Mode A/Mode S All-Call. Display the Mode S reply on the oscilloscope. a. STEP 1 - Mode S Preamble (Paragraph 3.6.1) Record the pulse duration of the first four reply pulses. Record the pulse spacing between the leading edge of the first and each of the second, third and fourth pulses. [Under environmental conditions, this procedure is required only under High Operating Temperature conditions.] b. STEP 2 - Mode S Reply Data Pulses (Paragraph 3.6.2) ***NOTE:*** *For Steps 2 through 6, examine pulses at the beginning, middle and end of the replies.* Record the duration for both short and long reply pulses throughout the Mode S reply. Record the pulse spacing of the fifth reply pulse with reference to the first reply pulse. ***NOTE:*** *This pulse spacing will be either 8.0 µs or 8.5 µs depending on the requested reply format.* [Under environmental conditions, this procedure is required only under High Operating Temperature conditions.] c. STEP 3 - Mode S Reply Amplitude Variation (Paragraph 3.6.4 b.) Record the maximum power difference between pulses in the Mode S reply. [Under environmental conditions, this procedure is required only under High Operating Temperature conditions.] d. STEP 4 - Mode S Reply Pulse Shape (Paragraph 3.6.4 a.)	**WG-49 Agreed** STEP 1 to STEP 6 only in **high temperature**	Step 1 Mode S Preamble (§2.2.4.2.1) Connect the equipment as shown in Figure 2-26. Interrogate the transponder with a standard Mode A ATCRBS/Mode S All-Call. Display the Mode S reply on the oscilloscope. Measure the pulse duration of the first four reply pulses. Measure pulse spacing between the leading edge of the first and each of the second, third and fourth pulses. [Under environmental conditions, this procedure is required only under High Operating Temperature conditions.] Step 2 Mode S Reply Data Pulses (§2.2.4.2.2) ***Note:*** *For Steps 2 through 6, examine pulses at the beginning, middle and end of the replies.* Connect equipment as in Figure 2-26. Measure the pulse duration for both short and long reply pulses throughout the Mode S reply. Measure the pulse spacing of the fifth reply pulse with reference to the first reply pulse. [Under environmental conditions, this procedure is required only under High Operating Temperature conditions.] Step 3 Mode S Reply Amplitude Variation (§2.2.4.2.3.a) Connect the equipment as in Figure 2-26. Measure the maximum power differential between pulses in the Mode S reply. [Under environmental conditions, this procedure is required only under High Operating Temperature conditions.]	**Note:** During the October, 2009, DCA Meeting, SC-209 agreed to add appropriate steps 1-6 from section **2.4** of DO-181D with basically the same sequence.

	Record the rise and decay time of the reply pulses. ***CAUTION:*** *If the detector is not known to be linear, checks should be made to determine what amplitude points on the detected pulse correspond to the 10% and 90% amplitude points of the RF pulses. In addition, checks should be made to determine the rise and decay time of the detector.* [Under environmental conditions, this procedure is required only under High Operating Temperature conditions.] e. STEP 5 - Mode S Reply Pulse Spacing Tolerance (Paragraph 3.6.5) Measure the deviation of the leading edges of reply pulses from their assigned position and record the maximum values. [Under environmental conditions, this procedure is required only under High Operating Temperature conditions.] f. STEP 6 - Long Replies Repeat STEPS 1 to 5, using an interrogation which requires a long reply. [Under environmental conditions, this procedure is required only under High Operating Temperature conditions.]		Step 4 Mode S Reply Pulse Shape(§2.2.4.2.3.b) Measure the rise time of the reply pulses. **CAUTION:** If the detector is not known to be linear, checks should be made to determine what amplitude points on the detected pulse correspond to the 10 percent and 90 percent amplitude points of the RF pulses. In addition, checks should be made to determine the rise and decay time of the detector. [Under environmental conditions, this procedure is required only under High Operating Temperature conditions.] Step 5 Mode S Reply Pulse Spacing Tolerance (§2.2.4.2.4) Connect equipment as in Figure 2-26. Determine that the leading edge of any reply pulse is within 50 nanoseconds of its assigned position. [Under environmental conditions, this procedure is required only under High Operating Temperature conditions.] Step 6 Long Replies (§2.2.4.2.1 –through- 2.2.4.2.4) Repeat steps 1 –through- 5 using an interrogations which require long replies. [Under environmental conditions, this procedure is required only under High Operating Temperature conditions.]	

Special Note:

The Extended Squitter procedure previously provided in ED-73C at this point have been removed and entered at the end of this document for reference purposes only.

During the Paris WG-49 meeting, the October SC-209 Meeting in DCA, and the November WG-49 meeting in Cologne, it was agreed that the detailed procedures previously provided do not belong in section 5.4 and definitely cannot be performed under environmental condition.

Prior to attempting to just re-enter the removed procedures into section 5.5 of ED-73C, it should be noted that there are some serious concerns with the procedures in regards to applicability and traceability to requirements. Some of these concerns are presented as follows:

1. The procedures appear to have come from RTCA DO-260 / EUROCAE ED-100 in that they do detail protocol testing of the the ADS-B requirements as opposed to detailed testing of extended squitter protocol testing as done in RTCA DO-181C.
2. Basically, there is little to no correlation between the procedures that were removed from ED-73 and those provided in RTCA DO-181D section 2.5.4.6.

Before completion of harmonization of ED-73C and DO-181D can be completed, new extended squitter test procedures must be developed for Section 5.5 of ED-73C. Such procedures must be able to be correlated with those in DO-181D and such procedures must not be reliant on content as defined in DO-260, DO-260A, B, or X.

With the understanding that new procedures will be developed for ED-73C, the following general procedures are provided for both ED-73C and DO-181D for environmental test purposes. As extended squitter functions are fundamentally software functions executed on a previously validated transponder platform, the

following procedures are intended only to demonstrate that the extended squitter fundamental basics are operational under environmental conditions.
Therefore:
A. WG-49 needs to add or amend ED-73C section 5.4.3.2.3 to read as provided in the following column 1 and 2.
B. SC-209 needs to add new section 2.3.2.13 to DO-181D as provided in the following column 3 and 4.

5.4.3.2.3	Test Procedure__Extended Squitter	**2.3.2.13**	**Extended Squitter** (§2.2.125 and 2.2.23)	
	a. STEP 1 - Airborne Position Message Validation (Paragraph 3.16.7.3 and 3.28.3.a) (1) Establish appropriate conditions where the transponder declares the Airborne State (2) Provide the transponder with appropriate latitude, longitude and altitude data via an appropriate interface. (3) Verify that the transponder provides Airborne Position Message extended squitter transmissions that: - are transmitted at average intervals of 0.40 –to- 0.60 seconds. - are alternated between the top and bottom antenna for diversity transponders - contain the appropriate information in the "MB" field b. STEP 2 - Airborne Velocity Message Validation (Paragraph 3.16.7.3 and 3.28.3.d) (1) Provide the transponder with appropriate velocity data via an appropriate interface. (2) Verify that the transponder provides Airborne Velocity Message extended squitter transmissions that: - are transmitted at average intervals of 0.40 –to- 0.60 seconds. - are alternated between the top and bottom antenna for diversity transponders - contain the appropriate information in the "MB" field c. STEP 3 – Aircraft Identification Message Validation (Paragraph 3.16.7.3 and 3.28.3.c) (1) Provide the transponder with appropriate velocity data via an appropriate interface. (2) Verify that the transponder provides Airborne Velocity Message extended squitter transmissions that: - are transmitted at average intervals of 4.8 –to-		a. STEP 1 - Airborne Position Message Validation (§2.2.12.5.2, 2.2.23.1.3.b) (1) Establish appropriate conditions where the transponder declares the Airborne State (2) Provide the transponder with appropriate latitude, longitude and altitude data via an appropriate interface. (3) Verify that the transponder provides Airborne Position Message extended squitter transmissions that: - are transmitted at average intervals of 0.40 –to- 0.60 seconds. - are alternated between the top and bottom antenna for diversity transponders - contain the appropriate information in the "MB" field b. STEP 2 - Airborne Velocity Message Validation (§2.2.12.5.2, 2.2.23.1.3.e) (1) Provide the transponder with appropriate velocity data via an appropriate interface. (2) Verify that the transponder provides Airborne Velocity Message extended squitter transmissions that: - are transmitted at average intervals of 0.40 –to- 0.60 seconds. - are alternated between the top and bottom antenna for diversity transponders - contain the appropriate information in the "MB" field c. STEP 3 – Aircraft Identification Message Validation (§2.2.12.5.2, 2.2.23.1.3.d) (1) Provide the transponder with appropriate velocity data via an appropriate interface. (2) Verify that the transponder provides Airborne Velocity Message extended squitter transmissions that: - are transmitted at average intervals of 4.8 –to-	**Note:** **Column 1 and 2 to be implemented in ED-73C** **Column 3 and 4 to be implemented in DO-181D.**

	05.2 seconds. - are alternated between the top and bottom antenna for diversity transponders - contain the appropriate information in the "MB" field d. STEP 4 - Airbore Position Message Termination (Paragraph 3.28.3.3) (1) Discontinue providing the transponder with appropriate latitude, longitude and altitude data via an appropriate interface. (2) Two seconds after interrupting data, verify that the transponder provides Airborne Position Message extended squitter transmissions that: - contain All ZERO's in the "MB" field e. STEP 5 - Airbore Velocity Message Termination (Paragraph 3.28.3.3) (1) Discontinue providing the transponder with appropriate velocity data via an appropriate interface. (2) Two seconds after interrupting data, verify that the transponder provides Airborne Velocity Message extended squitter transmissions that: - contain All ZERO's in the "MB" field f. STEP 6 - Surface Position Message Validation (Paragraph 3.16.7.3 and 3.28.3.b) (1) Establish appropriate conditions where the transponder declares the On-Ground State (2) Provide the transponder with appropriate latitude and longitude data via an appropriate interface. (3) Verify that the transponder provides Surface Position Message extended squitter transmissions that: - are transmitted at average intervals of 4.8 –to- 5.2 seconds. - are transmitted on the top antenna only for diversity transponders - contain the appropriate information in the "MB" field g. STEP 7 – Surface Position Message Termination (Paragraph 3.28.3.3) (1) Discontinue providing the transponder with appropriate latitude and longitude data via an		05.2 seconds. - are alternated between the top and bottom antenna for diversity transponders - contain the appropriate information in the "MB" field d. STEP 4 - Airbore Position Message Termination (§2.2.23.1.4.2) (1) Discontinue providing the transponder with appropriate latitude, longitude and altitude data via an appropriate interface. (2) Two seconds after interrupting data, verify that the transponder provides Airborne Position Message extended squitter transmissions that: - contain All ZERO's in the "MB" field e. STEP 5 - Airbore Velocity Message Termination (§2.2.23.1.4.2) (1) Discontinue providing the transponder with appropriate velocity data via an appropriate interface. (2) Two seconds after interrupting data, verify that the transponder provides Airborne Velocity Message extended squitter transmissions that: - contain All ZERO's in the "MB" field f. STEP 6 - Surface Position Message Validation (§2.2.12.5.2, 2.2.23.1.3.c) (1) Establish appropriate conditions where the transponder declares the On-Ground State (2) Provide the transponder with appropriate latitude and longitude data via an appropriate interface. (3) Verify that the transponder provides Surface Position Message extended squitter transmissions that: - are transmitted at average intervals of 4.8 –to- 5.2 seconds. - are transmitted on the top antenna only for diversity transponders - contain the appropriate information in the "MB" field g. STEP 7 – Surface Position Message Termination (§2.2.23.1.4.2) (1) Discontinue providing the transponder with appropriate latitude and longitude data via an	

	appropriate interface. (2) Two seconds after interrupting data, verify that the transponder provides Surface Position Message extended squitter transmissions that: - contain All ZERO's in the "MB" field		appropriate interface. (2) Two seconds after interrupting data, verify that the transponder provides Surface Position Message extended squitter transmissions that: - contain All ZERO's in the "MB" field	

EUROCAE ED-73B/C		RTCA DO-181D		COMMENT
5.4.3.3	**Mode A/C Reply Delay and Jitter (Paragraph 3.7.1)**	**2.3.2.3.1**	**ATCRBS Reply Pulse Characteristics (§ 2.2.4.1)**	
5.4.3.3.1	Test Equipment a. Transponder Test Set. b. Wide Band Dual Channel Oscilloscope.			
5.4.3.3.2	Test Procedures Connect the equipment as shown in Figure 5-3. a. STEP 1 - Reply Delay (Paragraph 3.7.1 a.) Interrogate the transponder with a Mode A interrogation. Synchronise the oscilloscope using the leading edge of P3. Record the average delay between the leading edge of P3 and the leading edge of the first reply pulse at the 50% amplitude points, for signal levels of MTL, -50 dBm and -21 dBm. [Under environmental conditions, it is sufficient to perform the above test at signal levels of MTL + 3 dB, -50 dBM, and -21 dBm.] b. STEP 2 - Reply Jitter (Paragraph 3.7.1 b.) Repeat STEP 1 recording the difference in extreme positions of the leading edge of the first reply pulse for signal levels of MTL +3 dB, -50 dBm, and -21 dBm. c. STEP 3 - Reply Delay Variation (Paragraph 3.7.1 c.) Repeat STEP 1 using alternate Mode C and Mode A interrogations. Record the reply delay variation between modes. [This procedure step is not required under environmental conditions.]	**Agreed** **Agreed** **Agreed**	Step 2 Reply Delay and Jitter (§2.2.4.1.6 a and b) Connect the equipment as shown in Figure 2-26. Interrogate the transponder with a standard Mode A interrogation. Measure the average delay between the leading edge of P3 and the leading edge of the first reply pulse at the 50% amplitude points and the extreme positions of the leading edge of the first reply pulse at signal levels of MTL +3 dB, -50 dBm and -21 dBm.	
5.4.3.4	**Mode S Reply Delay and Jitter** (Paragraph 3.7.2a)	**2.3.2.3.2**	**Mode S Replies** (§2.2.4.2)	
5.4.3.4.1	Test Equipment a. Transponder Test Set. b. Wide Band Dual Channel Oscilloscope			
5.4.3.4.2	Test Procedures Connect the equipment as shown in Figure 5-3. **[Should be MTL+3dB]** a. STEP 1 - Mode S Reply Delay and Jitter Interrogate the transponder with a Mode S interrogation using any format for which a reply is required. Synchronise the oscilloscope to the interrogation. For signal levels of MTL, -50 and -21 dBm, record: (1) The difference in extreme positions of the		Step 1 Mode S Reply Delay and Jitter (§ 2.2.4.2.5 a) Interrogate the transponder with a standard Mode S interrogation using any format for which a reply is required. Measure the extreme positions of the leading edge of the first reply pulse, at signal levels of MTL +3 dB, -50 dBm and -21 dBm, and the delay between the P6 sync phase reversal transient and the leading edge of the	Note: in ED-73C Step 1 needs to have MTL+3dB.

	leading edge of the first reply pulse, and (2) The average delay between the P6 sync-phase reversal and the leading edge of the first reply pulse. b. STEP 2 - Mode A/C/S All-Call Reply Delay and Jitter (Paragraph 3.7.2 b) Interrogate the transponder with a Mode A/C/S All-Call interrogation. Synchronise the oscilloscope to the interrogation. For signal levels of MTL+3dB, -50dBm and -21 dBm, record : (1) the difference in extreme positions of the leading edge of the first reply pulse, (2) the average delay between the leading edge of P4 and the leading edge of the first reply pulse.		first reply pulse. Step 2 ATCRBS/Mode S All-Call Reply Delay and Jitter (§ 2.2.4.2.5 b) Interrogate the transponder with a standard ATCRB S/Mode S All-Call interrogation. Measure the extreme positions of the leading edge of the first reply pulse at signal levels of MTL +3 dB, -50 dBm and -21 dBm, and the delay between the leading edge of P4 and the leading edge of the first reply pulse.	
5.4.4	**Side Lobe Suppression (Paragraph 3.8)**	**2.3.2.4**	**Side Lobe Suppression (§2.2.5)**	
5.4.4.1	**Mode A/C, Mode A/C-only All-Call and Mode A/C/S All-Call**			
5.4.4.1.1	Test Equipment a.2 Transponder Test Sets. b. Wide Band Dual Channel Oscilloscope. c. 3 Port Divider.			
5.4.4.1.2	Test Procedure Connect the equipment as shown in Figure 5-5. a. STEP 1 - Suppression Duration (Paragraph 3.8.1 a.) Interrogate the transponder at 450 interrogations per second with a P1-P2 pulse pair followed after 50 µs, by a P1 -P3 (Mode A, 8 µs) pulse pair. ***NOTE:*** *All pulse levels should be set to -24 dBm; any reply code may be selected.* Reduce this 50 µs interval until the transponder reply rate falls below 10%. Measure the time interval between the leading edges of P2 and P1 (of the P1-P3 pair), and record this as the suppression duration S(8). Repeat the above procedure using Mode C (21-microsecond spacing) for the P1-P3 pair; record the result as suppression duration S(21). b. STEP 2 - Suppression Re-initiation (Paragraph 3.8.1 c.) With an interrogation rate of 450 interrogations per second, generate a first P1-P2 pair followed by a second			**Note 1**: ED-73 Step 1 and DO-181D Step 4 are effectively equivalent with the exception that ED sets the reply rate at 10% and DO-181D sets the reply rate at "ceases to reply". Recommend change to DO-181D, Step 4 as annotated below. DO-181D does not repeat the test using Mode-C. Therefore, Step 4, below, is amended as needed.

	P1-P2 pair such that the spacing between P2 of the first pair and P1 of the second pair is S(8) plus 2 µs. Generate a third pair, P1-P3 Mode A, 50 µs after the second pair. ***NOTE:*** *All pulse levels should be set to -24 dBm; any reply code may be selected.* Reducing the interval between the P1-P2 pair and the P1-P3 pair, record the interval at which the transponder replies fall below 10%. Repeat the test using Mode C spacing for the P1-P3 pair and determine suppression duration S(21). [This procedure step is not required under environmental conditions.]	**Agreed**		
	c. STEP 3 - Recovery After Suppression (Paragraph 3.8.1 d.) Repeat STEP 1 using the following signal levels: (1) P1-P2 pair = -30 dBm; (1) P1-P3 pair = MTL. Record the reply ratio observed when the P2 (suppression) P1 (interrogation) spacing is no more than 1 µs greater than S(8, 21) determined in previous steps. [This procedure step is not required under environmental conditions.]	**Agreed**		
	d. STEP 4 - SLS Decoding (Paragraph 3.8.2 a.) Interrogate the transponder with a Mode A interrogation including a P2 pulse; (RF signal levels MTL+3dB, -50 dBm and -21 dBm; P2 level = P1 level). As the P1-P2 spacing is varied over the range from 1.85 to 2.15 µs, record the reply ratio and verify that it does not exceed 10%. [Under environmental conditions, it is sufficient to perform this test step with the RF signal level set to MTL + 3 dB].	**Agreed**	Step 1 SLS Decoding [§ 2.2.5.1 a (1) and (3)] Connect the equipment as shown in Figure 2-27. Interrogate the transponder with a standard Mode A interrogation plus P2 RF signal level to be at MTL +3 dB; P2 level = P1 level.. Verify that the reply ratio is less than one percent. Step 2 SLS Dynamic Range [§ 2.2.5.1 a (1) and (3)] Repeat Step 1 at RF signal levels: -60 dBm, -40 dBm and -21 dBm.	**Note:** During the October, 2007, DCA meeting, SC-209 made the decision that there was no need to change step 1 and 2 to call out a 1% limit.
	Special Note: **In regards to the following ED-73C, e. Step 5:** **During the November, 2007, Cologne Meeting, WG-49 agreed that the procedure is not required under environmental conditions. Therefore, the issue of being able to vary P1 and P2 at the same time becomes a mute point.** **However, DO-181D does not perform and equivalent test; therefore, the test needs to be added to DO-181D as section 2.4.2.4, Step 9.**			
	e. STEP 5 - Short Duration P2 (Paragraph 3.8.2 b (3)) Interrogate the transponder with a Mode A interrogation with : (1) P2 level = P1 level, (2) P2 duration less than 0.3 µs.		Step 9 Short Duration P2 (§2.2.5.1.b.(3)) Interrogate the transponder with a Mode A interrogation with : (1) P2 level = P1 level, (2) P2 duration less than 0.3 µs.	**Note:** Step 9, at left is to be added to section 2.4.2.4 and NOT to section 2.3.2.4.

	Record the reply ratio and verify the minimum is at least 90% at signal levels of MTL+3dB, -50 and -21dBm. [This procedure is not required under environmental conditions.]	**Agreed Cologne**		Record the reply ratio and verify the minimum is at least 90% at signal levels of MTL+3dB, -50 and -21dBm.	
	f. STEP 6 - SLS Pulse Ratio (Paragraph 3.8.2 b (1)) Interrogate the transponder with a Mode A interrogation including a P2 pulse; (P2 level = P1 -9dB). As the P1-P2 spacing is varied over 1 to 3 µs, record the reply efficiency and verify that the minimum is at least 90% at signal levels of MTL+3dB, -50 and - 21dBm. g. STEP 7 - Suppression on Mode A/C/S All-Call Repeat STEP 4, STEP 5, and STEP 6, with Mode A/C/S All-Call. [This procedure step is not required under environmental conditions.] h. STEP 8 - Simultaneous Interrogation of Mode A/C with P2 (Simultaneous decoding of Mode A/C interrogation with Mode A/C suppression) (Paragraph 3.8.2 d.) Interrogate the transponder with a Mode A pulse pair with: (1) RF signal level = -50dBm, (2) P2 level = P1 level. Generate a 0.8 µs pulse, at the same level as P2, 8 µs before the leading edge of P2. Observe that the reply ratio is less than 10%. Repeat this test with the 0.8 µs pulse, 21 µs before the leading edge of P2. [This procedure step is not required under environmental conditions.] i. STEP 9 - Low Signal Level Characteristics (Paragraph 3.8.2 c.) Interrogate the transponder with a Mode A interrogation, including a P2 pulse (P2 = P1 level). Vary the signal level from MTL to MTL+3dB. Verify that the reply ratio does not exceed 10%. [This procedure step is not required under environmental conditions.]	**Agreed** **Agreed** **Agreed**	Step 3 SLS Pulse Ratio (§ 2.2.5.1 b) Repeat Step 1 at RF signal levels of MTL + 3 dB, -50 dBm and -21 dBm. Set P_2 level 9 dB below P_1 Level. Verify that the reply efficiency is at least 90%. Step 4 Suppression Duration (§ 2.2.5.1 b) Interrogate the transponder with a P_1 - P_2 ATCRBS suppression pulse pair (2 microsecond spacing), followed after 50 microseconds with a P_1 - P_3 (Mode A, 8 microseconds) pulse pair. Reduce the spacing of the P_1 - P_3 pair until the transponder reply rate is below 10%. The time interval between the leading edges of P_2 and P_1 (of the P_1 - P_3 pair) is the suppression duration. Repeat the procedure using P_1 – P_3 (Mode C, 21 microseconds) pulse pair interrogations.	**Note:** During the October, 2007, DCA meeting, SC-209 agreed to change step 3 to read as shown at left. **Note:** During the October, 2007, DCA meeting, SC-209 agreed to change step 4 to read as shown at left.

EUROCAE ED-73B/C		RTCA DO-181D		COMMENT
5.4.4.2	**Mode S Formats (Paragraph 3.8.3)** [This procedure is not required under environmental conditions.]	**Agreed**		
5.4.4.2.1	Test Equipment a. 2 Transponder Test Sets. b. Wide Band Dual Channel Oscilloscope. c. 3 Port Divider.			
5.4.4.3	**Test Procedure** Connect the equipment as shown in Figure 5-5. a. STEP 1 - Conditions under which a Transponder must not reply Set the master test set to generate a Standard Mode S-only All-Call at levels of MTL+3dB, -60 dBm, -40dBm and -21 dBm. [Under environmental conditions, it is sufficient to perform this test step at levels of MTL + 3 dB and -21 dBm only.] Set the slave test set to generate a 0.8 ìs duration pulse at the P5 nominal position and at a level of P6+3dB. Verify that the reply ratio is less than 10%. b. STEP 2 - Conditions under which a Transponder must reply Repeat STEP 1 with P5 pulse at a level of P6-12dB. Verify that the reply ratio is at least 99%.	**Agreed**		
5.4.5	**Pulse Decoder Characteristics (Paragraph 3.9)**	**2.3.2.5**	**Pulse Decoder Characteristics (§2.2.6)**	
5.4.5.1	**Test Equipment** a. Transponder Test Set. b. Wide Band Dual Channel Oscilloscope.			
5.4.5.2	**Test Procedure** Connect the equipment as shown in Figure 5-3. a. STEP 1 - Pulse Level Tolerances, Mode A/C/S All-Call (Paragraph 3.9.2 a.) Using a Mode A interrogation followed by a 1.6-ìs P4 pulse at its nominal position, interrogate at the standard rate and at an RF signal level 10 dB above MTL. Vary the level of the P4 pulse between -10 dB and 0 dB with respect to P3. Measure and record : (1) the highest level of P4 relative to P3 at which 90% Mode A replies occur. (2) the lowest level of P4 relative to P3 at which 99% Mode S replies occur.		Step 1 Pulse Level Tolerances, ATCRBS/Mode S All-Call (§ 2.2.6.1.1) Connect the equipment as shown in Figure 2-26. Interrogate at the standard rate and at an input level 10 dB above MTL. Use an ATCRBS Mode A interrogation followed by a 1.6-microsecond P4 pulse in its nominal position. Vary the level of the P4 pulse between -10 and 0 dB in 1 dB steps with respect to P3. Verify the changeover from ATCRBS to Mode S replies at the relative P4 levels specified in §2.2.6.1.1 a and b.	

	Repeat the test at RF signal levels -60, -40 and -21 dBm. Repeat the tests using a Mode C interrogation. [Under environmental conditions, it is sufficient to perform this test step using only Mode A interrogations having an RF signal level of MTL + 10 dB.]	**Agreed**		
	b. STEP 2 - Pulse Level Tolerances, Mode A/C-Only All-Call (Paragraph 3.9.2 b.) Use set-up and signal levels as in STEP 1 above but use a 0.8 µs P4. Vary the level of the P4 pulse between -10 and 0 dB with respect to P3. Measure and record the P4 levels relative to P3 at which the Mode A reply rate falls below: (1) 90% (2) 10%. Repeat the test at input signal levels -60, -40 and -21 dBm. Repeat the tests using a Mode C interrogation. [Under environmental conditions, it is sufficient to perform this test step using only Mode A interrogations having an RF signal level of MTL + 10 dB.]	**Agreed**	Step 2 Pulse Level Tolerances, ATCRBS-Only All-Call (§ 2.2.6.1.2) Use setup and signal levels as in Step 1 above but employ a 0.8 microsecond P4. Vary the level of the P4 pulse between -10 and 0 dB in 1 dB steps with respect to P3. Verify the changeover from ATCRBS replies to no replies at the relative P4 levels specified in paragraphs 2.2.6.1.2 a. and b.	
	c. STEP 3 - Pulse Position Tolerances, (P1-P3) Mode A/C-Type Interrogations (Paragraphs 3.9.3 a. & c.) Using signal levels of MTL+10dB, interrogate with : (1) Mode A; (2) Mode C; (3) Mode A/Mode S All-Call; (4) Mode C/Mode S All-Call; (5) Mode A-Only All-Call; (6) Mode C-Only All-Call. For each interrogation type, (1) vary the P1-P3 spacing within the required acceptance range and record the minimum reply ratio, (2) vary the P1-P3 spacing to fall out of the permitted acceptance range and record the maximum reply ratio; (3) record the reply ratio to both the Mode A/C-Only All-Call modes. [Under environmental conditions, it is sufficient to perform this test step using only Mode A and Mode C/Mode S All-Call interrogations.]	**Agreed**	Step 3 Pulse Position Tolerances, P1/3, ATCRBS-Type Interrogations (§2.2.6.2 a and b) Use setup and signal levels as in Step 1 above. Interrogate with: a. ATCRBS Mode A b. ATCRBS Mode C/Mode S All-Call For each interrogation type vary the P1 -P3 spacing within the required acceptance range (§2.2.6.2 a) and verify that the reply ratio is at least 90%.	
	d. STEP 4 - Pulse Position Tolerances, P4, Mode A/C/S		Step 4 Pulse Position Tolerances, P4, ATCRBS/Mode S All-	

	All-Call Interrogatio(Paragraphs 3.9.3 b. & d.) Using signal levels as in STEP 1, interrogate with (1) Mode A/Mode S All-Call, (2) Mode C/Mode S All-Call. For each interrogation type, - vary the P3-P4 spacing within the required acceptance range and record the minimum reply ratio; - vary the P3-P4 spacing to fall out of the permitted acceptance range and record the maximum reply ratio; - record the reply ratio to both the Mode A/C-Only All-Call modes. [Under environmental conditions, it is sufficient to perform this test step using only Mode A/Mode S All-Call interrogations.]	**Agreed**		Calls (§ 2.2.6.2 a and c) Use setup and signal levels as in Step 1 and interrogate with an ATCRBS Mode A/Mode S All-Call. Vary the P3-P4 spacing within the required acceptance range. Determine conformance to requirements as in Step 3.	
e.	STEP 5-Pulse Duration Tolerances, Mode A/CInterrogations (Paragraphs 3.9.4 a.) Using signal levels as in STEP 1 above, interrogate with (1) Mode A, (2) Mode C. For each interrogation type, - vary the P1 duration within the required acceptance range and record the minimum reply ratio; - vary the P1 duration to fall out of the permitted acceptance range and record the maximum reply ratio. Repeat test varying the P3 duration in the same manner. [Under environmental conditions, this procedure is only required when performing Temperature testing. Also, when doing such testing, it is acceptable to vary duration of P1 and P3 at the same time if that is the capability of the Mode S Test Equipment being used.]	**Agreed**	STEP 5	Pulse Duration Tolerances, Mode A/CInterrogations (Paragraphs 2.2.6.2.x.x.x.) Using signal levels as in STEP 1 above, interrogate with (1) Mode A, (2) Mode C. For each interrogation type, - vary the P1 duration within the required acceptance range and record the minimum reply ratio; - vary the P1 duration to fall out of the permitted acceptance range and record the maximum reply ratio. Repeat test varying the P3 duration in the same manner. [Under environmental conditions, this procedure is only required when performing Temperature testing. Also, when doing such testing, it is acceptable to vary duration of P1 and P3 at the same time if that is the capability of the Mode S Test Equipment being used.]	**Note:** **DO-181D to ADD Step 5 and Step 6.** SC-209 will use the "Note" style for these comments shown in brackets.
f.	STEP 6 - Pulse Duration Tolerance, Mode A/C/S All-Call Interrogations (Paragraphs 3.9.4 b. & c.) Using signal levels as in STEP 1 above, interrogate with: (1) Mode A/Mode S All-Call, (2) Mode C/Mode S All-Call. For each interrogation type, - vary the P1 duration within the required acceptance range and record the minimum		STEP 6	Pulse Duration Tolerance, Mode A/C/S All-Call Interrogations (Paragraphs 2.2.6.2.x.x.x.) Using signal levels as in STEP 1 above, interrogate with: (1) Mode A/Mode S All-Call, (2) Mode C/Mode S All-Call. For each interrogation type, - vary the P1 duration within the required acceptance range and record the minimum	

	reply ratio; - vary the P1 duration to fall out of the permitted acceptance range and record the maximum reply ratio. Repeat test varying the P3 duration in the same manner. Repeat test varying the P4 duration in the same manner. [Under environmental conditions, this procedure is only required when performing Temperature testing. Also, when doing such testing, it is acceptable to vary duration of P1 and P3 at the same time if that is the capability of the Mode S Test Equipment being used.]	**Agreed**		reply ratio; - vary the P1 duration to fall out of the permitted acceptance range and record the maximum reply ratio. Repeat test varying the P3 duration in the same manner. Repeat test varying the P4 duration in the same manner. [Under environmental conditions, this procedure is only required when performing Temperature testing. Also, when doing such testing, it is acceptable to vary duration of P1 and P3 at the same time if that is the capability of the Mode S Test Equipment being used.]	
	g. STEP 7-Short Pulse Rejection, Mode A/C or Mode A/C/S All-Call Interrogations (Paragraph 3.9.4 d.) With an RF signal level at MTL, interrogate with each of the following interrogation types: (1) Mode A, (2) Mode C/Mode S All-Call. In each case, reduce the P1 duration to 0.3 µs and record the reply ratio. Repeat the tests at 5 dB increments up to -45 dBm input level. Repeat the tests reducing the P3 duration in the same manner. [Under environmental conditions, it is sufficient to perform this test step using input signal levels of MTL, -60 dBm, and -45 dBm. It is also sufficient to perform the tests with P1 set to a duration of 0.25 microseconds and then verifying that there are less than 10% replies to the interrogations provided.]	**Agreed**	Step 7	Short Pulse Rejection, ATCRBS-Type Interrogations (§ 2.2.6.3 c) Use setup as in Step 1 and set signal input level to MTL for each of the following interrogation types: a. ATCRBS Mode A b. ATCRBS Mode C/Mode S All-Call For each interrogation type set P1 duration to 0.25 microsecond and verify that less than 10% replies are generated. Repeat test for a P3 duration of 0.25 microsecond. Repeat tests at -60 dBm and -45 dBm input level.	**Note:** **DO-181D to RE-NUMBER to Step 7.**
	h. STEP 8 - Sync Phase Reversal Position Tolerance (from P2) (Paragraph 3.9.5b.) ***NOTE:*** *STEP 8 or STEP 9 may be used depending on the design of the transponder.* Set the Transponder Test Set to generate a Mode S-Only All-Call interrogation at MTL+3dB. Vary the spacing between the leading edge of P2 and the P6 sync-phase reversal transient by ±200 nanoseconds from the nominal 2.75 µs. Record the ranges over which at least 90% Mode S replies are received. Record the points at which no Mode S replies are received. Repeat for RF signal levels between -50 and -21 dBm in 5 dB steps. [Under environmental conditions, it is sufficient to perform this test step using signal levels of MTL + 3 dB,	**Agreed**	Step 8	Sync Phase Reversal Position Tolerance (from P2) (§2.2.6.4) Generate a standard Mode S-Only All-Call interrogation at MTL +3 dB. Vary the spacing between the P6 sync phase reversal and either P2 or P6 as applicable by 200 nanoseconds from the nominal spacing. Measure the range over which Mode S replies are received. Repeat for P1 levels of -50 dBm and -21 dBm.	**Note:** **DO-181D to RE-NUMBER to Step 8.**

	-50 dBm and -21 dBm.] i. STEP 9 - Sync Phase Reversal Position Tolerances (from P6) (Paragraph 3.9.5c.) Set the Transponder Test Set to generate a Mode S-Only All-Call interrogation at MTL+3dB. Vary the spacing between the leading edge of P6 and the P6 sync-phase reversal transient by ±200 nanoseconds from the nominal 1.25 µs. Record the range over which at least 90% Mode S replies are received. Record the points at which no Mode S replies are received. Repeat for RF signal levels between -50 and -21 dBm in 5 dB steps. [Under environmental conditions, it is sufficient to perform this test step using signal levels of MTL + 3 dB, -50 dBm and -21 dBm.]	**Agreed**		
	j. STEP 10 - Simultaneous Interrogation of Mode A and Mode C (Paragraph 3.12.2.b) Interrogate with Mode C. Inject a 0.8 µs pulse of amplitude equal to P1 and P3, such that it occurs 8 µs before the P3 pulse of a Mode C interrogation. Record that all replies are Mode C replies. [This procedure step is not required under environmental conditions.]	**Agreed**		**Rationale:** Updated ED-73C requirement reference to 3.12.2.b

EUROCAE ED-73B/C		RTCA DO-181D		COMMENT
5.4.6	**Transponder Desensitisation and Recovery** (Paragraph 3.10)	**2.3.2.6**	**Transponder Recovery and Desensitization (§ 2.2.7)**	
5.4.6.1	**Test Equipment** a. 2 Transponder Test Sets. b. Wide Band Dual Channel Oscilloscope. c. 3 Port Power Divider.			
5.4.6.2	**Test Procedure** Connect the equipment as shown in Figure 5-5. a. STEP 1-Mode A/C Single Pulse Desensitisation and Recovery (Paragraphs 3.10.1 a. and 3.10.2) Set the master test set to generate a single pulse not less than 0.7 µs wide at the Mode A/C interrogation rate and a power level equal to 50 dB .above MTL. Set the slave test set to generate a Mode A interrogation delayed 3 µs from the trailing edge of the single pulse. Record the amplitude of the slave test set signal required to produce 90% reply ratio. Repeat for master to slave test set delays of 6, 10 and 15 µs. [Under environmental conditions, it is sufficient to perform this test step with master to slave test set delays of 3 and 15 microseconds.] b. STEP 2 – Recovery from a Mode S Interrogation Requiring No Reply (Paragraph 3.10.2 c.) Set the master test set to generate a short Mode S surveillance interrogation with broadcast address. Set the slave test set to generate a Mode A interrogation at a power level equal to 3 dB above MTL and delayed with respect to the Mode S interrogation. Record the minimum delay time between the master and the slave test sets necessary to elicit a Mode A reply ratio of 90%. c. STEP 3 - Recovery from a Mode S Comm-C Interrogation Requiring No Reply (Paragraph 3.10.2 d.) Set the master test set to generate the initial segment of a properly addressed Comm-C interrogation at a signal level of -21 dBm. Set the slave test set to generate a Mode A interrogation delayed 45 µs from the sync-phase reversal of the master interrogation. Vary the amplitude of the slave test signal and record the minimum level required to produce 90% Mode A reply	**Agreed** **Agreed** **Agreed** **Agreed**	Step 1 ATCRBS Single Pulse Desensitization and Recovery (§ 2.2.7.1.1 and 2.2.7.2) Connect the equipment as shown in Figure 2-27. Set the master test set to generate a single pulse not less than 0.7 microsecond wide at the standard ATCRBS interrogation rate and a power level equal to 50 dB above MTL. Set the slave test set to generate an ATCRBS Mode A interrogation delayed 3 microseconds from the trailing edge of the single pulse. Determine the amplitude of the slave test set signal required to produce 90% reply efficiency. Repeat for master to slave test set delay of 15 microseconds. Step 2 Recovery from a Mode S Interrogation Requiring No Reply (§2.2.7.2.1) With equipment connected as shown in Figure 2-27, set the master test set to generate a short Mode S surveillance interrogation with broadcast address. Set the slave test set to generate an ATCRBS Mode A interrogation at a power level equal to 3 dB above MTL. Measure the delay time between the master and the slave test sets necessary to elicit a reply efficiency of 90%. Step 3 Recovery from a Mode S Comm-C Interrogation (§ 2.2.7.2.2) With equipment connected as shown in Figure 2-27, set the master test set to generate the initial segment of a properly addressed Comm-C interrogation at a signal level of -21 dBm. Set the slave test set to generate an ATCRBS Mode A inter-rogation delayed 45 microseconds from the sync phase reversal of the master interrogation. Determine the amplitude of the slave test	

	ratio. d. STEP 4 - Recovery from a Suppression Pair or unaccepted Mode A/C/S All-Call or Mode A/C-Only All-Call (Paragraphs 3.10.2 e, and 3.10.2 g.) Set the master test set to generate a P1-P2 pulse pair at the Mode A/C standard interrogation rate and a power level equal to -35 dBm. Set the slave test set to generate a Mode S-Only All-Call interrogation delayed 10 µs after the last pulse of the master test set interrogation. Determine the amplitude of the slave test set signal required to produce 90% reply efficiency. [The following paragraph of this test step is not required during environmental conditions.] Lock out the transponder to All-Calls and repeat the procedure with Mode A/C/S All-Call and Mode A/C-only All-Call interrogations in place of the suppression pair. e. STEP 5 - Narrow Pulse Performance (Paragraph 3.10.1 b.) Set the master test set to generate a single pulse between 0.6 and 0.7 µs wide, at the Mode A/C interrogation rate and level. Set the slave test set to generate a Mode A interrogation delayed 3 µs from the single pulse. Record the amplitude of the slave test set signal needed to produce 90% reply ratio. Repeat for master to slave test set delays of 6, 10 and 15 µs. [This procedure step is not required under environmental conditions.] f. STEP 6 - Dead Time (Paragraph 3.10.3) Set the master test set to generate a Mode A/C/S All-Call interrogation at a level of -21 dBm. Set the slave test set to generate a Mode S-Only All-Call interrogation at a level of 3 dB above MTL. Record the time delay between the end of the reply to the master interrogation and the start of the slave interrogation that elicits a 90% reply ratio from the transponder. Repeat with the master test set generating a Mode S-Only All-Call at -21 dBm and the slave test set generating a Mode A interrogation at MTL+3dB. [This procedure step is not required under environmental conditions.]	**Agreed** **Agreed** **Agreed** **Agreed** **Agreed**	signal required to produce 90% reply efficiency. Step 4 Recovery from a Suppression Pair (§ 2.2.7.2.1) With equipment connected as shown in Figure 2-27, set the master test set to generate a P_1 - P_2 pulse pair at the ATCRBS standard interrogation rate and a power level equal to -35 dBm. Set the slave test set to generate a Mode S-Only All-Call interrogation delayed 10 microseconds from the trailing edge of the P_2 pulse of the master test set interrogation. Determine the amplitude of the slave test set signal required to produce 90% reply efficiency.	

	g. STEP 7 - Recovery From a Mode S Interrogation Which Has Not Been Accepted (Paragraph 3.10.2 f) Set the master test set to generate a Mode S surveillance interrogation but with an address different from the standard. Set the slave test set to generate a Mode A interrogation. delays of 6, 10 and 15 µs. Varying the delay between the master and the slave test set signals, record the interval between the synch phase reversal of the master test set signal and the P1 pulse of the slave test set signal needed to produce 90% Mode A reply ratio. [This procedure step is not required under environmental conditions.]	**Agreed**		
	ED-73C to replace existing subparagraph g. Step 7, with the contents of the following column 2 subparagraph g. Step 7. DO-181D Section 2.4.2.6. Step 7 to be replaced with new Step 7 as provided in the following Column 4.			
	g. STEP 7: RECOVERY (3.10.2.f.) [This entire procedure is not required under environmental conditions.] STEP 7A: Recovery from a Mode –S interrogation which has not been accepted followed by an ATCRBS Mode-A Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate an ATCRBS Mode-A interrogation having a signal level of "MTL" + 3 dB. Measure the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency. Verify that the delay time is less than or equal to 45 microseconds after the Sync Phase Reversal (SPR) of the Mode-S surveillance interrogation. Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds. Verify that the transponder does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver.	**Agreed**	STEP 7: RECOVERY (2.2.7.2.4) Connect the equipment connected as shown in Figure 2-27. STEP 7A: Recovery from a Mode –S interrogation which has not been accepted (2.2.7.2.4) followed by an ATCRBS Mode-A Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate an ATCRBS Mode-A interrogation having a signal level of "MTL" + 3 dB. Measure the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency. Verify that the delay time is less than or equal to 45 microseconds after the Sync Phase Reversal (SPR) of the Mode-S surveillance interrogation. Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds. Verify that the transponder does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver.	

	NOTE: *Undesired replies are those containing any wrong or misleading information.* Repeat the procedure given in preceding paragraphs with the Master Test Set using Mode-S interrogations that are accepted but do NOT require a reply (e.g., All-Call or Broadcast interrogations). Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct. Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder. STEP 7B: Recovery from a Mode-S interrogatin which has not been accepted followed by ATCRBS Mode-C Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate an ATCRBS Mode-C interrogation having a signal level of "MTL" + 3 dB. Verify that the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency is less than or equal to 45 microseconds. Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds. Verify that the UUT starts to reply to the Slave Interrogations prior to reaching a delay of 45 microseconds. Verify that the UUT does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver. Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct. Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder. STEP 7C: Recovery from a Mode-S interrogation which has not been accepted followed by Mode S-		***NOTE:*** *Undesired replies are those containing any wrong or misleading information.* Repeat the procedure given in preceding paragraphs with the Master Test Set using Mode-S interrogations that are accepted but do NOT require a reply (e.g., All-Call or Broadcast interrogations). Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct. Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder. STEP 7B: Recovery from a Mode-S interrogatin which has not been accepted (2.2.7.2.4) followed by ATCRBS Mode-C Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate an ATCRBS Mode-C interrogation having a signal level of "MTL" + 3 dB. Verify that the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency is less than or equal to 45 microseconds. Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds. Verify that the UUT starts to reply to the Slave Interrogations prior to reaching a delay of 45 microseconds. Verify that the UUT does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver. Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct. Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder. STEP 7C: Recovery from a Mode-S interrogation which has not been accepted (2.2.7.2.4) followed by Mode S-Only	

	Only All-Call Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate a Mode S-Only All-Call interrogation having a signal level of "MTL" + 3 dB. Verify that the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency is less than or equal to 45 microseconds. Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds. Verify that the UUT starts to reply to the Slave Interrogations prior to reaching a delay of 45 microseconds. Verify that the UUT does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver. Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct. Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder. STEP 7D: Recovery from a Mode-S interrogation which has not been accepted followed by ATCRBS Mode A/Mode S All-Call Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate an ATCRBS Mode A/Mode S All-Call interrogation having a signal level of "MTL" + 3 dB. Verify that the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency is less than or equal to 45 microseconds. Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds. Verify that the UUT starts to reply to the Slave		All-Call Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate a Mode S-Only All-Call interrogation having a signal level of "MTL" + 3 dB. Verify that the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency is less than or equal to 45 microseconds. Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds. Verify that the UUT starts to reply to the Slave Interrogations prior to reaching a delay of 45 microseconds. Verify that the UUT does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver. Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct. Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder. STEP 7D: Recovery from a Mode-S interrogation which has not been accepted (2.2.7.2.4) followed by ATCRBS Mode A/Mode S All-Call Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate an ATCRBS Mode A/Mode S All-Call interrogation having a signal level of "MTL" + 3 dB. Verify that the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency is less than or equal to 45 microseconds. Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds.	

	Interrogations prior to reaching a delay of 45 microseconds. Verify that the UUT does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver. Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct. Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder. STEP 7E: Recovery from a Mode-S interrogation which has not been accepted followed by ATCRBS Mode C/Mode S All-Call Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate an ATCRBS Mode C/Mode S All-Call interrogation having a signal level of "MTL" + 3 dB. Verify that the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency is less than or equal to 45 microseconds. Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds. Verify that the UUT starts to reply to the Slave Interrogations prior to reaching a delay of 45 microseconds. Verify that the UUT does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver. Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct. Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder. STEP 7F: Recovery from a Mode-S interrogation which has not been accepted followed by ATCRBS Mode A-Only All-Call		Verify that the UUT starts to reply to the Slave Interrogations prior to reaching a delay of 45 microseconds. Verify that the UUT does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver. Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct. Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder. STEP 7E: Recovery from a Mode-S interrogation which has not been accepted (2.2.7.2.4) followed by ATCRBS Mode C/Mode S All-Call Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate an ATCRBS Mode C/Mode S All-Call interrogation having a signal level of "MTL" + 3 dB. Verify that the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency is less than or equal to 45 microseconds. Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds. Verify that the UUT starts to reply to the Slave Interrogations prior to reaching a delay of 45 microseconds. Verify that the UUT does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver. Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct. Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder. STEP 7F: Recovery from a Mode-S interrogation which has not been accepted (2.2.7.2.4) followed by ATCRBS Mode A-Only All-Call	

	Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate an ATCRBS Mode A-Only All-Call interrogation having a signal level of "MTL" + 3 dB. Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it is greater than 45 microseconds. Verify that the transponder does NOT reply to the Slave Interrogations. Verify that the transponder does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver. Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct. Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder. STEP 7G: Recovery from a Mode-S interrogation which has not been accepted followed by ATCRBS Mode C-Only All-Call Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate an ATCRBS Mode C-Only All-Call interrogation having a signal level of "MTL" + 3 dB. Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it is greater than 45 microseconds. Verify that the transponder does NOT reply to the Slave Interrogations. Verify that the transponder does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver. Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C		Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate an ATCRBS Mode A-Only All-Call interrogation having a signal level of "MTL" + 3 dB. Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it is greater than 45 microseconds. Verify that the transponder does NOT reply to the Slave Interrogations. Verify that the transponder does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver. Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct. Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder. STEP 7G: Recovery from a Mode-S interrogation which has not been accepted (2.2.7.2.4) followed by ATCRBS Mode C-Only All-Call Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate an ATCRBS Mode C-Only All-Call interrogation having a signal level of "MTL" + 3 dB. Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it is greater than 45 microseconds. Verify that the transponder does NOT reply to the Slave Interrogations. Verify that the transponder does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver. Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the	

	information provided in the transponder replies is correct. Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder. STEP 7H: Recovery from a Mode-S interrogation which has not been accepted followed by Directed Mode-S Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate a Directed Mode S (i.e., an address equivalent to the UUT Mode-S Discrete Address) interrogation having a signal level of "MTL" + 3 dB. Verify that the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency is less than or equal to 45 microseconds. Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds. Verify that the UUT starts to reply to the Slave Interrogations prior to reaching a delay of 45 microseconds. Verify that the UUT does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver. Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct. Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder.		transponder replies is correct. Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder. STEP 7H: Recovery from a Mode-S interrogation which has not been accepted (2.2.7.2.4) followed by Directed Mode-S Set the Master Test Set to generate a standard (i.e., -60 dBm) Mode-S Surveillance interrogation with an incorrect address (i.e., an address different from that of the UUT Mode-S Discrete Address). Set the Slave Test Set to generate a Directed Mode S (i.e., an address equivalent to the UUT Mode-S Discrete Address) interrogation having a signal level of "MTL" + 3 dB. Verify that the delay of the Slave Test Set signal from the Mode-S Sync Phase Reversal (SPR) required to produce 90% reply efficiency is less than or equal to 45 microseconds. Decrease the delay of the Slave Test Set signal such that the start of the Slave Interrogation is coincident with the end of the Master Interrogation. Then increase the delay of the Slave Interrogation such that it approaches 45 microseconds. Verify that the UUT starts to reply to the Slave Interrogations prior to reaching a delay of 45 microseconds. Verify that the UUT does not generate any undesired replies that can be detected by a properly operating Mode-S 1090 MHz. PAM receiver. Set the Master Test Set to generate a standard (i.e., -60 dBm) UF4, UF5, Mode A and Mode C interrogations and verify that the ATCRBS Mode A code and Altitude/ Mode C information provided in the transponder replies is correct. Repeat the procedure given in preceding paragraphs as needed to verify performance of the transponder on both top and bottom channels of diversity transponder.	

EUROCAE ED-73B/C		RTCA DO-181D		COMMENT
5.4.7	**Response in the Presence of Interference (Paragraph 3.12)**	**2.3.2.7**	**Standard Interference Pulse (§2.2.8.2) and Mode S SLS (§ 2.2.5.2)**	
5.4.7.1	**Test Equipment** a. 2 Transponder Test Sets. b. Wide Band Dual Channel Oscilloscope. c. 3 Port Power Divider.			
5.4.7.2	**Test Procedure** With the equipment connected as shown in Figure 5-5, interrogate the transponder with the Mode S-Only All-Call interrogation at a signal level of -50 dBm and follow Steps 1 through 4 below. a. STEP 1 - Low Level Asynchronous Interference (Paragraph 3.12.3) Inject a 0.8 µs wide pulse with amplitude 12 dB below the P1 of the Mode S-Only All-Call, at a repetition rate of 10 000 Hz. Record the reply ratio. ***NOTE:*** *Take care to avoid synchronisation of the 10 000 Hz rate with the Mode S standard rate.* [This procedure step is not required under environmental conditions.] b. STEP 2 - Standard Interference Pulse and Mode S SLS (Paragraphs 3.8.3 and 3.12.4) Insert the interfering pulse (duration: 0.8 µs, level: 6 dB below P6) at a position 1.8 µs after the leading edge of P6 of a Mode S-Only All-Call. Record the minimum reply ratio observed while slowly moving the interfering pulse from its initial position to the end of P6. Repeat the test for all signal levels between -68 and -21 dBm in 5 dB increments. Repeat the test with an interference pulse level 3 dB below the P6 level. [Under environmental conditions, it is sufficient to perform the above portions of this test step using signal levels of-68 dBm, -50 dBm, and -21 dBm for the Mode S-Only All-Call interrogations.] Inject the interfering pulse (now acting as P5) 0.85 µs after the leading edge of P6 and use a level 3 dB above the level of P6. Use signal levels between MTL+3dB and -21 dBm in 5	**Agreed** **Agreed**	Connect the equipment as shown in Figure 2-27. Interrogate the transponder with an interfering pulse (duration: 0.8 microsecond, level 6 dB below P6) inserted at a position 1.8 microseconds after the leading edge of P6 of a standard Mode S-Only All-Call. The Mode S-Only All-Call shall be at a power level of -50 dBm. Observe the reply ratio while slowly moving the interfering pulse from its initial position to the end of P6. Repeat the test for signal levels of -21, and -68 dBm. Repeat the test with an interference pulse level 3 dB below the P6 level. Insert the interfering pulse (now acting as P5) 0.85 microsecond after the leading edge of P6 and use a level 3 dB above the level of	

	dB increments. Record the maximum reply ratio in each case. Reduce level of P5 to a value 12 dB below the level of P6 and repeat the test at signal levels from MTL+3dB to -21 dBm in 5 dB increments. Record the minimum reply ratio in each case. [Under environmental conditions, it is sufficient to perform the above portion of this test step using signal levels of MTL + 3 dB and -21 dBm for the Mode S-Only All-Call interrogations. As such, the 5 dB increments are not required.]	**Agreed**	P6. Use signal levels of MTL +3 dB and -21 dBm. Reply ratio in all cases should be 10% or less (subparagraph 2.2.5.2 a). Reduce the level of P5 to a value 12 dB below the level of P6 and repeat the test at signal levels of MTL +3 dB and -21 dBm. Reply ratio should be 99% or more (§2.2.5.2 b).	
	c. <u>STEP 3 - Pulse Pair Interference</u> (Paragraphs 3.12.5 a, b, and c) Insert a 0.8 is pulse pair spaced 2.0 µs apart with amplitude 9 dB below P1 of the standard Mode S-Only All-Call, at a position such that the leading edge of the pulse pair occurs 0.25 µs after the leading edge of P1. Record the reply ratio while moving the interfering pulse pair in 0.25 µs steps from its initial position 0.25 µs after the trailing edge of P6. Determine the average reply efficiency from the recorded values. Repeat the test for all input levels between -68 and -21 dBm in 6 dB increments. [This procedure step is not required under environmental conditions.]	**Agreed**		
	d. <u>STEP 4 - DME and Other Spurious Pulse Interference Tests</u> (Paragraph 3.12.6) Inject pairs of pulses, of duration 3.5 µs, spaced 12 µs apart with amplitude of -30 dBm at a rate of 3 600 pulse pairs per second. Record the reply ratio observed as the frequency of the interfering signal is varied over the ranges of 962 to 1 020 MHz, and 1 041 to 1 213 MHz. Repeat the test using pulses spaced 30 µs apart. Repeat the test using single pulses of 6.4 µs duration at a rate of 2000 pulses per second, with an amplitude of -80 dBm and a frequency of 1 030 MHz. [This procedure step is not required under environmental conditions.]	**Agreed**		

Special Note: The following applies to the latest change made post WG49N12 in Cologne. November 6—8, 2007

The original Step 5 provided in ED-73B is provided directly below.

e. STEP 5 - Standard Interference Pulse Positioned at Mode A or Mode C Spacing before P1 of a Mode S Interrogation (Paragraphs 3.12.2 a and 3.12.5 d)

Insert standard interfering pulse 8 µs before, and at the same signal level as, the P1 pulse of a standard Mode S only All-Call interrogation.

Check and record that the transponder replies to the Mode S only All-Call interrogation.

Insert a standard interfering pulse 21 µs before, and at the same signal level as, the P1 pulse of a standard Mode S only All-Call interrogation.

Check and record that the transponder replies to the Mode S only All-Call interrogation.

NOTE: *This test checks that the suppression pair is the recognized pulse pair by testing that the following P6 is correctly decoded.*

As written, this procedure has been discussed and disagreed on multiple occasions. This is because the procedure as written has nothing to do with the requirements sections that it attempting to test. The requirements in 3.12.2.a and 3.12.5.d address the condition (1) when an interfering pulse is placed at Mode A or Mode C Spacing ahead of a P1-P2 Suppression pair. Yet the procedure as written is for a different condition, (2) where the interference Pulse is placed at Mode A or Mode C spacing ahead of the P1 pulse of a Mode S Interrogation. On top of this, various parties feel that the procedure should be addressing yet another condition (3) where the interference Pulse is placed at Mode A or Mode C spacing ahead of the P2 pulse of a Mode S Interrogation. As such, three different conditions are actually needed in which three different results need to be observed.

The issue was first addressed in response to WG-49 Action item A5/06 in Working Paper WG49N10_XX, "Review of Issues with ED-73B/C Test Procedure Section 5.4.7.2.e", dated 11 June 2007, R.H. Saffell.

During WG49N12 held at EASA on November 6—8, 2007, the issue was again discussed at length and convoluted due to the three different conditions discussed above. The first condition was addressed in Eurocae WG 49 #10, Working Paper N10_db, by David Bowen, and discussed at the EASA meeting in November. The solution provided by Mr. Bowen was also provided in the earlier WG49N10_XX document in June by Mr. Saffell. As such, the two authors agree with how to address the first condition.

In order to address all three possible conditions, the following ED-73C actions have been done in this edition:

1. ED-73C Subparagraph e, Step 5, has been re-written to address the case where the interference pulse is placed at Mode A or Mode C spacing ahead of the P1 pulse of a P1-P2 suppression pair. The test, as not written below, concurs with the prior inputs from Mr. Bowen and Mr. Saffell.
2. ED-73C Subparagraph f, Step 6, has been added to address the case where the interference pulse is place at Mode A or Mode C spacing ahead of the P1 Pulse of a Mode S interrogation.
3. ED-73C Subparagraph g, Step 7, has been added to address the case where the interference pulse is placed at Mode A or Mode C spacing ahead of the P2 Pulse of a Mode S interrogation.
4. ED-73C Subparagraph h, Step 8, has been added to address the case where the interference pulse is placed at Mode C spacing ahead of the P4 Pulse of a Mode A Only All-Call interrogation.
5. ED-73C previous subparagraph f, Step 6, has been moved to being subparagraph i, Step 9.
5. ED-73C Subparagraph j, Step 10, has been added to address new CW interference requirements entered into the SARPs. Note that the procedure was taken from DO-181D. Also note that an appropriate requirements section needs to be added to ED-73C that is equivalent to DO-181D section 2.2.8.6.

WHAT NEEDS TO BE DONE IN ED-73C

A. The following requirement needs to be added:

3.12.7 Response in the Presence of CW Interference

In the presence of non-coherent CW interference at a frequency of 1030 ±0.2 MHz, at signal levels of 20 dB or more below the desired ATCRBS or Mode S interrogation signal level, the transponder **shall** reply correctly to at least 90 percent of the interrogations.

	WHAT NEEDS TO BE DONE IN DO-181D: A. **Step 5, 6, 7, and 8 shown in column 4 need to be added to DO-181D section 2.4.2.7.** B. **The existing step 5 in section 2.4.2.7 needs to be moved to being step 9 in section 2.4.2.7.**			
	e. STEP 5 - Standard Interference Pulse Positioned at Mode A or Mode C Spacing before P2 of a P1-P2 Suppression Pair (Paragraphs 3.12.2 a and 3.12.5 d) ***Note:*** *The purpose of this test is to demonstrate that when the interference pulse combines with the P2 pulse of the P1-P2 suppression pair in a manner that results in a simultaneous detection of a Mode A/C interrogation and a Suppression Pair, that the transponder goes into suppression and does not reply.* (1) Mode A Insert standard interfering pulse 8 µs before, and at the same signal level as, the P2 pulse of a standard P1-P2 Suppression pair. Verify that the transponder does not reply. (2) Mode C Insert standard interfering pulse 21 µs before, and at the same signal level as, the P2 pulse of a standard P1-P2 Suppression pair. Verify that the transponder does not reply. [This procedure step is not required under environmental conditions.]	**Agreed**	STEP 5 - Standard Interference Pulse Positioned at Mode A or Mode C Spacing before P2 of a P1-P2 Suppression Pair (Paragraphs 2.2.8.2 and 2.2.8.5) ***Note:*** *The purpose of this test is to demonstrate that when the interference pulse combines with the P2 pulse of the P1-P2 suppression pair in a manner that results in a simultaneous detection of a Mode A/C interrogation and a Suppression Pair, that the transponder goes into suppression and does not reply.* (1) Mode A Insert standard interfering pulse 8 µs before, and at the same signal level as, the P2 pulse of a standard P1-P2 Suppression pair. Verify that the transponder does not reply. (2) Mode C Insert standard interfering pulse 21 µs before, and at the same signal level as, the P2 pulse of a standard P1-P2 Suppression pair. Verify that the transponder does not reply.	

	f. STEP 6 - Standard Interference Pulse Positioned at Mode A or Mode C Spacing before P1 of a Mode S Interrogation (Paragraphs 3.9.2.b and 3.12.5.d) ***Note:*** *The purpose of this test is to demonstrate that when the interference pulse combines with the P1 pulse of the P1-P2 pair of a Mode S interrogation, that the transponder detects the Mode A/C All-Call and does not reply.* (1) Mode A Insert standard interfering pulse 8 µs before, and at the same signal level as, the P1 pulse of a standard Mode S Only All-Call interrogation. Verify that the transponder does not reply with a Mode A/C reply. (2) Mode C Insert standard interfering pulse 21 µs before, and at the same signal level as, the P1 pulse of a standard Mode S Only All-Call interrogation. Verify that the transponder does not reply with a Mode A/C reply. ***Note:*** *In both case (1) and (2), transponders that are designed to continue processing of the Mode-S interrogation after discarding the Mode A/C Only All-Call may reply to the Mode-S interrogation. However, this exceeds the minimum requirements of this MOPS.* [This procedure step is not required under environmental conditions.]	**Agreed**	STEP 6 - Standard Interference Pulse Positioned at Mode A or Mode C Spacing before P1 of a Mode S Interrogation (Paragraphs 2.2.6.1.2.b) ***Note:*** *The purpose of this test is to demonstrate that when the interference pulse combines with the P1 pulse of the P1-P2 pair of a Mode S interrogation, that the transponder detects the ATCRBS All-Call and does not reply.* (1) Mode A Insert standard interfering pulse 8 µs before, and at the same signal level as, the P1 pulse of a standard Mode S Only All-Call interrogation. Verify that the transponder does not reply with an ATCRBS reply. (2) Mode C Insert standard interfering pulse 21 µs before, and at the same signal level as, the P1 pulse of a standard Mode S Only All-Call interrogation. Verify that the transponder does not reply with an ATCRBS reply. ***Note:*** *In both case (1) and (2), transponders that are designed to continue processing of the Mode-S interrogation after discarding the Mode A/C Only All-Call may reply to the Mode-S interrogation. However, this exceeds the minimum requirements of this MOPS.*	**This procedure addresses CASE 4 of PR, Eurocontrol concerns** **Note 1:** **Need to discuss with WG-49 prior to their January meeting**

	g. STEP 7 - Standard Interference Pulse Positioned at Mode A or Mode C Spacing before P2 of a Mode S Interrogation (Paragraphs 3.8.1.e) ***Note:*** *The purpose of this test is to demonstrate that when the interference pulse combines with the P2 pulse of the P1-P2 pair of a Mode S interrogation, that the transponder suppresses replies to Mode A/C interrogations but replies to the Mode S interrogations.* (1) Mode A Insert standard interfering pulse 8 µs before, and at the same signal level as, the P2 pulse of a standard Mode S Only All-Call interrogation. Verify that the transponder replies to the Mode S Only All-Call interrogation. (2) Mode C Insert standard interfering pulse 21 µs before, and at the same signal level as, the P2 pulse of a standard Mode S Only All-Call interrogation. Verify that the transponder replies to the Mode S Only All-Call interrogation. [This procedure step is not required under environmental conditions.]	**Agreed**	STEP 7 - Standard Interference Pulse Positioned at Mode A or Mode C Spacing before P2 of a Mode S Interrogation (Paragraphs 2.2.5.1.d.(5)) ***Note:*** *The purpose of this test is to demonstrate that when the interference pulse combines with the P2 pulse of the P1-P2 pair of a Mode S interrogation, that the transponder suppresses replies to ATCRBS interrogations but replies to the Mode S interrogations.* (1) Mode A Insert standard interfering pulse 8 µs before, and at the same signal level as, the P2 pulse of a standard Mode S Only All-Call interrogation. Verify that the transponder replies to the Mode S Only All-Call interrogation. (2) Mode C Insert standard interfering pulse 21 µs before, and at the same signal level as, the P2 pulse of a standard Mode S Only All-Call interrogation. Verify that the transponder replies to the Mode S Only All-Call interrogation.	**This procedure addresses CASE 1 of PR, Eurocontrol concerns**
	h. STEP 8 - Standard Interference Pulse Positioned at Mode C Spacing before P4 of a Mode A Only All-Call Interrogation (Paragraphs 3.22.2.2.k) ***Note:*** *The purpose of this test is to demonstrate that when the interference pulse combines with the P4 pulse of the P1-P3-P4 Mode A Only All-Call interrogation, that the transponder does not reply.* Insert standard interfering pulse 21 µs before, and at the same signal level as, the P4 pulse of a Mode A Only All-Call interrogation. Verify that the transponder does not reply [This procedure step is not required under environmental conditions.]	**To Be Agreed**	STEP 8 - Standard Interference Pulse Positioned at Mode C Spacing before P4 of a Mode A Only All-Call Interrogation (Paragraphs 2.2.18.2.2.k) ***Note:*** *The purpose of this test is to demonstrate that when the interference pulse combines with the P4 pulse of the P1-P3-P4 Mode A Only All-Call interrogation, that the transponder does not reply.* Insert standard interfering pulse 21 µs before, and at the same signal level as, the P4 pulse of a Mode A Only All-Call interrogation. Verify that the transponder does not reply	**This procedure addresses CASE 3 of PR, Eurocontrol concerns.**

	i. STEP 9 - Mode A and Mode C with Standard Interfering Pulse (paragraph 3.12.4) Overlay a Standard random Interfering Pulse over proper Mode A and Mode C interrogations with a level 10 dB below the level of the Mode A/C interrogations. Check and record that the transponder replies to at least 90 % of the Mode A and Mode C interrogations and does not recognise the random interference pulse as P1, P2 or P3. [This procedure step is not required under environmental conditions.]	**Agreed**		
	j. STEP 10 - Response in the Presence of CW Interference (§0) Interrogate the transponder with standard ATCRBS Mode A or Mode C interrogations having a signal level of –50 dBm. Insert non-coherent CW interference at a frequency of 1030 ±0.2 MHz. and at signal levels of -70 dBm. Verify that the transponder continues to reply to at least 90 percent of all interrogations. Repeat the procedure using Mode S UF = 4, 5, 20 or 21 interrogations. [This procedure step is not required under environmental conditions.]	**Agreed**		**Rationale:** **The procedure at left needs to be added to ED-73C as discussed in the Special Note above.**
5.4.8	**Undesired Replies (Paragraph 3.13)**	**2.3.2.8**	**Undesired Replies (§ 2.2.9)**	
5.4.8.1	**Test Equipment** Transponder Test Set			
5.4.8.2	**Test Procedure** Connect the RF terminal of the Transponder Test set to the transponder antenna terminal. Do not interrogate the Transponder. Count and record the number of Mode A/C replies for a minimum of one minute. Count and record the number of Mode S replies for a minimum of one minute. ***NOTE:*** *Squitter and Self Test transmissions, if not inhibited, must be disabled in this test.*		With no interrogations count the number of replies for a minimum of one minute.	

EUROCAE ED-73B/C		RTCA DO-181D		COMMENT
5.4.9	**Self-Test and Monitors (if provided) (Paragraph 3.14**	**2.3.2.9**	**Self-Test and Monitors (§ 2.2.10)**	
5.4.9.1	**Self-Test**			
5.4.9.1.1	Test Equipment a. Transponder Test Set. b. Wide Band Dual Channel Oscilloscope. c. RF Attenuator. d. ATC Transponder (Similar to unit under test - transmitter disabled). e. Frequency Counter.			
5.4.9.1.2	Test Procedure a. STEP 1 - Self-Test Interrogation/Reply Rate (Paragraph 3.14.1) Connect the equipment as shown in Figure 5-6. Activate the self-test function of the transponder under test and record the reply rate to the self-test interrogation for both Mode A/C and Mode S. ***NOTE:*** *The squitter generation function may be disabled for this test.* b. STEP 2 - Self-Test Interrogation Level (Paragraph 3.14.1) Connect the equipment as shown in Figure 5-7, with the coax connections in position A. Activate the self-test function of the transponder and adjust the RF attenuator until the other transponder just triggers, as indicated by the presence of suppression pulses. Without changing the RF attenuator setting, change the coax connections to position B. Set the Transponder Test Set to an interrogation rate equal to the reply rate determined in STEP 1 and interrogate in Mode A. Adjust the RF level of the Transponder Test Set until transponder number two just triggers. Record the Test Set output level. [This procedure step is not required under environmental conditions.]	**Agreed**	Step 1 Self-Test Interrogation/Reply Rate (§ 2.2.10.1 a and c) Activate the self-test function (if provided) of the transponder under test and determine the reply rate to the self-test interrogation.	

EUROCAE ED-73B/C		RTCA DO-181D		COMMENT
5.4.9.2	**Squitter Monitor** (Paragraph 3.14.2)	**2.3.2.9**	**Self-Test and Monitors (§ 2.2.10)**	
5.4.9.2.1	Test Equipment a. Transponder Test Set. b. Wide Band Dual Channel Oscilloscope.			
5.4.9.2.2	Test procedure Connect the equipment as shown in Figure 5-3 a. STEP 1 While monitoring the squitter transmissions, with the transponder in the inactive state, disable the squitter generator. Verify that the squitter monitor responds to the absence of squitter transmissions, and that the equipment is indicated as being invalid by the failure warning system. b. STEP 2 Repeat STEP 1 while interrogating the transponder with Mode A/C and Mode A/C/S All-Calls. In each case, verify that the squitter monitor responds to the absence of squitter transmissions, and that the equipment is indicated as being invalid by the failure warning system. [This procedure step is not required under environmental conditions.]	**Agreed**	Step 2 Squitter Monitor (§ 2.2.10.2) A specific test procedure for this function is not described. This test requires that the manufacturer artificially disable the squitter generation function. The detailed procedure for proving this capability must be left to the discretion of the manufacturer.	
5.4.9.3	**Failure Indication (Paragraph 3.14.3)** The manufacturer shall demonstrate that failures are properly detected by the self test or monitors and cause the indication to assume the "invalid" state . The generation of diagnostic error messages related to illegal 24 bit discrete addresses is tested in section 5.4.12.1.2. [This procedure step is not required under environmental conditions.]	**Agreed**		
5.4.10	**Mutual Suppression Capability (Paragraph 3.15)** [This procedure is not required under environmental conditions.]	**Agreed**		
5.4.10.1	**Test Equipment** a. Transponder Test Set. b. Wide Band Dual Channel Oscilloscope.			
5.4.10.2	**Test Procedure** Connect the equipment as shown in Figure 5-8. Interrogate on Mode A at 150 interrogations per second and set the signal level to -21 dBm.			

	Apply the suppression pulse for which the equipment is designed. For interrogations occurring within the period of the suppression pulse, note that the equipment is suppressed. Starting with the equipment suppressed, adjust for minimum delay between the trailing edge of the suppression pulse and the leading edge of the interrogation pulse pair which provides 90% reply efficiency. Record the value of this delay. Verify that the transponder generates a suppression pulse during its reply period.			
5.4.11	**Diversity Operation (Paragraph 3.16)**	**2.3.2.10**	**Diversity Operation (§ 2.2.12)**	
5.4.11.1	**Test Equipment** a. Two means of generating identical Mode A/C and Mode S interrogations which can be delayed from each other by from 125 to 375 nanoseconds. These two generators must also have independent control of power level. b. A means of determining the antenna terminal that emits the reply. c. A means of determining the reply power level on both antennas simultaneously. d. A means of determining the reply delay for each channel and between channels.		Two means of generating identical ATCRBS and Mode S interrogations which can be delayed from each other from 125 to 375 nanoseconds must be provided. These two generators must also have independent control of power level. Means of determining the antenna terminal that generates the reply. Means of determining the reply power level on both antennas simultaneously. Means of determining reply delay for each channel and between channels.	
5.4.11.2	**Test Procedure** ***NOTE 1:*** *Since tests in this paragraph can be satisfied by using many different pieces of test equipment in various configurations, no specific recommendations are made. However, the minimum functionality requirement is as stated in the following paragraphs.* ***NOTE 2:*** *Because the specifications for diversity operations are symmetrical in all respects, channels are arbitrarily designated A and B.* ***NOTE 3:*** *When measuring Channel A and B parameters take care that any cables used for measurements are of equal electrical length and equal loss.* ***NOTE 4:*** *With the exception of step 4 the following tests may be conducted with the squitter inhibited.* a. STEP 1 - Single Channel Test (Paragraphs 3.16.5 and 3.16.6) At signal level MTL+3dB use the following types of interrogations : (1) Mode A		Step 1 Single Channel Test (§ 2.2.12.3 and 2.2.12.4) When measuring channel A and B parameters take care that any cables used for measurements are of equal length and equal loss. Interrogate channel A only, while monitoring channel A and B. At signal level MTL +6 dB use the following types of interrogations and record the	

	(2) Mode C (3) Mode A/Mode S All-Call (4) Mode C-only All-Call (5) Mode S formats UF = 4, 11 and, if so equipped, UF = 21 Interrogate Channel A only, while monitoring both channels A and B. Observe and record parameters specified in (3) below. Repeat for signal levels of -50 and -21 dBm, using a Mode C and a Mode S format of UF = 4 types of interrogations only. Observe and record parameters specified below: (1) reply ratio, (2) reply channel, (3) power level of replies from Channel A, (4) power level of replies from Channel B (5) reply delay for each interrogation signal type and for the signal levels as specified; (6) power ratio as specified in Paragraph 3.16.5. Repeat the tests with the channels reversed. Compare records of reply delays for conformance with paragraph 3.16.6. b. [Under environmental conditions, it is not necessary to record the reply ratio in the test step above.]	**Agreed**	listed observations: ATCRBS Mode A ATCRBS Mode C/Mode S All-Call Mode S formats UF=0, and if so equipped 20 For signal levels of -50 dBm and -21 dBm use an ATCRBS Mode A and a Mode S format of UF=0 types of interrogations and record the listed observations. Observe: Correct reply channel. Reply delay for each interrogation signal type and for the signal levels as specified. Correct power ratio per subparagraph 2.2.12.3. Repeat the above test reversing channels. Compare records of reply delays for conformance with §2.2.12.4.	**Note:** DO-181D "UF=0" is in error and should be changed to "UF=4". DONE!
	b. STEP 2 - Signal Level Selection Test (Paragraph 3.16.2) Using the following interrogations in turn: (1) Mode A (2) Mode C (3) Mode A/Mode S All-Call (4) Mode C - only All-Call (5) Mode S formats UF = 4, 11 and, if so equipped, UF = 21 With Channel A leading: - Synchronise the interrogations to channels A and B so that they are 0.125 µs, +0.000/-0.040 µs. - Interrogate at a power level on Channel A of MTL and a power level on Channel B of MTL+3 dB. - Record the percentage of replies on Channel B (the requirement is not less than 90%). - Interrogate on Channel A at a power level of MTL + 3 dB, and on Channel B at a power level of MTL. - Record the percentage of replies on Channel A (the	**Agreed :** Change +4dB by +3dB	Step 2 Selection Test (§ 2.2.12.1. b) Synchronize the interrogations to channels A and B so that they are 0.125 +0.00/-0.040 microseconds apart where channel A is first. Use an ATCRBS Mode C and a Mode S UF=4 to interrogate at a power level on channel A of MTL and a power level on channel B of MTL +6 dB. Observe that the correct reply channel is channel B. Use an ATCRBS Mode C and a Mode S UF=4 to interrogate at a power level on channel A of MTL +6 dB and a power level on channel B of MTL.	

	requirement is not less than 90 %). [Under environment conditions for the above portion of this test step, it is sufficient to use a Mode C interrogation on one channel and Mode S UF=4 interrogation on the other channel. Also, it is sufficient to use a power level of MTL on channel A and MTL + 6 on channel B].	**Agreed**	Observe that the correct reply channel is channel A.	
	With Channel B leading: - Synchronise the interrogations to channels A and B so that they are 0.125 µs, +0.000/-0.040 µs apart. - Interrogate at a power level on Channel A of MTL and a power level on Channel B of MTL+3dB. - Record the percentage of replies on Channel B (the requirement is not less than 90%). - Interrogate at a power level on Channel A of MTL+3dB and a power level on Channel B of MTL. - Record the percentage of replies on Channel A (the requirement is not less than 90%). [Under environment conditions for the above portion of this test step, it is sufficient to use a Mode C interrogation on one channel and Mode S UF=4 interrogation on the other channel. Also, it is sufficient to use a power level of MTL on channel A and MTL + 6 on channel B].	**Agreed** **Agreed**	Synchronize the interrogations to channels A and B so that they are 0.125 +0.00/-0.040 microseconds apart where channel B is first. Use an ATCRBS Mode C and a Mode S UF=4 to interrogate at a power level on channel A of MTL and a power level on channel B of MTL +6 dB. Observe that the correct reply channel is channel B. Use an ATCRBS Mode C and a Mode S UF=4 to interrogate at a power level on channel A of MTL +6 dB and a power level on channel B of MTL. Observe that the correct reply channel is channel A.	
	c. <u>STEP 3 - Delay-Selection Test</u> (Paragraph 3.16.4) Using the following type of interrogation in turn : (1) Mode A (2) Mode C (3) Mode A/Mode S All-Call (4) Mode C-only All-Call (5) Mode S formats UF = 4, 11 and, if so equipped, UF = 21 With Channel A leading: - Synchronise the interrogations to channels A and B so that they are 0.375 µs, +0.040/-0.000 µs apart. - Interrogate on Channel A at a power level of MTL+3dB and on Channel B at a power level of -50 dBm. - Record the percentage of replies on Channel A (the requirement is not less than 90%). [Under environment conditions for the above portion of this test step, it is sufficient to use a Mode C interrogation on one channel and Mode S	**Agreed** **Agreed**	<u>Step 3</u> <u>Delay-Selection Test (§ 2.2.12.2)</u> Synchronize the interrogations to channels A and B so that they are 0.375 +0.040/-0.00 microseconds apart where channel A is first. Use an ATCRBS Mode C and a Mode S UF=4 to interrogate at a power level on channel A of MTL +6 and a power level on channel B of -50 dBm. Observe that the correct reply channel is channel A.	

	UF=4 interrogation on the other channel. Also, it is sufficient to use a power level of MTL + 6 on channel A.] With Channel B leading: - Synchronise the interrogations to channels A and B so that they are 0.375 µs, +0.040/-0.000 µs apart. - Interrogate on Channel A at a power level of -50 dBm and on Channel B at a power level of MTL+3dB. - Record the percentage of replies on Channel B (the requirement is not less than 90%). [Under environment conditions for the above portion of this test step, it is sufficient to use a Mode C interrogation on one channel and Mode S UF=4 interrogation on the other channel. Also, it is sufficient to use a power level of MTL + 6 on channel B.]	**Agreed** **Agreed**	Synchronize the interrogations to channels A and B so that they 0.375 +0.040/-0.00 microseconds apart where channel B is first. Use an ATCRBS Mode C and a Mode S UF=4 to interrogate at a power level on channel A of -50 dBm and a power level on channel B of MTL +6. Observe that the correct reply channel is channel B.	
	d. <u>STEP 4 - Squitter Antenna Selection</u> (Paragraph 3.16.7) Configure the transponder with 2 antennas and verify that the squitter transmissions occur alternately from the two antennas at the prescribed rate. Configure the transponder with one (bottom) antenna only. Verify that all squitters are directed at the prescribed rate to that antenna. With the transponder under SAS control, verify that the acquisition squitters are delivered at the correct rates from the correct antenna. The test should be performed as outlined in 5.4.3.2.4 g with the exception of the verification of the data content. [This procedure step is not required under environmental conditions.]	**Agreed**		

EUROCAE ED-73B/C		RTCA DO-181D		COMMENT
5.4.12	**Data Handling and Interfaces** (Paragraph 3.17) The procedures outlined in this paragraph are intended only to test "data in" and "data out" requirements of the transponder; they shall not be interpreted as being tests of the transponder's digital logic and protocols. Some tests correspond to requirements of optional features, and therefore do not apply to all transponders.	**2.3.2.11**	**Data Handling and Interfaces**	
5.4.12.1	**Fixed Direct Data** (Paragraph 3.17.1 a.)	**2.3.2.11.1**	**Fixed Direct Data (§ 2.2.13.1.1)**	
5.4.12.1.1	Test Equipment a. Transponder Test Set. b. Wide band dual channel oscilloscope.			
5.4.12.1.2	Test Procedure With the transponder RF port connected to the RF port of the Transponder Test Set, (Figure 5.3) perform the following test sequences: a. STEP 1 - Mode S All-Call Address Announced (AA) Field Interrogate the transponder with a Mode S - Only All-Call interrogation with PR, IC and CL Fields set to 0. Record that the AA field of the transponder reply contains the address which has been set at the transponder interface. Repeat with twenty-four different transponder addresses each consisting of 23 ZEROs and a single ONE. [Under environmental conditions, its is sufficient to use addresses consisting of AAAAAA Hex and 555555 Hex.] b. STEP 2 - Mode S Discrete Address Interrogate the transponder with a Mode S surveillance-altitude interrogation (UF=4) with the PC, RR, DI and SD fields set to 0 and an address consisting of ONE followed by 23 ZEROs. Record that the transponder replies with appropriate bits set in the AP field when the same address is set at the transponder interface, and does not respond when each of the other combination of 23 ZEROs and a single ONE are entered as addresses. c. STEP 3 - Maximum Airspeed Interrogate the transponder with a short special surveillance interrogation (UF=0) with the AQ field set to 1.	**Agreed** **Agreed**	With the transponder RF port connected to the RF port of the Mode S transponder test set, perform the following test sequences. Step 1 Mode S All-Call Addresses [§ 2.2.13.1.1 a (1)] Interrogate the transponder with a Mode-S Only All-Call interrogation with PR, IC and CL fields set to zero. Verify that the AA field of the transponder reply reflects the address which has been set into the transponder. Use two different addresses consisting of AAAAAAH and 555555H. Step 2 Mode S Discrete Address [§ 2.2.13.1.1 a (2)] Interrogate the transponder with a standard Mode S surveillance-altitude interrogation (UF=4) with the PC, RR, DI and SD fields set to 0 and an address consisting of ONE followed by 23 ZEROs. Verify that the transponder replies with appropriate bits set in the AP field when a like address is set into the transponder, and will not respond when each of the other combinations of 23 ZEROs and a single ONE are entered as addresses. Step 3 Maximum Airspeed [§ 2.2.13.1.1 b (2)] Interrogate the transponder with a short special surveillance interrogation (UF=0) with the AQ field set to 1. Verify that the RI field of the transponder reply	**Rationale:** Change addresses in ED-73C in order to align with DO-181D. **Rationale:** Deleted "Cruising True" in ED-73C as it needs to be maximum

	Record that the RI field of the transponder reply corresponds to the maximum airspeed code set at the transponder interface as each of the seven possible maximum airspeed codes is used. d. STEP 4 - Aircraft Identification Data Interrogate the transponder with a short surveillance-altitude interrogation (UF=4) with PC, DI and SD fields set to 0 and the RR field set to 18. Set the aircraft identification input to the transponder to 101010 ..... Repeat for an aircraft identification input of 010101 ..... Repeat with an aircraft identification input of ABCD1234 coded in accordance with the character coding specified in paragraph 3.21 .1.13 f. e. Step 5 – Invalid AA Put the transponder in the Power Off Condition and set the AA to all ZEROs. Turn on the transponder and verify that a transponder error condition is set. NOTE: the transponder will normally either go into Standby State, revert to a pure Mode A/C transponder or return to the Power Off Condition. Repeat this test with the AA set to all ONEs. Put the transponder in the Power On Condition with an AA set to ONE for the first bit and ZEROs for all other bits. Verify that the transponder functions normally as indicated in steps 1 and 2. Without putting the transponder in Power Off Condition change the AA to all ZEROs. Verify that the transponder generates a diagnostic error message for maintenance and that it keeps operating using the initial AA read during the power-on initialization process (first bit set to ONE and all other bits set to ZEROs). Repeat this test with the AA set to all ONEs. Repeat with the remaining twenty-three different transponder addresses each consisting of 23 ZEROs and a single ONE [This procedure step is not required under environmental conditions.]	**Agreed**	corresponds to the airspeed code set into the transponder as each of the seven possible airspeed codes is used. Step 4 Aircraft Identification Data (§ 2.2.13.1.1 .c) Interrogate the transponder with a short surveillance-altitude interrogation (UF=4) with PC, DI and SD fields set to 0 and the RR field set to 18. Set the aircraft identification input to the transponder to 101010 ..... Repeat for an aircraft identification input of 010101 ..... Repeat with an aircraft identification input of ABCD1234 coded in accordance with the character coding specified in paragraph 3.21 .1.13 f.	airspeed as per Annex 10 Vol. 4, section3.1.2.8.22 as this data is used for RI field for TCAS. It is not the same as that used for determining if diversity is required. .

EUROCAE ED-73B/C		RTCA DO-181D		COMMENT
5.4.12.2	**Variable Direct Data (Paragraph 3.17.1 b.)**	**2.3.2.11.2**	**Variable Direct Data (§2.2.13.1.2)**	
5.4.12.2.1	Test Equipment a. Transponder Test Set. b. Wide Band Dual Channel Oscilloscope.			
5.4.12.2.2	Test Procedure Connect the equipment as shown in Figure 5-3. a. STEP 1 - Pressure Altitude (Mode A/C) Interrogate the transponder with a Mode C interrogation. With the ALT switch on, set altitude code inputs to the transponder in a manner which should result in setting each of the altitude bits in the reply one at a time. Verify the proper positioning of these bits in the reply. Verify that only the framing pulses are present in the reply when the ALT switch is set to "OFF". [Under environmental conditions, the following paragraph of this test step is not required.] Set the input altitude data to invalid and interrogate the transponder with a Mode C interrogation. Verify that a reply is generated containing only the framing pulses. b. STEP 2 - 4096 Identification Code (Mode A/C) Interrogate the transponder with a Mode A interrogation. Set identification codes which should result in the setting of each of the identification reply bits one at a time. Record proper positioning of these bits in the reply. c. STEP 3 - Pressure Altitude (Mode S) Connect the transponder RF port to the transponder test set. (1) Interrogate the transponder with a standard surveillance-altitude interrogation (UF=4) with the PC, RR, DI and SD fields set to ZERO and the address the same as that provided to the transponder. (2) With the ALT switch ON, provide altitude code inputs from an altitude source in feet quantised to greater than 25 ft to the transponder which should result in setting each of the AC field bits of the reply, one at a time. (3) Verify that the correct bits are transmitted in the	**Agreed**	Step 1 Pressure Altitude (ATCRBS) [§2.2.13.1.2 a (1)] Connect the equipment as shown in Figure 2-26. Interrogate the transponder with a standard ATCRBS Mode C interrogation. With the ALT switch on, set altitude code inputs to the transponder, which should result in setting each of the altitude bits in the reply one at a time. Verify proper positioning of these bits in the reply. Verify that only the framing pulses are present in the reply when the ALT switch is set to "off." Step 2 4096 Identification Code (ATCRBS) (§ 2.2.13.1.2 b) With equipment connected as in Step 1, interrogate the transponder with a standard ATCRBS Mode A interrogation. Set identification codes which should result in the setting of each of the identification reply bits one at a time. Verify proper positioning of these bits, and that the correct bits are present in the reply. Step 3 Pressure Altitude (Mode S) [§2.2.13.1.2 a (2)] Connect the transponder RF port to the transponder test set. (1) Interrogate the transponder with a standard surveillance-altitude interrogation (UF=4) with the PC, RR, DI and SD fields set to ZERO and the address the same as that provided to the transponder. (2) With the ALT switch ON, provide altitude code inputs from an altitude source in feet quantised to greater than 25 ft to the transponder which should result in setting each of the AC field bits of the reply, one at a time. (3) Verify that the correct bits are transmitted in	**Rationale:** Delete procedure step in ED-73C in order to align with DO-181D. **Note:** Step three has been re-written to be consistent with the agreed content for both ED-73C and DO-181D. Then, the re-write is modified as shown in the next "Rationale".

	AC field of the reply with the Q bit set to 0 and the M bit set to 0. (4) With the ALT switch ON, provide altitude code inputs from an altitude source in feet quantised to 25 ft or less to the transponder and verify that the altitude report is correct as a minimum when the input indicates pressure altitudes of 17 050 and 34 125 ft. (5) Verify that the correct bits are transmitted in the AC field of the reply with the Q bit set to 1 and the M bit set to 0. (6) With the ALT switch ON, provide altitude code inputs from an altitude source quantised to 25 ft or less to the transponder. Verify that the altitude report is correct when the input indicates pressure altitudes of between 50 188 ft and 126 700 ft, which should result in setting each of the AC field bits of the reply. (7) Verify that the correct bits are transmitted in the AC field of the reply with the Q bit set to 0 to indicate a report to 100 ft quantisation and the M bit set to 0. (8) Repeat Step 3 (1) to (8) with the input indicating metric input if available and verify that the M bit is set to 1 in the AC field of all replies. [Under environmental conditions, paragraph (8) is not required.] (9) Verify that the AC field is all ZEROs when the ALT switch is set to " OFF ". Set the input altitude data to invalid and verify that the AC field is all ZEROs. d. STEP 4 - The 4096 Identification Code (Mode S) With the equipment connected as in STEP 3, interrogate the transponder with a standard surveillance-identity interrogation (UF=5) with PC, RR, DI and SD fields set to ZERO. Using the identification codes specified in STEP 2, record that the proper bit patterns exist in the ID field of the reply. e. STEP 5 - Flight Status and Vertical Status Interrogate with UF=0 and UF=16 and record that the VS field is a ONE when the "on-the-ground" port of the transponder is set to the "on-the-ground" condition, and a ZERO otherwise. Interrogate with formats UF=4, 5, 20, 21 and record that	**Agreed**	the AC field of the reply with the Q bit set to 0 and the M bit set to 0. (4) With the ALT switch ON, provide altitude code inputs from an altitude source in feet quantised to 25 ft or less to the transponder and verify that the altitude report is correct as a minimum when the input indicates pressure altitudes of 17 050 and 34 125 ft. (5) Verify that the correct bits are transmitted in the AC field of the reply with the Q bit set to 1 and the M bit set to 0. (6) With the ALT switch ON, provide altitude code inputs from an altitude source quantized to 25 ft or less to the transponder. Verify that the altitude report is correct when the input indicates pressure altitudes of between 50 188 ft and 126 700 ft, which should result in setting each of the AC field bits of the reply. (7) Verify that the correct bits are transmitted in the AC field of the reply with the Q bit set to 0 to indicate a report to 100 ft quantization and the M bit set to 0. (8) Verify that the AC field is all ZEROs when the ALT switch is set to " OFF ". Set the input altitude data to invalid and verify that the AC field is all ZEROs. Step 4 Identification Code (Mode S) (§ 2.2.13.1.2 b) With the equipment connected as in Step 3, interrogate the transponder with a standard surveillance-identity interrogation (UF=5) with PC, RR, DI and SD fields set to ZERO and the address the same as that provided to the transponder. Using the identity codes specified in Step 2, verify that the proper bit patterns exist in the ID field of the reply. Step 5 Flight Status and Vertical Status (§ 2.2.13.1.2 c and d) Interrogate with UF=0 and UF=16 and verify that the VS field is a ONE when the "on-the-ground port" of the transponder is set to the on-the-ground condition. Also, verify that the VS field is a ZERO otherwise.	

	the above indications are correctly contained in the FS field (3.18.4.12 and figure 3.12). and that CA is set to 4 (airborne) or 5.(ground), if a status is provided to the transponder, and code CA=6 (either airborne or on-the-ground) is reported when the input is idle (or not available). f. Step 6 Aircraft Identification Data (§ 2.2.13.1.2 e) If the transponder inputs aircraft identification data as variable data, the following test applies. Interrogate the transponder with a short surveillance-altitude (UF=4) with PC, DI and SD fields set to 0 and the RR field set to 18. Set the aircraft identification input to the transponder to 'LLLLLLLL' and verify that the encoded aircraft identification data is correctly transmitted in the MB field (MB Bits 9-56 = 001100001100 ...) of the transponder's reply. Repeat with an aircraft identification input of '33333333' and verify that the encoded aircraft identification data is correctly transmitted in the MB field (MB Bits 9-56 = 110011110011 ...) of the transponder's reply.		Interrogate with formats UF=4, 5, 20, 21 and verify that the transponder follows the protocol of §2.2.16.2.7 and Figure 2-13. Also verify that the CA field is set to 4 (airborne) or 5 (ground), if a status is provided to the transponder, and code CA=6 (either airborne or on-the-ground) is reported when the input is idle (or not available). Step 6 Aircraft Identification Data (§ 2.2.13.1.2 e) If the transponder inputs aircraft identification data as variable data, the following test applies. Interrogate the transponder with a short surveillance-altitude (UF=4) with PC, DI and SD fields set to 0 and the RR field set to 18. Set the aircraft identification input to the transponder to 'LLLLLLLL' and verify that the encoded aircraft identification data is correctly transmitted in the MB field (MB Bits 9-56 = 001100001100 ...) of the transponder's reply. Repeat with an aircraft identification input of '33333333' and verify that the encoded aircraft identification data is correctly transmitted in the MB field (MB Bits 9-56 = 110011110011 ...) of the transponder's reply.	

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5.4.12.3	**Standard Transaction Interfaces (Paragraph 3.17.3)**	**2.3.2.11.3**	**Standard Transaction Interfaces (§ 2.2.13.3)**	
5.4.12.3.1	Test Equipment a. Transponder Test Set. b. A means of injecting and extracting data at transponder interface ports. c. A means of timing transactions.			
5.4.12.3.2	Test Procedure Connect the equipment as shown in Figure 5.1. a. STEP 1 - Uplink Interface Information Content (Paragraph 3.17.3 c.) Interrogate the transponder with valid Mode S interrogations excluding UF 0, UF 11, UF 16 and UF 24 of all uplink formats which the transponder is designed to accept, including broadcast interrogations. Record that all fields (possibly excluding AP) of the interrogations are passed correctly through the transponder and appear at the uplink interface. Make additional valid interrogations with the Uplink Formats and field content randomly chosen. Record proper output of the uplink interface. Verify and record that broadcast interrogations are identified as such, either by AP content or a special purpose code. b. STEP 2 - Uplink Interface, "No-Storage" Design (Paragraph 3.17.3 c.) Interrogate the transponder with valid Mode S interrogations (including broadcast but excluding UF=1 1 and UF=24) of all Uplink Formats which the transponder is designed to accept. Record that all data appear correctly at the uplink interface prior to the start of the transponder reply. c. STEP 3 - Uplink Interface, "Storage Design" Acceptance Rate (Paragraph 3.17.3 c.) Interrogate the transponder with valid Mode S interrogations (both short and long) at the rates and time periods specified in Paragraph 3.17.3 c. Record that all data appear correctly at the uplink interface. d. STEP 4 - Uplink Interface, Non-acceptance (Paragraph 3.17.3 c.)		Step 1 Uplink Interface Information Content (§2.2.13.3.1 a) Interrogate the transponder with valid Mode S interrogations of all uplink formats that the transponder is designed to accept. Verify that all fields (possibly excluding AP) of the interrogations are passed correctly through the transponder and except for UF=0, 11, 16, and 24 (when it is a request for a downlink ELM) appear at the uplink interface. Step 2 Uplink Interface, "No-Storage Design" (§ 2.2.13.3.1 b) Interrogate the transponder with valid Mode S interrogations of all uplink formats that the transponder is designed to accept. Verify that all data appear correctly at the uplink interface prior to the start of the transponder reply. Step 3 Uplink Interface, "Storage Design" Acceptance Rate (§ 2.2.13.3.1 c) Interrogate the transponder with valid Mode S interrogations (both short and long) at the rates and time periods specified in subparagraph 2.2.3.4.2. Verify that all data appear correctly at the uplink interface.	

		Interrogate the transponder with valid long Mode S interrogations at a rate exceeding the one specified in Paragraph 3.17.3 c.(4) for the longest time period. Record that the transponder does not accept interrogations after the rate for which the transponder is designed has been exceeded. Record that all data correctly appear at the uplink interface for all accepted interrogations. With the uplink interface disconnected record that the transponder does not reply to valid long Mode S interrogations. [This procedure step is not required under environmental conditions.]	**Agreed**		
	e.	STEP 5 - Downlink Interface, Information Content (Paragraph 3.17.3 d.) Inject an all ONEs input directed to the MB message buffer accessed by RR = 16. Interrogate the transponder with all Uplink Formats that it is designed to accept (one interrogation of each format, RR=16 for long interrogations). Record that all bits in the transponder replies, not set by transponder protocol requirements, are ONE. Record that all fields in the replies, set by transponder protocol, have the correct value. [Under environmental conditions, the following paragraph of this test step is not required.] Repeat the 3 previous points with MB field data context 55 5555 5555 5555.	**Agreed**	Step 4	Downlink Interface, Information Content (§ 2.2.13.3.2 a) Insert an all ONEs input. Interrogate the transponder with all uplink formats that it is designed to accept (one interrogation of each format, RR=16 for long interrogations). Verify that all bits in the transponder replies, not set by transponder protocol requirements, are ONE. Verify that all fields in the replies, set by transponder protocol, have the correct value.
	f.	STEP 6 - Downlink Interface, "No-Storage Design" (Paragraph 3.17.3 d.) Insert an all ONEs input, directed to the BDS buffer, accessed by RR=20. Interrogate the transponder with a standard Comm-A, altitude interrogation. Record that the transponder reply contains the correct data.		Step 5	Downlink Interface, "No-Storage Design" (§ 2.2.13.3.2 b) Insert an all ONEs input. Interrogate the transponder with a standard Comm-A, altitude interrogation. Verify that data are inserted into the transponder at the proper time, and that the transponder reply contains the proper data.
	g.	STEP 7 - Downlink Interface, "Storage Design" Buffer Rate, Buffer Function (Paragraph 3.17.3 d.) Set up a sequence of Comm-B replies, associated with a specific BDS data source designator code, with the value of the 56 bit MB field of each reply set to a number to enable verification of reply sequence (e.g. value =2n where n is the number of the reply in the sequence). Apply this sequence of replies to the transponder down link interface at the rate specified for long interrogations in paragraph 3.17.3 d. Interrogate the transponder with a standard Comm-A,		Step 6	Downlink Interface, "Storage Design" Buffer Rate, Buffer Function (§ 2.2.13.3.2 c) Set up a sequence of Comm-B replies with the value of the last 48 bits of MB of each reply set to the number of the reply in the sequence (e.g., MB=1 for the first reply). Interrogate the transponder with a standard Comm-A, altitude interrogation at the rates specified for long interrogations in subparagraph 2.2.3.4. Verify that the replies include the proper data in the MB field. Repeat with RR equal to all valid codes from 16 through 18.

	altitude interrogation requesting the BDS data source designator under test at the rate specified for long interrogations in paragraph 3.17.3 d. Record that the replies include the correct data in the MB field. [Under environmental conditions, the following paragraph of this test step is not required.] Repeat for all valid BDS data source designator codes 0 to 255. [The following paragraph is required under all conditions] Repeat with RR equal to all valid codes from 16 through 18. ***NOTE:*** *BDS code 0,0 represents AICB messages. Testing of such messages requires such messages to be closed-out after being read.* h. STEP 8 - Downlink Interface. Unavailable Data (Paragraph 3.17.3 d.) Disconnect all inputs from the transponder's downlink interface port. Interrogate the transponder with a standard Comm-A, altitude interrogation containing RR=16. Record that the reply contains all ZEROs in the MB field. Repeat with all RR codes from 17 through 31. Verify that: - For RR code 17, bits of the MB field of the reply excluding bits 1-8, 24 and 26-36 are set to ZEROs (bits 1-8, 24, 26-32, 33 and 35 are or may eventually be set by the transponder itself when no interface is availble). - For RR code 18, the reply contains all ZEROs excluding bits 1 – 8, in the MB field if the aircraft identification consists of variable direct data, or the tail number if the aircraft identification consists of fixed direct data. - For RR code 19, bits 9-56 of the MB field of the reply are set to ZEROs. - For RR codes 20 though 31, verify that the reply contains all ZEROs in the MB field if not manage by the transponder itself. [This procedure step is not required under environmental conditions.]	**Agreed** **Agreed** **Agreed**		

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5.4.12.4	**ELM Service Interfaces (Paragraph 3.17.4)**	**2.3.2.11.4**	**ELM Service Interfaces (§ 2.2.13.4)**	
5.4.12.4.1	Test Equipment a. Transponder Test Set. b. Transponder ELM Data Link Device.			
5.4.12.4.2	Test Procedure Connect the equipment as shown in Figure 5-1. Connect the Transponder Test Set or the ELM data link device to the ELM interface port of the transponder and perform the following sequences. a. STEP 1 - ELM Uplink Interface, Data Rate (Paragraph 3.17.4 c.) Interrogate the transponder with four 16-segment uplink ELMs (each segment having unique coding) with interrogations spaced 50 µs apart, and a new 16-segment ELM starting each second. (If the transponder has enhanced ELM uplink capability, then start the new 16-segment ELM every 5 milliseconds). After 4 seconds, interrogate the transponder with another set of four 16-segment ELMs. (If the transponder has enhanced ELM uplink capability, start the interrogation of the transponder after 1 second.) Record that correct data appear at the ELM interface, within one second after completion of the delivery of the corresponding uplink ELM, for both interrogation sequences. [Under environmental conditions, the following paragraph of this test step is not required.] Verify that the interface reports an interrogator identifier code of 0. b. STEP 2 - ELM Uplink Interface, Interrogator Identification (Paragraph 3.17.4 e) Repeat STEP 1 using the multisite protocol. Use different Interrogator Identifier codes and verify that they are correctly reported at the interface. [This procedure step is not required under environmental conditions.] c. STEP 3 - ELM Downlink Interface, Data Rate (Paragraph 3.17.4 d.) Set up a downlink ELM which conforms to the maximum capability of the transponder (each segment with unique coding) on the Transponder Test Set or ELM data link	**Agreed** **Agreed**	Connect the transponder RF port to the RF port of the Mode S transponder test set. Connect the Mode S transponder test set of the ELM data link device to the ELM interface port of the transponder and perform the following sequences. Step 1 ELM Uplink Interface, Data Rate (§ 2.2.13.4.1) Interrogate the transponder with four 16-segment uplink ELMs (each segment having unique coding, interrogations spaced 50 microseconds apart, and a new 16 segment ELM starting every 5 milliseconds). After 4 seconds for transponders equipped for standard ELM operation and after 1 second for transponders equipped for enhanced uplink ELM operation, interrogate the transponder with another set of four 16-segment ELMs. Verify that correct data appear at the ELM interface for both interrogation bursts. Step 2 ELM Downlink Interface, Data Rate (§2.2.13.4.2 and 2.2.3.5) Set up a downlink ELM which conforms to the maximum capability of the transponder (each segment with unique	**Note:** Minor change needed to DO-181D where "136 +1" was changed to "136 +/- 1".

	device. Interrogate the transponder with a Comm-C (UF=24) with RC=3 and SRS="all ONEs". Check that all segments are correctly transmitted 136 ±1 µs, apart.		coding) on the Mode S transponder test set or ELM data link device. Interrogate the transponder with a Comm-C (UF=24) with RC=3 and SRS="all ONEs". Verify that all segments are properly transmitted 136 +/- 1 microseconds apart.	
5.4.12.5	**Comm-B Downlink Interface, Message Cancellation (Paragraph 3.17.5)** [This procedure is not required under environmental conditions]	**Agreed**		
5.4.12.5.1	Test Equipment a. Transponder Test Set. b. Transponder Data Link Device.			
5.4.12.5.2	Test Procedure Connect the equipment as shown in Figure 5-1. Connect the Transponder Test Set or the data link device to the interface port of the transponder and perform the following sequences. a. STEP 1 - Cancellation Before Transmission Interrogate the transponder with UF=4, 5, 20 and 21 and RR z16. Verify that the DR code in the transponder reply is set to 0. Insert a Comm-B message into the downlink interface for transmission. Interrogate the transponder with UF=4, 5, 20 and 21 in turn. Verify that the DR code in its replies is set to 1. Cancel the message via the interface, interrogate again to verify that the DR code is set to zero. b. STEP 2 - Cancellation After Transmission Interrogate the transponder with UF=4, 5, 20 and 21, RR z 16 and verify that the DR code is set to 0. Insert a Comm-B message into the downlink interface for transmission. Interrogate the transponder with UF=4, 5, 20 or 21 and extract the message using RR=16. Cancel the message via the interface, interrogate again with UF = 4, 5, 20 or 21 with RR = 16 to verify that the DR code in the transponder reply is set to zero. c. STEP 3 - Cancellation in Multisite Environment Interrogate the transponder with UF=4, 5, 20 and 21 and verify that the DR code is set to 0. Prepare two messages, m1 and m2, of differing content, for insertion into the interface.			

	Insert m1 into the downlink interface for transmission and extract message using the multisite protocol (RR=16, DI=1, IIS more than 0, MBS=1). Cancel m1 via the interface and reinterrogate to verify that the UM field does not show a Comm-B reservation and that the DR code in the transponder reply is set to zero. Within less than 15 seconds of cancelling m1, insert m2 into the interface and extract using the multisite protocol with different IIS. Verify that the second message has been extracted and close out the transaction using DI=1, IIS as for m2, MBS=2. Verify that the DR field in the transponder reply is set to zero and that the UM field does not show a Comm-B reservation. ***NOTE:*** *This two-message sequence is needed to verify that a complete cancellation has been achieved by way of the interface.* d. STEP 4 - Cancellation Within a Queue If the interface is designed to store more than one message in the transponder, where one message is ready to be transmitted and other messages are queued for subsequent transmission, the following test shall be performed. Insert the maximum number of messages into the transponder and cancel via the data interface one of the messages that is not scheduled for immediate transmission. Extract all messages and verify that the cancelled message does not appear. Repeat the test for each possible message location in the queue.			
5.4.12.6	**Downlink ELM Interface, Message Cancellation (Paragraph 3.17.5)** [This procedure is not required under environmental conditions]	**Agreed**		
5.4.12.6.1	Test Equipment a. Transponder Test Set. b. Transponder ELM Data Link Device.			

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5.4.12.6.2	Test Procedure Connect the equipment as shown in Figure 5-1. Connect the Transponder Test Set or the ELM data link device to the ELM interface port of the transponder and perform the following sequences. a. STEP 1 - Cancellation Before Transmission Insert an ELM message, occupying as many segments as the transponder will permit, into the downlink interface for transmission. Interrogate the transponder with UF=4, 5, 20 and 21. Verify that the DR code in the replies is larger than 16 and correctly reflects the number of inserted segments. Cancel the message via the interface. Interrogate again and verify that the DR code is now not larger than 16. b. STEP 2 - Cancellation After Transmission Insert an ELM message, occupying as many segments as the transponder will permit, into the downlink interface for transmission. Extract the message with a valid interrogation UF=24 using RC=3 and SRS set to extract the correct number of segments. Cancel the message via the interface. Interrogate again and verify that the DR code is now not larger than 16.			
5.4.13	**Interface Integrity Testing (Paragraph 3.17.2 b.)** Compliance with this requirement shall be demonstrated either by direct test in a simulated operational environment or by analysis based on the known characteristics of proven interface techniques.	**2.3.2.11.5**	**Interface Integrity Tests (§2.2.13.2.2)** Specific test procedures for these functions are not described. Detailed procedures for demonstrating compliance with §2.2.13.2.2 are left to the discretion of the manufacturer.	
5.4.14	**Power Interruption (Paragraph 3.24)** Apply the momentary power interruption sequence appropriate for the transponder environmental category as specified in ED-14D Section 16. Two seconds after the restoration of power following each power interruption, interrogate the transponder with a Mode S-only All-Call interrogation (UF=1 1) with IC and CI equal to 0. Verify that a correct All-Call reply (DF=1 1) is transmitted in response to this interrogation.	**2.3.2.12**	**Restoration of Power (§ 2.2.19)** Apply the momentary power interruption sequence appropriate for the transponder environmental category as specified in DO-160B, Section 16. Two seconds after the restoration of power following each power interruption, interrogate the transponder with a Mode S-Only All-Call interrogation with PR, IC and CL fields set to zero. Verify that a correct All-Call reply (DF=1 1) is transmitted in response to this interrogation.	

Special Note: Extended Squitter Procedures previously provided above, have been moved below for future reference if needed.	
5.4.3.2.2 (continued)5.4.3.2.3	g. STEP 7 - Squitter Generation (Paragraph 3.22.2.6) Record the acquisition squitter transmission and verify its format. Monitor the acquisition squitter transmission with the transponder in the inactive state. Verify that squitter is emitted at intervals between 0.8 and 1.2 seconds using a time quantisation of no greater than 15 milliseconds. Verify the random nature of the process. During a acquisition squitter transmission, trigger an interrogation at the transponder test set. Verify that the squitter is not interrupted. Interrogate the transponder at the rates defined in para 3.4.2 to the maximum capacity of the transponder. Record the acquisition squitter time interval. Verify that the distribution remains random, and is widened by no more than expected. ***NOTE:*** *The widening of the distribution is dependant on the longest transaction cycle i.e. less than 2 milliseconds.* Suppress the transponder for more than 1.2 seconds. Measure the time between deactivating the suppression and the following acquisition squitter. ***NOTE:*** *Some transponders may not be capable of being suppressed for as long as 1.2 seconds if the mutual suppression pulses are A.C.-coupled. Special arrangements may have to be made to by-pass the suppression input isolating capacitor in order to be able to demonstrate compliance with this test.* For transponders with extended squitter capability additionally perform the following tests: (1) If any type of extended squitter is in progress verify that a scheduled acquisition squitter is delayed. (2) Verify that if an acquisition squitter has begun it is not interrupted by any type of extended squitter. (3) Verify that if the transponder is reporting surface position extended squitters that no acquisition squitters are transmitted. Conversely verify that acquisition squitters are transmitted as soon as surface position extended squitters cease. (4) Verify that a means exist of inhibiting the transmission of acquisition squitters while extended squitters are being transmitted
5.4.3.2.3	Test Procedure (Extended Squitter Generation) (Paragraph 3.28) This procedure is only applicable to transponders equipped for extended squitter. Equipment Required: Provide a method of loading valid data for the generation of Airborne Position, Surface Position, Aircraft Identification and Type, Airborne Velocity, Intent, Operational Coordination, and Operational Status broadcast messages into the transponder under test Provide a method of recording and time stamping all messages transmitted by the transponder under test with the time stamping quantisation being 15 milliseconds or less. Procedure: Connect the equipment as shown in Figure 5-3a. Display/record the Mode S squitter information. a. STEP 1 - Airborne Position Report: (1) Load GICB register 05 {HEX} with data pattern 50 00 0A AA AA AA AA {HEX} and refresh this data each 1 second. Input a barometric altitude shown in one of the tables below on the appropriate pins of the transponder and refresh this data at the required rate. (Use table with Q bit=0 if alticoder capable of 100 ft resolution only or table with Q bit = 1 if 25 ft resolution). Enable the airborne condition (squat switch discretes). Record the extended squitter transmission (DF=17) and verify its format. Verify the transponder has correctly inserted the altitude code in the squitter. Bits 9 to 20 of the 56 bit ME field. Monitor the extended squitter (DF=17) with the transponder in the inactive state. Verify that the extended squitter (DF=17) is transmitted at intervals between 0.4 and 0.6 seconds using a time quantisation of no greater than 15 milliseconds. Verify the random nature (see paragraph 3.21.2.6.3) of these squitters. (2) During the extended squitter transmission, generate an interrogation by the transponder test set. Verify the squitter is not interrupted. (3) Load GICB register 05 {HEX} with data pattern 50 00 0A AA AA AA AA {HEX} and refresh this data each 1 second. Input a barometric altitude shown in one of the tables below on the appropriate pins of the transponder and refresh this data at the required rate. (Use table with Q bit=0 if alticoder capable of 100 ft resolution only or table with Q bit = 1 if 25 ft resolution). Enable the airborne condition (squat switch discretes).

REFER DIRECTLY TO ED-73B/C FOR TABLES:

(4) Stop refreshing the GICB register 05 {HEX} data and verify that the extended squitter (DF=17) ceases after 2 seconds.

(5) Restart refreshing the GICB register 05 {HEX} data and verify that the DF17 extended squitter is sent and the content is correct.

b. STEP 2 - Surface position report, high squitter rate (paragraph 3.28.3 b):

(1) Load GICB register 06 {HEX} to set surface format type = 6 and movement field to 30 kts with data pattern 35 6A AA AA AA AA AA {HEX} and refresh this data each 1 second. Enable the on-the-ground condition (squat switch discretes).

Record the extended squitter transmission (DF=17) and verify its format.

Monitor the extended squitter (DF=17) with the transponder in the in-active state. Verify the squitter is emitted at intervals between 0.4 and 0.6 seconds using a time quantisation of no greater than 15 milliseconds. Verify the random nature of the process.

(2) During the extended squitter transmission, trigger an interrogation at the transponder test set. Verify the squitter is not interrupted.

(3) Repeat (1) and (2) for data patterns 35 65 55 55 55 55 55 {HEX}, 35 60 00 00 00 00 00 and 35 6F FF FF FF FF FF {HEX}.

(4) Stop refreshing the GICB register 06 {HEX} data and verify that the extended squitter (DF=17) ceases after two seconds.

(5) Restart refreshing the GICB register 06 {HEX} data and verify that the extended squitter (DF=17) is sent again and the content is correct.

c. STEP 3 - Surface position report low squitter rate (paragraph 3.28.3 b) :

(1) Load GICB register 06 {HEX} to set surface format type = 6 and movement field to 0 kts. with data pattern 30 1A AA AA AA AA AA {HEX} and refresh this data each 1 second. Enable the on-the-ground condition (squat switch discretes).

Record the extended squitter transmission (DF=17) and verify its format.

Monitor the extended squitter (DF=17) with the transponder in the in-active state. Verify the squitter is emitted at intervals between 4.8 and 5.2 seconds. Verify the random nature of the process.

(2) During the extended squitter transmission, trigger an interrogation at the transponder test set. Verify the squitter is not interrupted.

(3) Repeat (1) and (2) for data patterns 30 15 55 55 55 55 55 {HEX}, 30 10 00 00 00 00 00 and 30 1F FF FF FF FF FF {HEX}.

(4) Stop refreshing the GICB register 06 {HEX} data and verify that the extended squitter (DF=17) ceases after two seconds.

(5) Restart refreshing the GICB register 06 {HEX} data and verify that the extended squitter (DF=17) is sent again and the content is correct.

d. STEP 4 - Aircraft Identification Squitter (paragraph 3.28.2 c):

(1) Enable airborne condition (squat switch discretes).

(2) Load GICB register 08 {HEX} (Aircraft Identification Squitter) to set format type = 4, plus large aircraft (75000 to 190000 lb.) with data pattern 23 AA AA AA AA AA AA {HEX} and refresh data every 200 ms.

(3) Monitor the extended squitter (DF=17) with the transponder in the in-active state. Verify the format of the squitter. Verify the squitter is emitted at intervals between 4.8 to 5.2 seconds using a time quantisation of no greater than 15 milliseconds. Verify the random nature of the process.

(4) Repeat steps (2) and (3) with data patterns 23 55 55 55 55 55 55 {HEX}, 23 00 00 00 00 00 00 {HEX} and 23 FF FF FF FF FF FF {HEX}.

(5) Stop refreshing GICB register 08 {HEX} and verify the contents of the extended aircraft identification squitter remains unchanged.

(6) Enable surface condition (squat switch discretes). Enable the high rate of the surface position squitter.

(7) Repeat steps (2) to (5).

(8) Enable surface condition (squat switch discretes). Enable the low rate of the surface position squitter.

(9) Repeat steps (2) to (5) but check in (3) that the identification squitter is now emitted at intervals between 9.6 to 10.4 seconds using a time quantisation of no greater than 15 milliseconds. Verify the random nature of the process.

e. STEP 5 - Airborne Velocity Squitter (paragraph 3.28.2 d):

(1) Load GICB register 09 {HEX} to indicate format type = 19 and subtype = 0 with data pattern 98 AA AA AA AA AA AA {HEX} and refresh data every 200 ms. Enable airborne condition (squat switch discretes).

(2) Monitor the extended airborne velocity squitter (DF=17) with the transponder in the inactive state. Verify the DF 17 format of the squitter. Verify the airborne velocity

vector squitter is emitted at intervals between 0.4 to 0.6 seconds using a time quantisation of no greater than 15 milliseconds. Verify the random nature of the process.

(3) During the extended squitter transmission, trigger an interrogation at the transponder test set. Verify the squitter is not interrupted.

(4) Repeat (1) to (3) for data patterns 98 55 55 55 55 55 55 {HEX}, 98 00 00 00 00 00 00 {HEX} and 98 FF FF FF FF FF FF {HEX}.

(5) Stop refreshing the GICB register 09 {HEX} data and verify that the extended airborne velocity vector squitter (DF=17) ceases after two seconds.

(6) Restart refreshing the GICB register 09 {HEX} data and verify that the extended airborne velocity vector squitter (DF=17) content is again correct.

(7) Load GICB register 09 {HEX} with data pattern 98 AA AA AA AA AA AA {HEX} and refresh data every 200 ms.

(8) Enable surface condition (squat switch discretes) and verify that the extended airborne velocity squitter ceases.

f. STEP 6 - Event driven Squitter (paragraph 3.28.2 e) :

(1) General

Load GICB register 0A {HEX} to indicate format type = 29 and subtype = 0 with data pattern E8 AA AA AA AA AA AA {HEX}. Enable airborne condition (squat switch discretes).

Monitor the event driven squitter (DF=17) with the transponder in the inactive state. Verify the format of the squitter. Verify the squitter is transmitted one time only.

During the extended squitter transmission, trigger an interrogation at the transponder test set. Verify the squitter is not interrupted.

(2) Rate Limit

Load GICB register 0A {HEX} with data pattern E8 AA AA AA AA AA AA {HEX} and refresh this data each 200 ms.

Verify that the event driven squitter rate is limited to once every 500 ms. Verify the content of the event driven squitter (DF=1 7).

(3) Delay due to Rate Limit

Using the transponder test set, interrogate the transponder at a high rate in order to obtain the rate limiting condition. Now load GICB register 0A {HEX} with data E8 55 55 55 55 55 55 {HEX} and verify that there is no extended squitter transmission whilst the rate limiting condition is maintained.

(4) Rate Limit boundaries

Reduce the rate of interrogation below the rate limiting condition. Verify that the event driven extended squitter is now transmitted once only. Verify the format of the event driven squitter (DF=17).

Using the transponder test set, interrogate the transponder at a high rate in order to obtain the rate limiting condition. Now load GICB register 0A {HEX} with data E8 55 55 55 55 55 55 {HEX} and verify that there is no extended squitter transmission whilst the rate limiting condition is maintained.

(5) Data Overwrite

Now load GICB register 0A {HEX} with data pattern E8 77 77 77 77 77 77 {HEX} whilst maintaining the rate limiting condition.

Reduce the rate of interrogation below the rate limiting condition. Verify that the event driven extended squitter data E8 55 55 55 55 55 55 {HEX} has been overwritten and data E8 77 77 77 77 77 77 {HEX} is now transmitted once only. Verify the format of the event driven squitter (DF=17).

g. STEP 7 - ADS-B Aircraft Trajectory Intent Message Measurement Procedure:

Ensure that no Trajectory Intent data is available. Verify that no Trajectory intent message is output for a period of 20 seconds. Inject the appropriate valid ADS-B Trajectory Intent data and verify that the ADS-B Trajectory Intent message is broadcast at intervals that are distributed over the range of 1.6 to 1.8 seconds using a time quantisation of no greater than 15 milliseconds as specified in subparagraph 3.21.2.6.3 f. for as long and data is available.

Repeat the procedure for each Trajectory Intent message independently as necessary.

h. STEP 8 - ADS-B Aircraft Operational Co-ordination Message Measurement Procedure:

(1) Initialization (subparagraph 3.28.3. g)

Ensure that no Aircraft Operational Coordination data is available. Verify that no Operational Coordination message is output for a period of 20 seconds. Inject the appropriate valid ADS-B Operational Coordination data. Verify that the ADS-B Aircraft Operational Coordination message is broadcast at intervals that are distributed over the range of 1.9 to 2.1 seconds using a time quantisation of no greater than 15 milliseconds as specified in subparagraph 2.2.3.3.2.6.2.b for a period of 30 +/- 1 seconds.

(2) Steady State (Subparagraph 3.28.3.g)

Initialize the equipment as in Step 1 above and when a time of 19 seconds has elapsed, verify that the ADS-B Aircraft Operational Coordination message is broadcast

at intervals that are distributed over the range of 4.8 to 5.2 seconds using a time quantisation of no greater than 15 milliseconds as specified in subparagraph 3.28.3.g (2).

i. STEP 9 - ADS-B Aircraft Operational Status Message Measurement Procedure:

Ensure that no Aircraft Operational Status data is available. Verify that no Aircraft Operational Status message is output for a period of 20 seconds. Inject the appropriate valid ADS-B Aircraft Operational Status data. Verify that the ADS-B Aircraft Operational Status message is broadcast at intervals that are distributed over the range of 1.6 to 1.8 seconds using a time quantisation of no greater than 15 milliseconds as specified in subparagraph 3.21.2.6.3 .h. (2) for a period of 30 +/- 1 seconds.

j. STEP 10 - "Extended Squitter Aircraft Status" ADS-B Event - Driven Message Measurement Procedure:

Establish the emergency condition in accordance with ED-102/Do-260 Appendix A., Figure A.8-9, Note 2. Verify that the Emergency/Status Event Driven Message (Type-28, Subtype=1) is broadcast at intervals that are distributed over the range of 0.8 to 1.2 seconds using a time quantisation of no greater than 15 milliseconds. Clear the established emergency condition and verify that NO Emergency/Status Event Driven Messages are broadcast.

k. STEP 11 - Maximum Message Transmission Rates Equipment Required:

Provide equipment capable of loading valid data for broadcast messages into the equipment under test through the operational interface.

Provide a method of monitoring broadcast messages output by the equipment under test.

Provide a Wide Band Dual Channel Oscilloscope (HP 17l0B, or equivalent). Measurement Procedure:

(1) Maximum Combined Message Output rate (ED-102/DO-260 Subparagraph 2.2.3.3.2.10) -Airborne

Set the Airborne condition and load valid data into all the Broadcast messages that can be supported by the equipment under test at a rate ensuring maximum transmission rate. Also ensure that the data for all event driven messages changes at a rate requiring more than the permitted maximum output rate of two messages per second. Verify that each of the Broadcast message types are output at rates within the specified tolerance, that the Airborne Position Messages are being transmitted, and that only two event driven messages per second are transmitted. Also verify that the total combined rate is less than or equal to 6.2 messages per second.

During this test, also verify that the transmitted output power remains within the specified limits.

l. STEP 12 - Overall Squitter Randomness

Test that when several different types of squitter are being transmitted that the total process is still of a random nature.

(1) Surface condition

Enable the acquisition squitter, the extended surface squitter and the aircraft identification squitter. Measure the times between all these squitters and show that the squitter time quantisation is no greater that 15 milliseconds.

(2) Airborne condition

Enable the acquisition squitter, the extended airborne squitter, the aircraft identification squitter and the airborne velocity squitter. Measure the times between all these squitters and show that the squitter time quantisation is no greater that 15 milliseconds.

m. STEP 13 - Delayed transmission of extended squitters

(1) For each different type of extended squitter. Verify that if the transponder is in a transition cycle that that the extended squitter emission being tested is delayed until the transition cycle has finished.

(2) Verify that if an acquisition squitter or another type of extended squitter is in progress that the extended squitter under test is delayed until the process is finished.

(3) Verify that if a mutual suppression pulse is active that the extended squitter under test is delayed until the end of the suppression pulse.

(4) Repeat the above steps (1) to (3) for the five types of extended squitter, Airborne position, Surface position, Aircraft identification, Airborne velocity and Event driven squitter.

n. STEP 14 - Extended squitter antenna selection tests

For transponders operating with antenna diversity. Verify that when the transponder is in the airborne condition (squat switch discretes) that the transponder shall transmit each type of extended squitter alternately from the two antennas.

(1) Airborne squitter

Load GICB register 05 {HEX} with data pattern 50 AA AA AA AA AA AA {HEX} and refresh this data each 200 ms. Input a barometric altitude of 1000 feet on the appropriate pins of the transponder and refresh this data at the required rate. Enable the airborne condition (squat switch discretes).

Verify that the extended squitter is transmitted alternately on top and bottom antennas.

	(2) Aircraft identity squitter Load GICB register 08 {HEX} with data pattern 23 BB BB BB BB BB BB {HEX} and refresh this data each 200 ms. Enable the airborne condition (squat switch discretes). Verify that the extended squitter is transmitted alternately on top and bottom antennas. (3) Airborne velocity squitter Load GICB register 09 {HEX} with data pattern 98 CC CC CC CC CC CC {HEX} and refresh this data each 200 ms. Enable the airborne condition (squat switch discretes). Verify that the extended squitter is transmitted alternately on top and bottom antennas. (4) Event driven squitter not defined
5.4.3.2.4	Test Procedure (Extended Squitter Control) (Paragraph 3.28.7) This procedure is only applicable to transponders equipped for extended squitter. Connect the equipment as shown in Figure 5-3a. Display/record the Mode S squitter information. Test the Type Control Subfield (TCS) in SD. a. STEP 1 - TCS command subfield Load GICB register 05 {HEX} with data pattern 50 66 66 66 66 66 66 {HEX} and refresh this data every 200 ms. Load GICB register 06 {HEX} with data pattern 35 6E EE EE EE EE EE {HEX} and refresh data every 200 ms. Enable the airborne condition Verify the airborne extended squitter (DF=17) transmission format. Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS=0, RCS=0 and SAS=0.. Verify that the extended squitter emission (DF=17) is still the airborne type. b. STEP 2 - Test 15 sec. surface report command Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 1, RCS=0 and SAS=0. Verify that the extended squitter emission (DF=17) reports the surface type message for 15 seconds and then reverts to the airborne type. c. STEP 3 - Test 60 sec. surface report command Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2 and TCS = 2, RCS=0 and SAS=0. Verify that the extended squitter emission (DF=17) reports the surface type message for 60 seconds and then reverts to the airborne type. d. STEP 4 - Test cancel 15 sec. surface report command Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 1, RCS=0 and SAS=0. Verify that the extended squitter emission (DF=17) reports the surface type message then send an interrogation with the test set with DI=2 and TCS=3 and verify that the extended squitter reverts immediately to the airborne type. e. STEP 5 - Test cancel 60 sec. surface report command Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 2, RCS=0 and SAS=0. Verify that the DF 17 extended squitter emission reports the surface type message then send an interrogation with the test set with DI=2 and TCS=3 and verify that the extended squitter reverts immediately to the airborne type. f. STEP 6 - Test the Rate Control Subfields (RCS) surface rate commands (Paragraph 3.21.2.6.7): (1) Load GICB register 05 {HEX} with data pattern 50 66 66 66 66 66 66 {HEX} and refresh this data every 200 ms. (2) Load GICB register 06 {HEX} with data pattern 30 1E EE EE EE EE EE {HEX} and refresh data every 200 ms. (3) Enable the surface condition Verify the surface extended squitter (DF=17) transmission format, and that it is at low rate. (4) Test high rate one shot of 60 sec:

Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=1 and SAS=0. Verify that the extended squitter emission (DF=17) reports the surface type message for 60 seconds at the high rate and then reverts to the low rate.

(5) Test high rate one shot plus restart after 30 seconds:

Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=1 and SAS=0. After 30 seconds send the same RCS command again. Verify that the DF17 extended squitter emission reports the surface type message for 90 seconds at the high rate and then reverts to the low rate.

(6) Enable the airborne condition and verify the airborne extended squitter (DF=17) transmission format.

(7) Test non-effect on airborne squitter rates:

Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=1 and SAS=0. Verify that the extended squitter emission (DF=17) continues to report the airborne type message at the normal rate for airborne squitters.

(8) Enable the surface condition, load GICB register 06 {HEX} with data pattern 35 6E EE EE EE EE EE {HEX} and refresh data every 200 ms. and verify the surface extended squitter (DF=17) transmission format and that it is now at high rate.

(9) Test 60 sec. surface low rate command:

Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=2 and SAS=0. Verify that the extended squitter (DF=17) emission reports the surface type message for 60 seconds at the low rate and then reverts to high rate.

(10) Low rate one shot plus restart after 30 seconds

Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=2 and SAS=0. After 30 seconds send the same RCS command again. Verify that the extended squitter emission (DF=17) reports the surface type message for 90 seconds at the low rate and then reverts to high rate.

(11) Test 60 sec. suppression command:

Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=3 and SAS=0. Verify that all extended squitter emission (DF=17) surface type messages are suppressed for 60 seconds and then restarts correctly.

(12) Test 120 sec. suppression command:

Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=4 and SAS=0. Verify that all extended squitter emission (DF=17) surface type messages are suppressed for 120 seconds and then restarts correctly.

(13) Enable the airborne condition and verify the airborne extended squitter (DF=17) transmission format.

(14) Test non-effect of 60 sec. suppression command on airborne squitters.

Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=3 and SAS=0. Verify that the DF 17 extended squitter emission airborne type message are not suppressed and continue normally.

(15) Test non-effect of 120 sec. suppression command on airborne squitters.

Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=4 and SAS=0. Verify that the extended squitter emission (DF=17) airborne type message are not suppressed and continue normally.

g. STEP 7 - Surface Antenna Subfield (SAS) for surface squitters (paragraph 3.28.7):

(For transponders with antenna diversity capability)

(1) Load GICB register 05 {HEX} with data pattern 50 66 66 66 66 66 66 {HEX} and refresh this data every 200 ms.

(2) Load GICB register 06 {HEX} with data pattern 35 6E EE EE EE EE EE {HEX} and refresh data every 200 ms.

(3) Enable the surface condition

Verify that the extended surface squitter (DF=17) is transmitted on the top antenna (default condition). Verify the contents of the squitter.

(4) Test SAS = 0 has no effect:

Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=0 and SAS=0. Verify that the extended squitter emission (DF=17) surface type message continues normally on the top antenna.

(5) Test SAS = 1 selects alternate antennas for 120 sec.:

Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=0 and SAS=1. Verify that the extended squitter

emission (DF=17) surface type message is transmitted alternately on the top and bottom antennas for a period of 120 seconds, and then reverts to the top antenna only.

(6) Test SAS=2 selects bottom antenna only for 120 sec.:

Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=0 and SAS=2. Verify that the extended squitter emission (DF=17) surface type message is transmitted on the bottom antenna only for a period of 120 seconds, and then reverts to the top antenna only.

(7) Test SAS=3 returns to default condition when alternate antennas selected:

Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=0 and SAS=1. Verify that the extended squitter emission (DF=17) surface type message is transmitted alternately on the top and bottom antennas and then send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=0 and SAS=3 and verify that the emission reverts immediately to the top antenna only.

(8) Test SAS=3 returns to default condition when bottom antenna selected :

Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=0 and SAS=2. Verify that the extended squitter emission (DF=17) surface type message is transmitted on the bottom antenna only then send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=0 and SAS=3 and verify that the squitter emission reverts immediately to the top antenna only.

(9) Enable the airborne condition.

(10) Repeat the above tests in the airborne condition and verify that the airborne squitters and squitter rates are not effected.

h. STEP 8 - Test the Squitter Capability Subfield (SCS) field in capability report (paragraph 3.23.1.12 f):

(1) With the transponder in the in-active state: Using the test set extract the GICB register 10 {HEX} capability report.

Verify that the SCS 1-bit field (Bit 34 of MB field) is zero (i.e. Squitter registers are not being updated).

(2) Enable the airborne condition

Load GICB register 05 {HEX} with data pattern 50 66 66 66 66 66 66 {HEX} and refresh this data every 200 ms.

Load GICB register 06 {HEX} with data pattern 35 6E EE EE EE EE EE {HEX} and refresh data every 200 ms.

Verify that the airborne extended squitter is emitted.

Verify that a change in capability broadcast message is announced by the transponder.

Extract the announced broadcast message and verify content.

Verify that the SCS bit in the capability report (bit 34 in the MB field) is now set to 1 (i.e. Squitter registers are now being updated).

(3) Stop refreshing the GICB register 05 {HEX} and GICB register 06 {HEX} data.

Extract the announced broadcast message and verify content.

Verify that after 10 ± 1 seconds that the SCS bit in the capability report is set to zero.

Verify that a change in capability broadcast message is announced by the transponder.

(4) Enable the surface condition

(5) Load GICB register 05 {HEX} with data pattern 05 66 66 66 66 66 66 {HEX} and refresh this data every 200 ms.

(6) Load GICB register 06 {HEX} with data pattern 35 6E EE EE EE EE EE {HEX} and refresh data every 200 ms.

Verify that the surface extended squitter is emitted.

Extract the announced broadcast message and verify content. Verify that the SCS bit in the capability report is now set to 1.

Verify that a change in capability broadcast message is announced by the transponder.

(7) Stop refreshing the GICB register 05 {HEX} and GICB register 06 {HEX} data.

Extract the announced broadcast message and verify content.

Verify that after 10 ± 1 second that the SCS bit in the capability report is set to zero.

Verify that a change in capability broadcast message is announced by the transponder.

i. STEP 9 - Test Surveillance Status Subfield (SSS) in ME (Airborne condition)

(1) Enable the airborne condition

Load GICB register 05 {HEX} with data pattern 05 66 66 66 66 66 66 {HEX} and refresh this data every 200 ms.

(2) Ensure the transponder is in the inactive state.

Verify that the airborne extended squitter is emitted.

Verify that the SSS field in ME is zero (Bits 6 and 7 of the ME field).

(3) Input 4096 identification code 7500 octal to the transponder by inputting the corresponding Control word to the transponder on the appropriate pins.

Verify the code 7500 with the transponder test set in a DF 5 reply. Verify that the SSS field is now permanently set to value 1.

(4) Input 4096 identification code 1234 octal to the transponder by inputting the corresponding Control word to the transponder on the appropriate pins.

Verify the code 1234 with the transponder test set in a DF 5 reply.

Verify that the SSS field is now set to value 2 for a period of 18 ± 1 seconds and then is set to zero at the expiration of the TC timer.

(5) Repeat the above two test for 4096 codes 7600 and 7700.

(6) Activate the Special Position Identification pulse by inputting the corresponding Control word to the transponder on the appropriate pins.

Verify the SPI with the transponder test set in a DF 4 or 5 reply.

Verify that the SSS field is now set to value 3 for a period of 18 ± 1 seconds and then is set to zero at the expiration of the TI timer.

(7) Input 4096 identification code 7500 octal to the transponder by inputting the corresponding Control word to the transponder on the appropriate pins.

(8) Activate the Special Position Identification pulse by inputting the corresponding Control word to the transponder on the appropriate pins.

Verify the code 7500 with the transponder test set in a DF 5 reply. Verify that the SSS field is permanently set to value 1.

(9) Input 4096 identification code 3456 octal to the transponder by inputting the corresponding Control word to the transponder on the appropriate pins. After 10 seconds activate the Special Position Identification pulse by inputting the corresponding Control word to the transponder on the appropriate pins.

Verify the code 3456 with the transponder test set in a DF 5 reply.

Verify that the SSS field is set to value 2 for a period of 18 ± 1 seconds and then is set to 3 at the expiration of the TC timer and then is set to 3 until the expiration of the TI timer when it is set to zero.

j. STEP 10 - Test Altitude Code Subfield (ACS) in ME and ATS subfield in GICB register 07 {HEX} (Paragraph 3.28.8)

(1) Enable the airborne condition

(2) Load GICB register 05 {HEX} with data pattern 50 66 66 66 66 66 66 {HEX} and refresh this data every 200 ms.

(3) Ensure the transponder is in the non-active state. Verify that the airborne extended squitter is emitted.

(4) Load GICB register 07 {HEX} (Squitter Status Report) with data 20 00 00 00 00 00 00 {HEX}.

(5) With the test set extract GICB register 07 {HEX} and verify that the ATS 1 bit field (bit 3 of the MB field) is zero.

(6) Input a barometric altitude code to the transponder on the appropriate pins

Verify the ACS 12 bit subfield in the airborne extended squitter is correct. The contents of the ACS subfield shall be specified as the contents of the 13 bit AC field except that the M bit shall be omitted.

(7) Repeat above test for several barometric altitude values.

(8) Load GICB register 07 {HEX} with data pattern 00 00 00 00 20 00 00 {H EX}.

(9) With the test set extract GICB register 07 {HEX} and verify that the ATS 1 bit field (bit 3 of MB field) is zero.

(10) Input a barometric altitude code to the transponder on the appropriate pins.

Verify the ACS 12 bit subfield in the airborne extended squitter is now ZERO.

<To be expanded by GNSS height tests>

(11) Repeat above test for several barometric altitude values.

k. STEP 11 - Test Transmission Rate Subfield TRS in GICB register 07 {HEX} (Paragraph 3.28.9):

The transponder shall transmit surface squitters at a high or low rate depending on the values of the TRS subfield in GICB register 07 {HEX}.

	(1) Enable the surface condition (2) Load GICB register 06 {HEX} format type = 6 and aircraft movement 30 kts. with data pattern 35 66 66 66 66 66 66 {HEX} and refresh this data every 200 ms. (3) Ensure the transponder is in the non-active state and that the squitter rate is high. (4) Load GICB register 07 {HEX} with field TRS = 2 i.e. 80 00 00 00 00 00 00 {HEX} and refresh this data every 1 second and verify that the TRS field (bits 1 and 2 of the MB field) has a value of 2. Verify that the surface squitter rate is now low. (5) Load GICB register 07 {HEX} with 40 00 00 00 00 00 00 {HEX} and refresh this data every 1 second and verify that the TRS field (bits 1 and 2 of the MB field) has a value of 1. Verify that the surface squitter rate is now high. (6) Stop updating GICB register 07 {HEX} and verify that the contents are set to zero after 2 seconds. l. STEP 12 - Test that RCS commands override TRS commands (1) Enable the surface condition (2) Load GICB register 06 {HEX} format type = 6 and aircraft movement 30 kts. with data pattern 35 66 66 66 66 66 66 {HEX} and refresh this data every 200 ms. (3) Load GICB register 07 {HEX} with 40 00 00 00 00 00 00 {HEX} and refresh this data every 1 second and verify that the TRS field (bits 1 and 2 of the MB field) has value 1. (4) Ensure the transponder is in the non-active state and that the surface squitter rate is high. (5) Test RCS 60 sec. surface low rate command: Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=2 and SAS=0. Verify that the extended squitter (DF=17) emission reports the surface type message for 60 seconds at the low rate and then reverts to high rate. (6) Test RCS low rate one shot plus restart after 30 seconds Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=2 and SAS=0. After 30 seconds send the same RCS command again. Verify that the extended squitter emission (DF=17) reports the surface type message for 90 seconds at the low rate and then reverts to high rate. (7) Test RCS 60 sec. suppression command: Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=3 and SAS=0. Verify that all extended squitter emission (DF=17) surface type messages are suppressed for 60 seconds and then restart correctly. (8) Load GICB register 07 {HEX} with field TRS = 2 i.e. 80 00 00 00 00 00 00 {HEX} and refresh this data every 1 second and verify that the TRS field (bits 1 and 2 of MB) has value 2. Verify that the surface squitter rate is now low. (9) Test RCS high rate one shot of 60 sec: Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=1 and SAS=0. Verify that the extended squitter emission (DF=17) reports the surface type message for 60 seconds at the high rate and then reverts to the low rate. (10) Test RCS high rate one shot plus restart after 30 seconds: Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=1 and SAS=0. After 30 seconds send the same RCS command again. Verify that the DF17 extended squitter emission reports the surface type message for 90 seconds at the high rate and then reverts to the low rate. (11) Test RCS 120 sec. suppression command: Using the transponder test set. Send a UF 4, 5, 20 or 21 interrogation to the transponder, with DI=2, TCS = 0, RCS=4 and SAS=0. Verify that all extended squitter emission (DF=17) surface type messages are suppressed for 120 seconds and then restart correctly.