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Review of differences between ED73 and do181 noted during February 2007 SC209/WG-49

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SUMMARY

During common meeting held in February 2007 between SC209 and WG49 differences between DO181 and ED73 were reviewed.
A number of these differences were not explained or resolved during the meeting. This WP present the result of further investigation performed on these differences.

General comments

#	Do-181	ED-73	Comment 140	Proposal
G-1				Adopt a consistent and uniform identification of the optional requirements and associated tests.
G-2				After page 273 the page restarts at 259. Use continuous page numbering
G-3			Reply rate in SSR 1200/s?	Xpdr manufacturers agreed to test their transponders – Need to update ED , DO, ICAO annex 10?
G-4			Hijack mode to be removed from ED?	
G-5			Data-flash also in DO?	RTCA agreed to copy data-flash in DO Check that data-flash is in line with ICAO annex10
G-6			ELS/EHS testing: ♦ Review specification and check with RTCA proposal ♦ Incorporate it in ED73? o 3.20 Level 1 o 3.21. Level 2 o 3.22. Level 3 o 3.23. Level 4 o 3.24. Level 5 o 3.25. Transponder supporting ACAS o 3.26 ES o 3.27 ELS o 3.28 EHS ♦ In fact ELS is required for international traffic ♦ Review generic procedure be sure of correct testing of reg 10 bit 25, 33, … MSSNV ♦ Insert detailed RTCA procedure as an example ♦ Check BDS 40 ♦ Comm B broadcast ♦ Interleaving space in AC bits in Reg 40 ♦ Mode b	
G-7			Invalid address at Start-up	Honeywell problem on some transponder which continue to reply in Mode S
G-8			Check Environmental test (vibration,…)	AH action
G-9			ICAO CW interference to be added to ED + DO	

Comment [rhs1]: All vendors completed tests and assured that transponders can meet the 1200/second rate. However, this is with limiting removed which requires special software load. As such, production units are limited. Therefore, units in the field will not pass the test due to the limiting being applied.

Specific comments

On the ground status and FS and VS fields

<table>
<tr><th>#</th><th>Do-181</th><th>ED-73</th><th>Comment</th><th>Proposal</th></tr>
<tr><td>S-1</td><td>2.2.13.1.2 p 39 (Data handling and interface requirements)
Variable Direct Data
…
c. "On-the-Ground" Condition
The transponder shall report the automatically determined on-the-ground state as determined by the aircraft in the Flight Status (FS), Vertical Status (VS), and Capability (CA) fields (see §2.2.14.4.14, §2.2.14.4.42, and §2.2.14.4.6), except when reporting airborne status when on-the-ground is reported to the transponder under the conditions specified in §2.2.18.2.7.
Note: The on-the-ground state determined by the aircraft does not include the effect of any TCS commands (see §2.2.23.1.7).</td><td>3.17.1 p 43/44 (Data handling and interface requirements)
Direct Data
…
(3) "On the Ground" Condition
The transponder shall report the automatically determined on-the-ground state as determined by the aircraft in the Flight Status (FS), Vertical Status (VS), and Capability (CA) fields except when reporting airborne status when on-the-ground is reported to the transponder under the conditions specified in subparagraph 3.20.2.7. (Ed note: Check sub para No)

NOTE : The on-the-ground state determined by the aircraft does not include the effect of any TCS commands.</td><td>Identical §.</td><td>Corresponding sub-para of ED is 3.20.2.7.</td></tr>
<tr><td>S-2</td><td>2.2.14.4.14 p 52 (Mode S requirements)
FS Flight Status
This 3-bit (6-8) downlink field reports the flight status of the aircraft and is used in formats DF=4, 5, 20 and 21. Aircraft without the means of automatically determining the on-the-ground condition shall always report airborne state. The codes are:
<table>
<tr><th>CODE</th><th>Alert</th><th>SPI</th><th>Airborne</th><th>On the Ground</th></tr>
<tr><td>0</td><td>no</td><td>no</td><td>yes</td><td>no</td></tr>
<tr><td>1</td><td>no</td><td>no</td><td>no</td><td>yes</td></tr>
<tr><td>2</td><td>yes</td><td>no</td><td>yes</td><td>no</td></tr>
<tr><td>3</td><td>yes</td><td>no</td><td>no</td><td>yes</td></tr>
<tr><td>4</td><td>yes</td><td>yes</td><td colspan="2">Either</td></tr>
<tr><td>5</td><td>no</td><td>yes</td><td colspan="2">Either</td></tr>
<tr><td colspan="5">6 is reserved and 7 is not assigned</td></tr>
</table></td><td>3.18.4.12 p 51 (Mode S requirements)
Flight Status FS
This 3-bit (6-8) downlink field reports the flight status of the aircraft and is used in formats DF=4, 5, 20 and 21. The codes are:
<table>
<tr><th>CODE</th><th>Alert</th><th>SPI</th><th>Airborne</th><th>On the Ground</th></tr>
<tr><td>0</td><td>no</td><td>no</td><td>yes</td><td>no</td></tr>
<tr><td>1</td><td>no</td><td>no</td><td>no</td><td>yes</td></tr>
<tr><td>2</td><td>yes</td><td>no</td><td>yes</td><td>no</td></tr>
<tr><td>3</td><td>yes</td><td>no</td><td>no</td><td>yes</td></tr>
<tr><td>4</td><td>yes</td><td>yes</td><td colspan="2">Either</td></tr>
<tr><td>5</td><td>no</td><td>yes</td><td colspan="2">Either</td></tr>
<tr><td colspan="5">6 and 7 are not assigned</td></tr>
</table></td><td>Additional requirement in DO-181 and code 6 reserved instead of not assigned</td><td>Align ED-73</td></tr>
<tr><td>S-3</td><td>2.2.14.4.42 p 59
VS Vertical Status
This 1-bit (6) downlink field in DF=0, 16 indicates, when ZERO, that the aircraft is airborne and, when ONE, that the aircraft is on the ground. Aircraft without the means of automatically determining the on-the-ground condition shall always report airborne state.</td><td>3.18.4.38 p 56
Vertical Status VS
This 1-bit (6) downlink field in DF=0, 16 indicates, when ZERO, that the aircraft is airborne and, when ONE, that the aircraft is on the ground.</td><td>Additional requirement in DO-181</td><td>Align ED-73</td></tr>
</table>

<table>
<tr><th>#</th><th>Do-181</th><th>ED-73</th><th>Comment</th><th>Proposal</th></tr>
<tr><td>S-4</td>
<td>2.2.18.2.7 p 71/72 (Level 1 requirements)
Flight Status and Vertical Status Protocols (Figure 2-13)
…
c. Validation of declared on-the-ground status
Note 2: For aircraft with an automatic means of determining vertical status, the CA field reports whether the aircraft is airborne or on the ground. ACAS II acquires aircraft using the short or Extended Squitter, both of which contain the CA field. If an aircraft reports on-the-ground status, that aircraft will not be interrogated by ACAS II in order to reduce unnecessary interrogation activity. If the aircraft is equipped to report Extended Squitter messages, the function that formats these messages may have information available to validate that an aircraft reporting “on-the-ground” is actually airborne.
Aircraft with an automatic means for determining the on-the-ground condition that are equipped to format Extended Squitter messages shall perform the following validation check:
If the automatically-determined air/ground status is not available or is “airborne”, no validation shall be performed. If the automatically-determined air/ground status is available and “on-the-ground” condition is being reported, the air/ground status shall be overridden and changed to “airborne” if the conditions given for the vehicle category in the following table are satisfied.
<table>
<tr><th colspan="6">Determination of airborne status</th></tr>
<tr><th>A/V category</th><th>Ground Speed (knots)</th><th></th><th>Airspeed (knots)</th><th></th><th>Radio Altitude (feet)</th></tr>
<tr><td>No information</td><td colspan="5">No change to on-the-ground status</td></tr>
<tr><td>Weight < 15,500 lbs (7,031 kg)</td><td colspan="5">No change to on-the-ground status</td></tr>
<tr><td>Weight 15,500 lbs (7,031 kg)</td><td>>100</td><td>or</td><td>>100</td><td>or</td><td>>50</td></tr>
<tr><td>High performance (>5 g acceleration and >400 knots)</td><td>>100</td><td>or</td><td>>100</td><td>or</td><td>>50</td></tr>
<tr><td>Rotorcraft</td><td colspan="5">No change to on-the-ground status</td></tr>
</table>
Note 3: While this test is only required for aircraft that are equipped to format Extended Squitter messages, this feature is desirable for all aircraft.</td>
<td>3.20.2.7 p 61 (level 1 requirements)
Flight Status and Vertical Status Protocols (Figure 3-12)
Mode S-equipped aircraft shall report details of their flight status. The source of and the rules for such reports are as follows:
a. Alert - The transponder shall transmit the 4096 identification code in Mode A replies and in the ID field of downlink format DF=5. This code can be changed by the pilot, and when a change is made an alert condition shall be established. If the identification code is changed to 7500, 7600 or 7700, the alert condition shall be permanent. If the identification code is changed to any other value, the alert condition shall be temporary and self-cancelling after 18 ±1.0 seconds (Tc timer). The alert condition shall be reported in the FS field. The permanent alert condition shall be terminated and replaced by a temporary alert condition when the identification code is set to a value other than 7500, 7600 or 7700.
b. On-the-Ground Report – The on-the-ground status of the aircraft shall be reported in the FS field and the VS field and the CA field. If a means for automatically indicating the on-the-ground condition (e.g., a weight on wheels or strut switch) is available at the transponder data interface, it shall be used as the basis for the reporting of status (FS, VS, for CA codes 4 or 5 for airborne or on-the ground). If a means for automatically indicating the on-the-ground condition is not available at the transponder data interface, the FS and VS codes shall indicate that the aircraft is airborne and the CA field shall indicate that the aircraft is either airborne or on the ground (CA=6).
c. Special Position Identification - When manually selected, the transponder shall transmit the equivalent of the SPI in the FS field of surveillance replies DF=4,5. This code shall be transmitted for 18 ±1.0 seconds (TI timer) after initiation and can be reinitiated at any time.</td>
<td>Requirements related to the validation of the on-the-ground status are missing in ED.</td>
<td>WG49 will insert this paragraph in level 2 section.
RTCA SC209 to consider to move this requirement in level 2 section</td></tr>
</table>

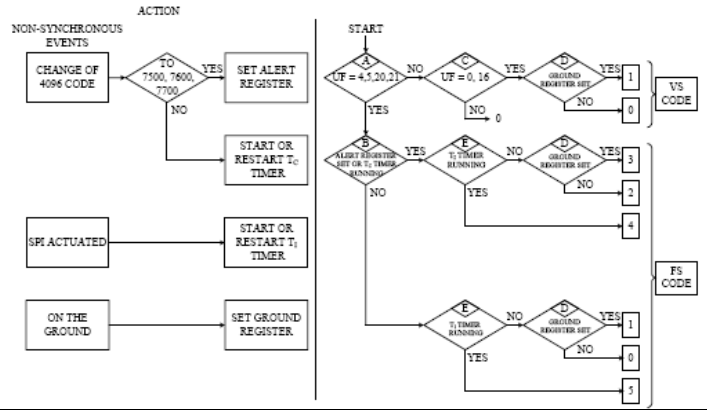
Comment [rhs2]: No issue with moving the requirement to level 2 section as long as test procedures are also aligned properly.

#	Do-181	ED-73	Comment	Proposal
S-5	2.2.23.3.7 p 132 (ES level requirements) Airborne/Surface State Determination Aircraft with an automatic means of determining on-the-ground condition shall use this input to select whether to report the airborne or surface message types. Aircraft without such means shall report the airborne type messages.	3.21.2.6.5 p 86/87 (ES level requirements *Airborne/Surface State Determination* Aircraft with an automatic means of determining on-the-ground condition shall use this input to select whether to report the airborne or surface message types. Aircraft without such means shall report the airborne type messages. Aircraft with or without such automatic on-the-ground determination shall use position message types as commanded by control codes in the TCS subfield (Paragraph 3.21.2.6.7). After timeout of the TCS commands, control of airborne/surface determination shall revert to the means described above. *NOTE: Extended squitter ground stations determine aircraft airborne or surface status by monitoring aircraft position, altitude and ground speed. Aircraft determined to be on the ground that are not reporting the surface position message type will be commanded to report the surface format via the TCS subfield. The normal return to the airborne position message type is via a ground command to report the airborne message type. To guard against loss of communications after takeoff, commands to report the surface position message type automatically timeout.*		The on the ground validation is already covered in level 2 transponder in both documents . SC209 to consider to add the highlighted paragraph
S-6	2.4.2.12.2 p 176 (test procedure) Variable Direct Data (§2.2.13.1.2) Step 5 Flight Status and Vertical Status (§2.2.13.1.2.c) 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. Interrogate with formats UF=4, 5, 20, 21 and verify that the transponder follows the protocol of §2.2.14.4.14, and Figure 2-13.	5.4.12.2 p 186 (test procedure) Variable Direct Data (§2.2.13.1.2) 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 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).		Wg-49 to add text highlighted in blue. SC209 to check reference to figure 2-13. SC209 to consider to add text highlighted in yellow to cover CA field.

Comment [rhs3]: The highlighted information shown at left is already provided in DO-181D Section 2.2.23.1.5.2, "Ground Controlled Format Selection".

Comment [rhs4]: Figure 2-13 is the correct figure for FS and VS Protocol and is located on page 80 associated with section 2.2.19.1.6. One should note that the Figures in DO-181D are not presently numbered in sequence. If this changes, then all of the references will need to be changed and reviewed at a later date.

Comment [rhs5]: No issue with adding the test for CA code.

#	Do-181	ED-73	Comment	Proposal
S-7	2.5.4.7 p 203 Procedure #7 FS and VS Protocol/Code Tests Required Code Verification Test Observe that the FS code follows the transponder states as specified in §2.2.14.4.14 and verify that VS=1, if and only if the "on-the-ground" input is active. *Note: The Alert Register is set when the manual or interface input to the ID function is 7500, 7600, 7700.* *The TC timer is started when the input to the ID function is changed.* *The TI timer is started when manual or interface input exists for SPI momentarily.* *The Ground Register is set when input to the "on-the-ground" interface indicates that condition.*  	5.5.8.7 p 207 PROCEDURE #7 FS and VS Protocol/Code Tests … 5.5.8.7.2 Required Code Verification Test Observe that the FS code follows the transponder states as specified in paragraph 3.18.4.12 and verify that VS=1, if and only if the "on-the-ground" input is active. In particular, the following shall be verified : a. when the input of the ID function is changed to 7500, 7600, 7700 verify that: (1) the alert register is permanently set, (2) the FS field value is 2, 3, or 4, (3) TC is not started (4) verify that the FS field value changes to a value not equal to 2, 3, or 4 only when a new input of the ID function other than 7500, 7600, 7700 is made. b. when the input of the ID function is changed to other values than 7500, 7600, 7700 verify that: (1) the alert register is set, (2) the FS field value is 2, 3, or 4, (3) TC is started, (3) following TC expiry, verify that the FS field value is not 2, 3, nor 4. c. when manual or interface input exists for SPI, verify that : (1) TI timer is started, (2) the FS field value is 4 or 5, (3) following TI expiry, verify that the FS field value is neither 4 nor 5.		Replace (3) by (4) in ED. NO difference between DO181 and ED73

#	Do-181	ED-73	Comment	Proposal
S-8	2.5.4.7 p 204 Procedure #7 FS and VS Protocol/Code Tests On-the-Ground Validation Test For transponders that support automatic on-the-ground condition input and either implement Extended Squitter formatting or support the on-the-ground validation requirements of §2.2.18.2.7.c, the following test shall be performed. The on-the-ground input is used in determining the codes for FS, VS and CA fields. The requirements of Section §2.2.18.2.7.c utilize radio altitude, ground speed and airspeed inputs to validate the on-the-ground status when indicated by the input to the transponder. If the conditions for overriding the on-the-ground status indicated by the input to the transponder, the airborne status shall be utilized to select FS, VS and CA field coding. Also, for extender squitter format selection, airborne formats shall be transmitted unless overridden by ground station interrogation commands. CA field validation for Acquisition squitters and Extended Squitters is verified as part of Procedure #6 in §2.5.4.6, so the following test can be incorporated as part of that testing. Setup the transponder to indicate on-the-ground status by input to the transponder. With no input of radio altitude, airspeed and ground speed to the transponder, verify that the FS codes are determined by the transponder states above with the Ground Register set to on-the-ground and VS is set to 1. Input radio altitude, airspeed and ground speed to the transponder. Since not all aircraft installations may have access to all three inputs, testing is required for all combinations of inputs being provided to the transponder so that each input is tested individually and collectively. This is to insure that any one input reporting a value that sets airborne status as specified in §2.2.18.2.7.c, properly outputs FS values according to Figure 2-13 with the Ground Register reset to NOT indicate on-the-ground condition and VS is ZERO. If all inputs are supported by the transponder, a total of 27 combinations are required. This represents 9 cases with radio altitude not input, 9 cases with a value above 50 feet and 9 cases with a value below or equal to 50 feet. The same variation for airspeed and ground speed is required except the values selected would be above 100 knots to satisfy the requirement to reset the Ground Register to NOT indicate on-the-ground condition and a value at 100 knots or below to not modify the on-the ground status.	5.5.8.7 p 205/206 PROCEDURE #7 FS and VS Protocol/Code Tests …		Test procedure step for On-the-ground validation is not present in ED. Text in line with DO181 text to be added. SC209 to consider revision of DO181 text in particular the second paragraph starting by if conditions…
S-9	It is proposed to include a a further step in test procedure #4 in ED and DO to address the replying of the transponder to All-Call interrogations depending on the same conditions as the On-the ground status. Set the Air-Ground discrete input to no input (as when there is no automatic detection on board the aircraft), interrogate the transponder with Mode S All-Call and verify it is not replying. Set the Air-Ground discrete input to Ground, interrogate the transponder with Mode S All-Call and verify it is not replying. Set the Air-Ground discrete input to Airborne, interrogate the transponder with Mode S All-Call and verify it is replying. Set the Air-Ground discrete input to Ground/No input, simulate the 27 conditions as described above and check that when the on-the-ground status is not overridden the transponder does not reply to All-Call interrogations and that it does reply when the on-the-ground status is overridden as airborne. A similar test procedure step shall be defined in test procedure #6 in ED and DO to check that ES capable transponder transmit airborne or surface message type according to the overridden or not on the ground status.			EP to prepare the test procedures

Comment [rhs6]: The procedure provided in DO-181D seems overly burdensome. It should be kept simple. The On-Ground state is set if indicated by the Air/Ground discrete input and the airspeed, ground speed, or radar altimeter limits have not been met so as to force the state to the Airborne state. Otherwise, the state is Airborne.

Comment [rhs7]: The Air/Ground discretes are defined as being Active Low for being on the ground. As such, you can not force the no input state as the open-circuit state represents airborne. So, the test step needs to be re-worded to indicate "if possible" to do so condition.

<table>
<tr><th>#</th><th>Do-181</th><th>ED-73</th><th>Comment</th><th>Proposal</th></tr>
<tr><td>S-10</td><td>3.3.14 p 256 (Installation tests)
On-the-Ground Condition
Verify that the equipment correctly reports the “on-the-ground” condition. If it is feasible to simulate the airborne condition, verify that the equipment correctly reports an “airborne” condition.
Also verify that when the unit is in the “inhibit replies” condition (see §2.1.7.b), the transponder continues to generated Mode S squitters and replies to discretely-addressed Mode S interrogations (UF=0, 4, 5, 16, 20, 21, 24), but does not reply to ATCRBS, ATCRBS/Mode S All-Call or Mode S-Only All-Call interrogations. If the unit is not in the “inhibit replies” condition verify that the transponder continues to generate Mode S squitters and to reply to ATCRBS, ATCRBS/Mode S All-C all or Mode S-Only All-Call and discretely-addressed Mode S interrogations (UF=0, 4, 5, 16, 20, 21, 24).</td><td>6.2.13 p 276 (Installation tests)
Validation of declared on-the-ground status
Note.- While this is only a requirement for aircraft that are equipped with extended squitter functionality, this feature is desirable for all aircraft.
Aircraft with an automatic means for determining the on-the-ground condition that are equipped to format extended squitter messages shall perform the following validation check:
If the automatically determined air/ground status is not available or is “airborne”, no validation shall be performed. If the automatically determined air/ground status is available and “on-the-ground” condition is being reported, the air/ground status shall be overridden and changed to “airborne” if the conditions given for the vehicle category in the table below are satisfied,

<table>
<tr><td colspan="7">Determination of airborne status</td></tr>
<tr><td>A/V category</td><td>Ground Speed</td><td></td><td>Airspeed</td><td></td><td>Radio Altitude</td></tr>
<tr><td>No information</td><td colspan="5">No change to on-the-ground status</td></tr>
<tr><td>Weight < 15 500 lbs (7 031 kg)</td><td colspan="5">No change to on-the-ground status</td></tr>
<tr><td>Weight > or = 15 500 lbs (7 031 kg)</td><td>>100 knots</td><td>or</td><td>>100 knots</td><td>or</td><td>>50 feet</td></tr>
<tr><td>High Performance (>5g acceleration and 400 knots)</td><td>>100 knots</td><td>or</td><td>>100 knots</td><td>or</td><td>>50 feet</td></tr>
<tr><td>Rotorcraft</td><td colspan="5">No change to on-the-ground status</td></tr>
</table></td><td></td><td>Blue paragraph to be modified to be consistent with requirement on all level2 transponder.

EP to combine text from DO181 with text from ED73. table in 2.2.18.2.7</td></tr>
</table>

CA field

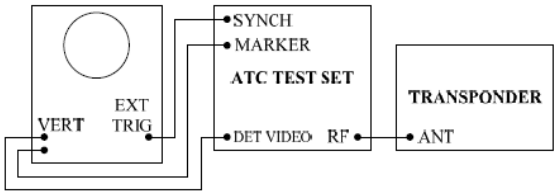
<table>
<tr><th>#</th><th>Do-181</th><th>ED-73</th><th>Comment</th><th>Proposal</th></tr>
<tr><td>S-11</td><td>2.2.14.4.6 note p 49/50
CA Transponder Capability
This 3-bit (6-8) downlink field is used in DF=11, the All-Call reply and acquisition squitter, and in DF=17, the Extended Squitter. The codes are:
<table><tr><td>0</td><td>=</td><td>signifies no communications capability (surveillance only), no ability to set CA code 7, either on the ground or airborne</td></tr><tr><td>1</td><td>=</td><td>Reserved</td></tr><tr><td>2</td><td>=</td><td>Reserved</td></tr><tr><td>3</td><td>=</td><td>Reserved</td></tr><tr><td>4</td><td>=</td><td>signifies at least Comm-A and Comm-B capability, ability to set CA code 7, on the ground</td></tr><tr><td>5</td><td>=</td><td>signifies at least Comm-A and Comm-B capability, ability to set CA code 7, airborne</td></tr><tr><td>6</td><td>=</td><td>signifies at least Comm-A and Comm-B capability, ability to set CA code 7, either on the ground or airborne</td></tr><tr><td>7</td><td>=</td><td>signifies DR is ≠ to zero, or FS equals 2,3,4,5, either on the ground or airborne (see § 2.2.14.4.8 & 2.2.14.4.9).</td></tr></table>When the conditions for CA code 7 are not satisfied, installations that have communications capability but do not have automatic means to set on-the-ground conditions shall use CA code 6. Aircraft with automatic on-the-ground determination shall use CA codes 4 and 5. Data link capability reports (see §2.2.19.1.12.5) shall be available for CA codes 4, 5, 6 and 7.
Note: CA codes 1 to 3 were used by earlier Mode S transponders that did not use CA code 7. Transponders with these codes provide a data link capability report (see §2.2.19.1.12.5). No data link transactions other than GICB extraction including aircraft identity, TCAS RA extraction, and downlink broadcast extraction, should be attempted with these transponders.</td><td>3.18.4.5 Note p 49/50
Transponder Capability CA
This 3-bit (6-8) downlink field reports transponder capability and is used in DF=11, the All-Call reply. The codes are:
<table><tr><td>0</td><td>=</td><td>signifies no communications capability (surveillance only), no ability to set CA code 7, either on the ground or airborne</td></tr><tr><td>1</td><td>=</td><td>Reserved</td></tr><tr><td>2</td><td>=</td><td>Reserved</td></tr><tr><td>3</td><td>=</td><td>Reserved</td></tr><tr><td>4</td><td>=</td><td>signifies at least Comm-A and Comm-B capability, ability to set CA code 7, on the ground</td></tr><tr><td>5</td><td>=</td><td>signifies at least Comm-A and Comm-B capability, ability to set CA code 7, airborne</td></tr><tr><td>6</td><td>=</td><td>signifies at least Comm-A and Comm-B capability, ability to set CA code 7, either on the ground or airborne</td></tr><tr><td>7</td><td>=</td><td>signifies DR is ≠ to zero, or FS equals 2,3,4,5, either on the ground or airborne (see paragraphs 3.18.4.10, 3.18.4.12 and3.18.4.37).</td></tr></table>When the conditions for CA code 7 are not satisfied, installations that have communications capability but do not have automatic means to set on-the-ground conditions shall use CA code 6. Aircraft with automatic on-the-ground determination shall use CA codes 4 and 5. Data link capability reports (paragraph 3.21.1.12 d) shall be available for CA codes 4, 5, 6 and 7.
NOTE: CA codes 1 to 3 were used by earlier Mode S transponders that did not use CA code 7.</td><td></td><td>Text in yellow in DO shall be added to ED.</td></tr>
<tr><td>S-12</td><td>2.2.19.1.7 p 80
Capability Report
The transponder shall reply with a non-zero value of CA (see §2.2.14.4.6) in the capability field of DF=11 and DF=17, indicating that further data link information is available in a data link capability report (§2.2.19.1.12.5</td><td>3.21.1.7 p 66
Capability Report
The transponder shall reply with a non-zero value of CA (paragraph 3.18.4.5) in the capability field of DF=11, indicating that further data link information is available in a data link capability report (paragraph 3.21.1.12 d).</td><td></td><td>In ED the reference shall be to item e instead of d.</td></tr>
</table>

Mode S Reply rate capability

#	Do-181	ED-73	Comment	Proposal
S-13	2.2.3.4.2 p 21 Mode S Reply Rate Capability a. A transponder equipped for only short Mode S downlink formats (DF), shall have the following minimum reply rate capabilities: 50 Mode S replies in any 1-second interval. 18 Mode S replies in a 100-millisecond interval. 8 Mode S replies in a 25-millisecond interval. 4 Mode S replies in a l.6-millisecond interval. b. A transponder equipped for long Mode S reply formats shall be able to transmit as long replies: At least 16 of the 50 Mode S replies in any 1-second interval. At least 6 of the 18 Mode S replies in a 100-millisecond interval. At least 4 of the 8 Mode S replies in a 25-millisecond interval. At least 2 of the 4 Mode S replies in a l.6-millisecond interval. c. A transponder equipped with the enhanced data link protocols (see §2.2.21) shall be able to transmit as long replies: At least 24 of the 50 Mode S replies in any 1-second interval. At least 9 of 18 Mode S replies in a 100-millisecond interval. At least 6 of 8 Mode S replies in a 25 millisecond interval. At least 2 of 4 Mode S replies in a 1.6 millisecond interval. All of the above reply rates shall be in addition to any squitter transmissions that the transponder is required to make. *Note: Higher reply rates are required by a TCAS-compatible transponder (see §2.2.22.b.).*	3.4.2 p 29 Reply Rate Capability - Mode S The total reply rate over each time interval specified below, shall be the sum of the individual Mode A/C replies at an average rate of 500 per second and the Mode S reply rate over that interval. a. Short DF Reply Rates A transponder equipped for only short Mode S Downlink Formats (DF), shall have the following minimum reply rate capabilities. (1) 50 Mode S replies in any one-second interval; (2) 18 Mode S replies in a 100-millisecond interval; (3) 8 Mode S replies in a 25-millisecond interval; (4) 4 Mode S replies in a 1.6-millisecond interval. b. Long DF Reply Rates A transponder equipped for long Mode S reply formats shall be able to transmit as long replies, (1) at least 16 of the 50 Mode S replies in any one-second interval; (2) at least 6 of the 18 Mode S replies in a 100-millisecond interval; (3) at least 4 of the 8 Mode S replies in a 25-millisecond interval; (4) at least 2 of the 4 Mode S replies in a 1.6-millisecond interval.		SC209 to consider DO shall specify that the Mode S reply rate shall be in addition to the ATCRBS reply rate of 500 replies per second. ED shall specify that the Mode S reply rate shall be in addition to any squitter transmissions that the transponder is required to make. ED shall include a similar note as DO making reference to § 3.23.b. ED to be modified with the yellow text.

Comment [rhs8]: The green insert for ED above is confusing in that it infers that the total reply rate of 500 per second is inclusive of both ATCRBS and Mode-S. This is not the case as Mode-S reply rates are tested in section 2.4 with the standard ATCRBS interrogation rate of 450 +/- 50 being in effect. Worse case testing should be done with 500 ATCRBS and 60 longs for TCAS UF=16.

RF peak power

#	Do-181	ED-73	Comment	Proposal
S-14	2.3.2.2.2 p 139 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.  Figure 2-26: Step 2 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.		ED does not describe specific procedures for environmental testing and only makes reference to the standard procedure and describes the range of environmental conditions to be tested.	It is proposed to remove the assumed duplicated procedure and to make reference in the DO document to the procedure described in § 2.4.2.2.2 and move figure 2-26 in this section. To be discussed under general discussion on environmental test procedure

#	Do-181	ED-73	Comment	Proposal
S-15	2.4.2.2.2 p 156/157 RF Peak Power Output (§2.2.3.2) Equipment Required: ATC Test Set with P4 capability (TIC T-50-3A/4B, or equivalent). Wide Band Dual Channel Oscilloscope (HP 1710B, or equivalent). Measurement Procedure: Step I ATCRBS Power Output (§2.2.3.2) Connect the equipment as shown in Figure 2-26. Set the transponder for a 14 (7777) pulse reply. Interrogate the transponder with a standard Mode A interrogation and measure the single pulse having the least RF power output. While varying the interrogation rate from 100 interrogations per second to the maximum interrogation rate specified for the transponder, determine that the power output meets the requirements of §2.2.3.2. Repeat the procedure measuring the single pulse having the most RF power output. Step 2 Mode S Power Output (§2.2.3.2) Repeat Step I with a standard Mode A ATCRBS/Mode S All-Call interrogation at standard rate only. -	5.4.2.2.2 p 147 *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. b. STEP 2 - Mode S Power Output (Paragraph 3.3.3) Repeat STEP 1 with a Mode A/Mode S All-Call interrogation at standard rate only. For transponders with long reply capability, repeat STEP 1 with a Mode S interrogation, using any format and coding for which a long reply is required.		1st item do nothing, record means record and check against requirement 2nd item WG49 to rewrite text for long Mode S reply and specify long Mode S interrogation rate in both ED and DO to be 16 per second for level2 transponder and adding the transmission of 6 extended squitter for the transponder that are ES capable + TCAS Refer WG49N11-05 RF Peak Power Output 5.4.2.2.2 SC209 to consider inclusion of ED text in DO in the 2.4 chapter and 2.3.2.2.2 chapter

Comment [rhs10]: I don't see what changes need to be made to DO-181D. I suspect that the desire is to add power variation testing as shown in the ED document. However, DO-181D provides detailed testing of the pulse shape and power in section 2.4.2.3.

Comment [rhs9]: Probably want to use UF=5 or 21 to get a DF=21 for Identity Surveillance.

RR field

<table>
<tr><th>#</th><th>Do-181</th><th>ED-73</th><th>Comment</th><th>Proposal</th></tr>
<tr><td>S-16</td>
<td>2.2.14.4.35 p 58
RR Reply Request
This 5-bit (9-13) uplink field contains length and content of the reply requested by the interrogators. RR is part of the surveillance and Comm-A interrogations UF=4, 5, 20, 21.
The codes are outlined below:
<table>
<tr><th>RR Code</th><th>Reply Length</th><th>MB Content</th></tr>
<tr><td>0-15</td><td>Short</td><td>-------</td></tr>
<tr><td>16</td><td>Long</td><td>Air-Initiated Comm B (§2.2.19.1.12.4)</td></tr>
<tr><td>17</td><td>Long</td><td>Data Link Capability Report (§2.2.19.1.12.5)</td></tr>
<tr><td>18</td><td>Long</td><td>Flight ID (§2.2.19.1.13)</td></tr>
<tr><td>19</td><td>Long</td><td>TCAS Resolution Advisory Report (§2.2.22.3.4)</td></tr>
<tr><td>20-31</td><td>Long</td><td>Not Assigned</td></tr>
</table>
Note: If the first bit of the RR code is ONE, the last four bits of the 5-bit RR code, if transformed into their decimal equivalent, designate the number (BDS1) of the requested source. BDS2 is assumed to be ZERO if not specified by DI=3 or 7 and RRS.</td>
<td>3.18.4.32 p 55
Reply Request RR
This 5-bit (9-13) uplink field contains length and content of the reply requested by the interrogators. RR is part of the surveillance and Comm-A interrogations UF=4, 5, 20, 21. The codes are outlined below:
<table>
<tr><td>RR Code</td><td>Reply Length</td><td>MB Content</td></tr>
<tr><td>0-15</td><td>Short</td><td>Not applicable</td></tr>
<tr><td>16</td><td>Long</td><td>Air-Initiated Comm-B (3.21.1.12 b)</td></tr>
<tr><td>17</td><td>Long</td><td>"Data Link Capability Report" (3.21.1.12 e)</td></tr>
<tr><td>18</td><td>Long</td><td>Flight ID (3.21.1.13)</td></tr>
<tr><td>19</td><td>Long</td><td>ACAS Resolution Advisory Report (3.23.3.4)</td></tr>
<tr><td>20-31</td><td>Long</td><td>Not assigned</td></tr>
</table>
NOTE 1: If the first bit of the RR code is ONE, the last four bits of the 5-bit RR code, if transformed into their decimal equivalent, designate the number (BDS1) of the requested source. BDS2 is assumed to be ZERO if not specified by DI=7 and RRS. See paragraph 3.21.2.1 a(4).
NOTE 2: Codes 20-31 are reserved for applications such as data link communications, ACAS, etc.</td>
<td>RR 20-31 to clarify (20-40)
In Note 1 of ED DI = 3 has been forgotten whereas § 3.21.2.1.(6) makes reference to § 3.18.4.32</td>
<td>Extend the table as follows in both DO and ED to take into account BDS 40, 50 and 60 for ELS.
<table>
<tr><td>RR Code</td><td>Reply Length</td><td>MB Content</td></tr>
<tr><td>0-15</td><td>Short</td><td>Not applicable</td></tr>
<tr><td>16</td><td>Long</td><td>Air-Initiated Comm-B (3.21.1.12 b)</td></tr>
<tr><td>17</td><td>Long</td><td>"Data Link Capability Report" (3.21.1.12 e)</td></tr>
<tr><td>18</td><td>Long</td><td>Flight ID (3.21.1.13)</td></tr>
<tr><td>19</td><td>Long</td><td>ACAS Resolution Advisory Report (3.23.3.4)</td></tr>
<tr><td>20</td><td>Long</td><td>Selected vertical intention</td></tr>
<tr><td>21</td><td>Long</td><td>Track and turn report</td></tr>
<tr><td>22</td><td>Long</td><td>Heading and speed report</td></tr>
<tr><td>23</td><td>Long</td><td>Reserved</td></tr>
<tr><td>24-31</td><td>Long</td><td>Not assigned</td></tr>
</table>
Sc209 to considerate it together with SC209 WP01-08R1

Add reference to the sections describing registers 40 50 60
Remove Note 2 subsequently
In ED include DI = 3 in Note 1.</td></tr>
</table>

Comment [rhs11]: I am not sure that you really want to add BDS 4,0 / 5,0 / and 6,0 to this extraction format. Originally, there were only two BDS registers established to be pulled by this method known as the Data Source Designators defined in DO-181C section 2.2.17.1.12.1 or DO-181D section 2.2.19.1.12.1. These two original registers were BDS 1,0 Data Link Capability and BDS 2,0 Flight Identification. Then when TCAS came along, BDS 3,0 Resolution Advisory was added. Agreed that BDS 4,0 / 5,0 / and 6,0 or X,0 can be accessed using Data Source Designators; however, all of these registers can be extracted using the Ground-Initiated Comm-B protocol defined in DO-181C Section 2.2.17.1.12.1 or DO-181D section 2.2.19.1.12.2. Question is, do you want to be testing it both ways and for what purpose?????

Interrogation standard repetition rate

#	Do-181	ED-73	Comment	Proposal
S-17	2.4.1.h.1 p 152 (f) Interrogation Repetition Standard Rate: Unless otherwise noted in the measurement procedure, interrogation rates shall be 450 ±25 Hz for ATCRBS interrogations and 45 ±5 Hz for All-Call and Mode S interrogation.	5.2.1 p 142 f. Interrogation Repetition 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.	Different wordings.	Align ED on DO and include standard

Comment [rhs12]: It should be considered to increase the Mode-S interrogation rate up to 60 long (UF=16) due to the TCAS requirement. Otherwise, align as stated.

Mode S replies: Pulse shape and spectrum

<table>
<tr><th>#</th><th>Do-181</th><th>ED-73</th><th>Comment</th><th>Proposal</th></tr>
<tr><td>S-18</td><td>2.2.4.2.3 p 24
Mode S Reply Pulse Shape
a. The pulse amplitude variation between one pulse and any other pulse in a reply shall not exceed 2 dB.
b. The pulse rise time shall not exceed 0.1 microsecond.
c. The pulse decay time shall not exceed 0.2 microsecond.
d. The spectrum of a reply shall not exceed the following bounds:
<table><tr><th>Frequency Difference (MHz From Carrier)</th><th>Maximum Relative Response (dB Down From Peak)</th></tr><tr><td>> 1.3 and < 7</td><td>3</td></tr><tr><td>> 7 and < 23</td><td>20</td></tr><tr><td>> 23 and < 78</td><td>40</td></tr><tr><td>> 78</td><td>60</td></tr></table></td><td>3.3.2 p 25

Transmitter Reply Spectrum
The spectrum of the transponder transmitter output shall not exceed the limits shown in Table 3.1 and Figure 3.1.
<table><tr><th>Frequency Difference from Carrier (MHz)</th><th>Maximum Relative Response from Peak</th></tr><tr><td>≥ 1.3 and < 7</td><td>-3 dB</td></tr><tr><td>≥ 7 and < 23</td><td>-20 dB</td></tr><tr><td>≥ 23 and < 78</td><td>-40 dB</td></tr><tr><td>> 78</td><td>-60 dB</td></tr></table></td><td></td><td>Add = sign for all low limits in both ED (78MHz) and DO

SC209 to consider this addition</td></tr>
<tr><td>S-19</td><td>2.2.4.23 p 24
Mode S Reply Pulse Shape
a. The pulse amplitude variation between one pulse and any other pulse in a reply shall not exceed 2 dB.
b. The pulse rise time shall not exceed 0.1 microsecond.
c. The pulse decay time shall not exceed 0.2 microsecond.</td><td>3.6.4 p 29
Mode S Reply Pulse Shape
a. All Mode S reply pulses shall have the following characteristics.
Duration: See paragraph 3.6.2 c.
Rise time: Between 0.05 and 0.1 µs.
Decay time: Between 0.05 and 0.2 µs.
b. The pulse amplitude variation between one pulse and any other pulse in a reply shall not exceed 2 dB.</td><td></td><td>ED specifies minimum and maximum rise and decay times whereas DO only specifies maximum.

SC209 to consider addition of minimum rise and decay time of 0.05 µs to be in line with ICAO Annex 10 3.1.1.6.4</td></tr>
<tr><td>S-20</td><td>2.4.2.3.4 p 163
Frequency Spectrum of Mode S Replies (§2.2.4.2.3.d)
Connect the equipment as shown in Figure 2-32. Interrogate the transponder with a standard Mode S surveillance-identity interrogation and observe the spectral response of the reply.</td><td>5.4.2.3.2 p 148
Transmitter Spectrum
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.</td><td></td><td>DO specifies UF interrogation whereas ED specifies UF 11 interrogation. To be harmonised.

To be amended after discussion in common SC209-WG49 meeting with manufacturers</td></tr>
</table>

Comment [rhs13]: The original DO-181 had the equivalency marks as shown in the ED document with the exception that it used "≥ 78" in the last row which is more accurate for consistency purposes. Therefore, the change should be made to DO-181D.

Comment [rhs14]: I agree that DO-181D can be clarified to make it look like both specifications are saying the same. However, when interpreted as a whole, DO-181 does specify both minimum and maximum rise and fall times.
First, in section 2.2.4.1.4, it provides:
"2.2.4.1.4 . ATCRBS Reply Pulse Shape
All reply pulses and SPI pulses shall be 0.45 +/- 0.10 microsecond duration and have rise times of from 0.05 to 0.1 microsecond and decay times of from 0.05 to 0.2 microsecond. The rise and decay time may be less, providing the sideband radiation is no greater than that which would be produced theoretically by a trapezoidal wave having the stated rise and decay time. The Mode S reply spectrum requirement of section 2.2.4.2.3.d is an acceptable specification for meeting ATCRBS minimum rise and fall time requirements.

The Pulse amplitude variation of one pulse, with respect to any other pulse in a reply train, shall not exceed 1 dB.
Note: The above characteristics for ATCRBS reply pulse shapes are compatible with characteristics for Mode S reply pulse shapes (see section 2.2.4.2.3)."
Then, DO-181D provides the Mode-S requirements as shown in 2.2.4.23 an ... [1]

Comment [rhs15]: All the way up through DO-181C, the measurement procedure required:
"Connect the equipment as shown in Figure 2-32. Set the transponder to the 7777 identification code. Interrogate the transponder with a Standard Mode S Surveillance Identity Interrogation and observe the spectral response of the reply."
This was a good test as it forced the "ID" field to all "ONES" which results in the transmitted pulse either rising or falling at each half of the bit time which also forces the transmitter to work the most.
Then, for some reason, DO-181D drops the requirement to set the 4096 code to "7777" which is an ERROR on the part of DO-181D and should be fixed. ... [2]

Mode A/C replies: Pulse shape and spectrum

#	Do-181	ED-73	Comment	Proposal
S-21	2.4.2.3.1 p 160 ATCRBS Reply Pulse Characteristics (§2.2.4.1) … Step 2 ATCRBS Reply Pulse Shape (§2.2.4.1.4) Using a standard ATCRBS Mode A interrogation, measure the duration of each reply pulse. Measure rise and decay times of each pulse. Measure 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 percent and 90 percent amplitude points of the RF pulses.* In addition, checks should be made to determine the rise time of the detector. Step 3 SPI Pulse (§2.2.4.1.3, §2.2.4.1.4 and §2.2.4.1.5) Momentarily activate the SPI pulse control. Interrogate the transponder with a standard ATCRBS Mode-A interrogation. Measure the position of the SPI pulse with respect to the last framing pulse and the time the pulse remains in the reply train. Measure the width of the SPI pulse. With the SPI pulse activated, interrogate the transponder with a standard ATCRBS Mode-C interrogation. Verify that the SPI pulse is not present in the reply train.	5.4.3.1 p 151 Mode A/C Replies … 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.* 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. 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.		SC209 to consider to Align DO on ED regarding the type of reply for step2 (i.e. 15 pulses including a SPI pulse). SC209 to consider to split step3 in step3 / step4, a step 4 including the last 2 sentences of step 3.

Comment [rhs16]: Both DO-181D and ED-73C are doing the same thing. That is:
a.Measure Pulse shape relative to all other pulses in the reply
b.Verify that the SPI pulse has the proper shape and occurs in the right place in both Mode-A and Mode-C replies
Basically, if all pulses in the Mode-A and Mode-C replies are in the right place and have the right shape and then the SPI shows up properly, then there is no need to run the test to begin with using an SPI pulse as ED-73C does.
Overall, the results are equivalent.

Fixed Direct Data

#	Do-181	ED-73	Comment	Proposal
S-22	2.4.2.11.2 p 175 Fixed Direct Data (§2.2.13.1.1) Step 4 Aircraft Identification Data (§2.2.13.1.1.c) If the transponder inputs aircraft identification data as fixed 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.	5.4.12.1 p 183 Fixed Direct Data 5.4.12.1.2 Test Procedure 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.....(etc) and record that the identification data are properly transmitted in the MB field of the transponder's reply. Repeat for an aircraft identification input of 010101.....(etc). Repeat with an aircraft identification input of ABCD1234 coded in accordance with the character coding specified in paragraph 3.21.1.13 f.		Clarify in both documents that this test is only applicable if the transponder is able to report Aircraft Identification Data as the data available on the registration marking input. Clarify also that if the input data becomes unavailable or if the transponder is switched off/on, the output shall be TBC EP to make a separate WP explaining the issue and proposing a new text

Comment [rhs17]: It would appear that the DO-181D test is attempting to maximize the distribution of One's and Zero's in the Flight Id. Reply. The only way you can do this precisely is via an ADLP input which can set each bit to either one or zero. Using ARINC inputs or other than the ADLP restricts the amount of one and zero distribution. As an ADLP is not normally available, one must use the ARINC inputs. As for what happens if data is lost, as well as bit distribution, all of the requirements are strongly tested in the ELS requirements and Test Procedures being added to DO-181D. For instance, if data is lost and cannot be replaced by Aircraft Registry data, then BDS 1,7 and 1,0 must be updated to declare loss of capability. This will result in a Comm.-B Broadcast being available for 18+/- 1 seconds. If an interrogation is received to extract the register after that, then the transponder can either NOT REPLY or Reply with ALL ZERO's. At any rate, all theses cases are re-addressed in the ELS Procedures.

Variable Direct Data

#	Do-181	ED-73	Comment	Proposal
S-23	2.2.13.1.2 p 38 Variable Direct Data a. Pressure Altitude (2) Mode S (a) Bit 26 shall be designated as the M bit and shall be ZERO if the altitude is reported in feet. M equals ONE shall be reserved for possible future use to indicate that the altitude reporting is in metric units. *Note: Use of the M bit as defined here does not alter any conventions regarding the X bit in ATCRBS replies.*	3.17.1 p 43 Direct Data b. Variable Direct Data (1) Pressure Altitude (ii) Mode S (a) Bit 26 shall be designated as the M bit and shall be ZERO if the altitude is reported in feet. M equals ONE shall be reserved for possible future use to indicate that the altitude reporting is in metric units. *NOTE: Use of the M bit as defined here does not alter any conventions regarding the X bit in ATCRBS replies.*		Replace ATCRBS by Mode A/C in the whole section 3.17 of the ED document.

#	Do-181	ED-73	Comment	Proposal
S-24	2.4.2.12.2 p 176/177 Variable Direct Data (§2.2.13.1.2) Step 3 Pressure Altitude (Mode S) [§2.2.13.1.2.a (2)] Connect the transponder RF port to the Mode S test set. 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. With the ALT switch on, provide altitude code inputs to the transponder which should result in setting each of the ac field bits (including the M bit or the Q bit if the transponder is equipped to report altitude in 25-foot increments) of the reply one at a time. Verify that the correct bits are transmitted in the AC field of the reply. Verify that the AC field is all ZEROs when the ALT switch is set to "off."	5.4.12.2.2 p 185 Variable Direct Data (Paragraph 3.17.1 b.) c. STEP 3 - Pressure Altitude (Mode S) (1) Connect the transponder RF port to the transponder test set. (2) 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. (3) 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. (4) Verify that the correct bits are transmitted in the AC field of the reply with the Q bit set to 0 and the M bit set to 0. (5) 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. (6) 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. (7) 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. (8) 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. (9) 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. 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.		SC209 to consider addition of step 3.9 to ensure correct implementation of metric altitude if implemented. SC209 to consider addition of invalid altitude testing (I.e. Add last sentence of ED in DO).

Comment [rhs18]: The test procedure provided in ED-73 is more accurate and covers all cases. In particular, it covers the case where altitude exceeds 50,175 feet when the transponder must change to Gillham encoding for replies and set the Q Bit for 100 foot reporting. Yet, it can retain 25 foot reporting to TCAS. Therefore, at this time, there is a difference in the reporting that goes into replies and that which is provided to the on-board TCAS. I suggest updating DO-181D to be consistent with ED-73B.

#	Do-181	ED-73	Comment	Proposal
S-25	-	5.4.12.2.2 p 187 Variable Direct Data (Paragraph 3.17.1 b.) f. Step 6 – Invalid AA 1. 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 Mode A/C transponder or return to the Power Off Condition. 2. Repeat this test with the AA set to all ONEs. 3. 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. 4. 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 initialisation process (first bit set to ONE and all other bits set to ZEROs). 5. Repeat this test with the AA set to all ONEs. 6. Repeat with the remaining twenty-three different transponder addresses each consisting of 23 ZEROs and a single ONE.		To be removed from ED as AA is a fixed data. It is already incorporated in fixed direct data. Already done in DO181 D v0.8
S-26	2.4.2.12.2 p 176/177 Variable Direct Data (§2.2.13.1.2) 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.	-	No corresponding test procedure in ED	Same procedure to be added in ED73. to be checked with EP action on fixed direct data. Include in ED same procedure as in DO and specify that it corresponds to the setting where the Aircraft Identification is variable, i.e. different of registration marking (e.g. call sign). Check if test is complete (e.g. invalid input).

Comment [rhs19]: As discussed earlier during S-22, detailed requirements and test procedures have been added for ELS; therefore, this test procedure could be deferred to such sections. Particularly since ELS is now required.

SPI data

#	Do-181	ED-73	Comment	Proposal
S-27	2.2.4.1.3 p 22 ATCRBS-SPI In addition to the information pulses provided, an SPI pulse, which may be used with any of the other information pulses upon request, shall be provided at a spacing 4.35 microseconds following the last framing pulse. The SPI pulse shall be initiated by an IDENT switch. Upon activation of the IDENT switch, the SPI pulse shall be transmitted when replying to ATCRBS Mode A interrogations for a period of 18 ±1.0 seconds. The SPI pulse shall be transmitted only if the IDENT switch is first activated. The SPI pulse shall not be transmitted when replying to Mode C interrogations.	3.5.3 p 27 Mode A/C Special Position Identification (SPI) Pulse a. In addition to the information pulses, a SPI pulse, which may be used with any of the other information pulses upon request, shall be provided at a spacing 4.35 µs following the last framing pulse of Mode A replies only. b. The SPI pulse shall only be initiated by an IDENT switch. c. Upon activation of the IDENT switch, the SPI pulse shall be transmitted when replying to Mode A interrogations for a period of 18 ±1.0 seconds.		Different specifications in the documents could be clearer. Conclusion: Add in ED 73 at the end of bullet a 'The SPI pulse shall not be transmitted when replying to Mode C interrogations. '
S-28		3.6.3 p 29 Special Position Identification (SPI) a. When manually activated, the SPI condition is indicated in the FS field of Mode S replies (DF = 4, 5, 20 and 21). b. This information shall be present for a period of 18 ±1.0 seconds, after activation.		No equivalent specification in the Mode S replies section of the DO document. In fact there a section on SPI in 2.2.18.7d for level 1 transponder it does not include df20/21 but erroneously include ES. For level2 section 2.2.19.1.6 makes reference to FS. SC 209 to check that SPI is correctly covered. There is no corresponding test procedure in ED 5.4.3.2.2 Mode S replies, there is one but in the ES control. Same comment for DO, as there is no requirement.

Comment [rhs20]: The SPI is specifiec in DO-181D, section 2.2.13.1.2.d, as follows:
"d. . Special Position Identification (SPI)
. In the ATCRBS mode, an SPI pulse shall be transmitted upon request, following a Mode A reply. In the FS field of Mode S replies, an equivalent of the ATCRBS SPI pulse shall be transmitted upon the same request. The code is transmitted for 18 +/- 1.0 seconds after initiation and can be reinitiated at any time."
DO-181D, section 2.1.7.d, establishes initiation of the SPI as follows:
. "d. . Means of initiating the IDENT (SPI) feature.
DO-181D, section 2.2.14.4.14 goes on to define the "FS" field where a Coding of "4" or "5" is indicative of the SPI being active.
DO-181D, Figure 2-5 clearly identifies the "FS" field as being part of DF=4,5,20, and 21 replies.
DO-181D, section 2.2.18.2.7.d specifies:
"d. . Special Position Identification (SPI) – When manually selected, the transponder shall transmit the equivalent of the ATCRBS SPI in the FS field of surveillance replies DF=4,5 [this should be updated to read DF=4,5,20,21] and in the Surveillance Status Suybfield (see section 2.2.23.1.8) of Extended Squitter transmissions (DF=17) when they contain the airborne position report. This code shall be transmitted for 18 +/- 1 seconds (T1 timer) after initiation and can be reinitiated at any time."
DO-181D, section 2.4.2.12.2, Step 5, then provides baseline testing of the "FS" protocol and SPI setting using UF=4,5,20, and 21, including timing with the use of Figure 2-13.
DO-181D, section 2.5.4.7 then provides appropriate test procedures to validate the "FS" field including the setting of the SPI condition with the "SSS" of extended Squitter
Although the requirements are distributed, it appears that the SPI requirements are being covered and tested appropriately in DO-181D. ED requirements are likewise scattered. More time will have to be available to directly map each and every requirement and validate same between both documents.

#	Do-181	ED-73	Comment	Proposal
S-29	2.2.13.1.2 p 39 Variable Direct Data d. Special Position Identification (SPI) In the ATCRBS mode, an SPI pulse **shall** be transmitted upon request, following a Mode A reply. In the FS field of Mode S replies, an equivalent of the ATCRBS SPI pulse **shall** be transmitted upon the same request. The code is transmitted for 18 ±1.0 seconds after initiation and can be reinitiated at any time.	3.17.1 p 44 Direct Data … b. Variable Direct Data … (4) the presence of the Special Position Identification (SPI). In Mode A/C, an SPI pulse shall be transmitted upon request, following a Mode A reply. In the FS field of Mode S replies, an equivalent of the SPI pulse shall be transmitted upon the same request. The code is transmitted for 18 ±1.0 seconds after initiation and can be reinitiated at any time. *(repetetive statement, ED 73 B 3.5.3)*		Remove the remark in ED consistent with DO (Could be more consistent to reference 3.5.3 in ED and 2.2.4.1 in DO.)

Comment [rhs21]: More on SPI as discussed in the previous comment.

Miscellaneous

#	Do-181	ED-73	Comment	Proposal
S-30	1.6.2 p 9/10 Detailed Test Procedures Detailed test procedures for hardware qualifications in ambient conditions are specified in Subsection §2.4. The test procedures contained in Subsection §2.5 verify the transponder's surveillance and communication protocols. These tests are conducted at the equipment level and are intended to provide a laboratory means of demonstrating compliance with the requirements of Subsections §2.1 and §2.2. Test results may be used by equipment manufacturers as design guidance, for monitoring manufacturing compliance and, in certain cases, for obtaining formal approval of equipment design and manufacture.		What is the meaning of this statement?	General discussion on environmental tests

Comment [rhs22]: Ambient Conditions are specifically defined in section 2.4.1.f. as follows:

"f. . Ambient Conditions – Unless otherwise specified, all tests **shall** be conducted under conditions of ambient room temperature, pressure and humidity. However, the room temperature **shall** not be lower than 10 degrees C."

ME for extended squitter

<table>
<tr><th>#</th><th>Do-181</th><th>ED-73</th><th>Comment</th><th>Proposal</th></tr>
<tr><td>S-31</td><td>2.2.23.1.8 p 129
Subfields in ME for Extended Squitter
SSS, the 2-bit (38-39) Surveillance Status Subfield in ME shall report the surveillance status of the transponder when this field contains the airborne position squitter report. The following codes have been assigned:
<table><tr><th>Code</th><th>Description</th></tr><tr><td>0</td><td>No status information</td></tr><tr><td>1</td><td>Transponder reporting permanent alert condition (§2.2.18.2.7.a)</td></tr><tr><td>2</td><td>Transponder reporting a temporary alert condition (§2.2.18.2.7.a)</td></tr><tr><td>3</td><td>Transponder reporting SPI condition (§2.2.18.2.7.c)</td></tr></table></td><td>3.21.2.6.8 p 89
Subfields in ME for Extended Squitter
SSS, the 2-bit (38,39) Surveillance Status Subfield in ME shall report the surveillance status of the transponder when ME contains the airborne position squitter report. The following codes have been assigned:
0 = No status information.
1 = Transponder reporting permanent alert condition (3.20.2.7 a).
2 = Transponder reporting a temporary alert condition (3.20.2.7 a).
3 = Transponder reporting SPI condition (3.20.2.7 c).</td><td></td><td>SC209 to check and correct reference for Code 3 (it shall refer to § 2.2.18.2.7.d in DO)</td></tr>
</table>

Standard transaction interfaces

#	Do-181	ED-73	Comment	Proposal
S-32	The requirement and test sections related to Standard Transaction interfaces need to be discussed because of various issues like ADLP can be partly outside the transponder and partly inside (see below), is it needed to address UF 24, etc.			
S-33	2.2.13.3.1 p 42 Standard Transaction Interfaces Uplink Interface f. Transponder Capability – The transponder datalink communication capacity information shall be made available to the ADLP. This information includes the ELM capacity of the transponder and the ability of the transponder to support the enhanced datalink protocols. *Note: This information is used by the ADLP to build the datalink capability report.*	3.17.3 p 46 Standard Transaction Interfaces c. Uplink Interface		An item 6 identical to item f of DO shall be added in ED. WG49 decided to add bullet f in ED to be consistent with DO. There is no equivalent test procedure in DO and of course in ED A test should be developed.

#	Do-181	ED-73	Comment	Proposal
S-34	2.4.2.12.3 p 177 Standard Transaction Interfaces (§2.2.13.3) Step l Uplink Interface Information Content (§2.2.13.3.1 a and e) Interrogate the transponder with valid Mode S interrogations of all uplink formats which the transponder is designed to accept, including broadcast interrogations. 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. Make additional valid interrogations with the uplink formats (excluding UF=11 and UF=24) and field content randomly chosen. Verify proper output of the uplink interface. Verify that broadcast interrogations are identified as such, either by AP content or by a special purpose code. 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 which 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 §2.2.3.4.2. Verify that all data appear correctly at the uplink interface.	5.4.12.3 p 186/187 *Standard Transaction Interfaces (Paragraph 3.17.3)* *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 and UF 16 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=11 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.		To modify ED to also exclude DF24 for Downlink request ie. RC=3 In ED the 3 steps shall specify “UF=0, 11, 16, and 24 (when it is a request for a downlink ELM)…” according to 3.17.3. SC209 and WG49 to check if the same exclusion applies to all steps.

#	Do-181	ED-73	Comment	Proposal
S-35	2.4.2.12.3 p 177/178 Standard Transaction Interfaces (§2.2.13.3) … Step 4 Uplink Interface, Non-acceptance (§2.2.13.3.1.d) Interrogate the transponder with valid long Mode S interrogations at a rate exceeding the one specified in §2.2.3.4.2 for the longest time period. Verify that the transponder does not accept interrogations after the rate for which the transponder is designed. Also, verify that all data correctly appear at the uplink interface for all accepted interrogations.	5.4.12.3 p 187 *Standard Transaction Interfaces (Paragraph 3.17.3)* *Test Procedure* … d. STEP 4 - Uplink Interface, Non-acceptance (Paragraph 3.17.3 c.) 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.		Both in DO and ED specify "valid long Mode S interrogations (UF 20/21)" Remove the last statement of ED as the two options are now accepted by ICAO. Add reference to the new ICAO Annex 10 text 3.1.2.4.1.2.3 + new note
S-36	2.4.2.12.3 p 178 Standard Transaction Interfaces (§2.2.13.3) … Step 5 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. Repeat this procedure with MB field data context 55 5555 5555 5555.	5.4.12.3 p 188 *Standard Transaction Interfaces (Paragraph 3.17.3)* *Test Procedure* … 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. Repeat the 3 previous points with MB field data context 55 5555 5555 5555.	repetition of test with 55555… is not included in the corresponding § of section 2.3 of the DO document.	Section 2.3 covers environmental testing. This is an example of difference with testing in normal conditions. See action on environmental testing.

#	Do-181	ED-73	Comment	Proposal
S-37	2.4.2.12.3 p 178 Standard Transaction Interfaces (§2.2.13.3) … Step 7 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 first reply). Interrogate the transponder with a standard Comm-A, altitude interrogation at the rates specified for long interrogations in §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.	5.4.12.3 p 188 *Standard Transaction Interfaces (Paragraph 3.17.3)* *Test Procedure* … 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 paragraph3.17.3 d. Interrogate the transponder with a standard Comm-A, 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. Repeat for all valid BDS data source designator codes 0 to 255. *NOTE: BDS code 0 represents AICB messages. Testing of such messages requires such messages to be closed-out after being read.*		SC209 to consider addition of green text to cover the extraction of all registers. WG49 to replace BDS 0 by BDS 0;0.

#	Do-181	ED-73	Comment	Proposal
S-38	2.4.2.13.3 p 178 Standard Transaction Interfaces (§2.2.13.3) … Step 8 Downlink Interface, Unavailable Data (§2.2.13.3.2.e) Disconnect all inputs from the transponder's downlink interface port. Interrogate the transponder with a standard Comm-A, altitude interrogation containing RR=16. Verify that the reply contains all ZEROs in the MB field. Repeat with all RR codes from 17 through 31, noting that: - For RR code 17, bits of the MB field of the reply excluding bits 1-8, 24, 26-32, 33 and 35 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 available). - 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.	5.4.12.3 p 188 *Standard Transaction Interfaces (Paragraph 3.17.3)* *Test Procedure* … 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, 26-32, 33 and 35 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 available). - For RR code 18, the reply contains either all ZEROs 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.	Which downlink interface port?	SC209 and WG49 to exclude bit36 from RR= 17 , bit 34 (squitter) need to be tested before and after corresponding timer expiration. WG49 to use the DO text for RR18 Wg49 to add 'if not manage by the transponder itself at the end of RR 20-31. Sc209 to consider addition of the last bullet.

ELM service interfaces

#	Do-181	ED-73	Comment	Proposal
S-39	2.4.2.12.4 p 179 ELM Service Interfaces (§2.2.20.1.4 and §2.2.20.1.2) Step 1 ELM Uplink Interface, Data Rate (§2.2.20.1.4) 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 5 milliseconds after the previous ELM). After 4 seconds for transponders equipped for standard ELM operation or after 1 second for transponders equipped for enhanced uplink ELM operation, interrogate the transponder with another set of four 16-segment ELMs. Verify that the correct data appears at the ELM interface no later than one second after completion of the corresponding uplink ELM for both interrogation sequences. Verify that the interface reports an interrogator identity code of ZERO. Step 2 ELM Uplink Interface, Interrogator Identification (§2.2.20.1.2) Repeat the procedures of Step 1 using the multisite protocol. Use different Interrogator Identifier codes and verify that they are correctly reported at the interface. Step 3 ELM Downlink Interface, Data Rate (§2.2.20.2.4 and §2.2.3.5) Set up a downlink ELM which conforms to the maximum capability of the transponder (each segment with unique 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.	5.4.12.4.2 p 190 ELM Service Interfaces (Paragraph 3.17.4) a. STEP 1 - ELM Uplink Interface, Data Rate (Paragraph 3.17.4c.) 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. After 4 seconds, interrogate the transponder with another set of four 16-segment ELMs. 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. 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. 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 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.	The text in yellow in DO is addressed in § 5.5.8.28.2 in ED.	Consistent between DO and ED. Nothing to do

Sensitivity level operation

#	Do-181	ED-73	Comment	Proposal
S-40	2.5.4.30 p 237 Procedure #30 Sensitivity Level Operation (§2.2.22.1.1 and §2.2.22.1.5) … b. Interrogate the transponder with a UF=20 interrogation containing a Sensitivity Level Command Message (ADS1=0, ADS2=5, and TMS=0) with IIS=1 and SLC=4. Show that the IIS and SLC subfields are correctly output on the transponder/TCAS interface. c. Interrogate the transponder with a UF=21 interrogation containing a Sensitivity Level Command Message with IIS=15 and SLC=5. Show that the IIS and SLC subfields are correctly output on the transponder/TCAS interface.	5.5.8.34 p 235 PROCEDURE #30 Sensitivity Level Operation (Paragraphs 3.23.1..1 and 3.23.1.5) … b. Interrogate the transponder with a UF=20 interrogation containing a Sensitivity Level Command Message (See paragraph 3.23.1.1) with IIS=1 and SLC=4. Show that the IIS and SLC subfields are correctly output on the transponder/ACAS interface. c. Interrogate the transponder with a UF=21 interrogation containing a Sensitivity Level Command Message with IIS=15 and SLC=5. Show that the IIS and SLC subfields are correctly output on the transponder/ACAS interface. d. Interrogate the transponder with a UF=20 interrogation containing a Sensitivity Level Command Message with SIS=1 and SLC=4. Show that the SIS and SLC subfields are correctly output on the transponder/ACAS interface. e. Interrogate the transponder with a UF=21 interrogation containing a Sensitivity Level Command Message with SIS=63 and SLC=5. Show that the SIS and SLC subfields are correctly output on the transponder/ACAS interface.	According to Annex 10 volume IV § 4.3.7.3.4 it is only applicable if TMS = 0 and DI =1 or 7. There is a need to define negative tests. Clarify whether the test are to be defined for SI code capable transponders (i.e. corresponding to steps d and e in ED). The interrogations corresponding to test d and e are not possible according to Annex 10 vol IV, when DI = 1 or 7 there is no SIS field in SD.	State in both ED and DO that b, c, are to be repeated with TMS = 0 and DI =1 and 7. Discuss the issue of SLC with SI code with ICAO and SC209 and ARINC committee. EP to raise the issue to TSG before next meeting.

MU message

#	Do-181	ED-73	Comment	Proposal
S-41	2.2.22.1.3 p 118 MU Message, Comm-U Used by TCAS The Mode S transponder shall supply the MU field (see §2.2.14.4.25) of a long special surveillance interrogation, UF=16, to TCAS only under the following conditions: a. The interrogation contains the transponder's discrete address and UDS=48. b. The interrogation contains the broadcast address (all ONES) and UDS=50 *Notes:* *1. The MU field is used by TCAS to transmit a TCAS Broadcast Interrogation Message containing own transponder's address for the purpose of controlling interference caused by TCAS interrogations, or to transmit a TCAS Resolution Message for air-to-air resolution advisory coordination.* *2. Ideally the transponder should serve as a modem for TCAS and supply the entire MU field to TCAS (including the UDS Field) of any received UF=16 interrogation. Currently implemented transponder/TCAS interface protocols do not provide the UDS Field information to TCAS so it is necessary for these transponders to select the UDS messages that are passed to TCAS. If this interface limitation is removed in the future, then all UDS messages would be passed to TCAS.* Subfield in MU for a TCAS Resolution Message UDS: U-Definition Subfield – This 8-bit (33-40) subfield defines the data content and coding in the remainder of the MU field. For convenience in coding, UDS is expressed in two groups of 4 bits each; UDS1, 33 through 36, and UDS2, 37 through 40. TCAS Resolution Messages shall be identified by UDS1=3 and UDS2=0, the combination of which is equivalent to UDS=48. Subfield in MU for a TCAS Broadcast Message UDS: U-Definition Subfield – A TCAS Broadcast Interrogation Message is identified by UDS1=3 and UDS2=2, the combination of which is equivalent to UDS=50.	3.23.1.3 p 103 MU Message, Comm-U used by ACAS The Mode S transponder shall supply the MU field (paragraph 3.18.4.22) of a long air-air surveillance interrogation, UF=16, to ACAS. *NOTE: The MU field is used by ACAS to transmit a ACAS Broadcast Interrogation Message containing own transponders's address for the purpose of controlling interference caused by ACAS interrogations, or to transmit a ACAS Resolution Message for air-to-air resolution advisory coordination.* Subfield in MU for a ACAS Resolution Message UDS: U-Definition Subfield - This 8-bit (33-40) subfield defines the data content and coding in the remainder of the MU field. For convenience in coding, UDS is expressed in two groups of 4 bits each; UDS1, (33-36), and UDS2, (37-40). ACAS Resolution Messages shall be identified by UDS1=3 and UDS2=0, the combination of which is equivalent to UDS=48. Subfield in MU for a ACAS Broadcast Message UDS: U-Definition Subfield - A ACAS Broadcast Interrogation Message is identified by UDS1=3 and UDS2=2, the combination of which is equivalent to UDS=50.		wG49 to add note 2 (yellow) in ED

#	Do-181	ED-73	Comment	Proposal
S-42	2.5.4.35 p 247/248 Procedure #35 MU Messages To TCAS (§2.2.22.1.3) This test verifies that the transponder correctly: 1) accepts UF=16 interrogations with MU data containing a TCAS Resolution Message (UDS=48) and passes all necessary information to the TCAS unit; 2) accepts UF=16 broadcast interrogations with MU data containing a TCAS Broadcast Message (UDS=50) and passes all necessary information to the TCAS unit; 3) does not transfer the MU data of UF=16 discrete interrogations with UDS≠48 and broadcast interrogations with UDS≠50 to the TCAS unit. a. Interrogate the transponder with a valid UF=16 TCAS Coordination Message (UDS1=3, UDS2=0). Verify that the transponder replies with a valid DF=16 Coordination Reply Message and the data content of the MU field is correctly output on the transponder/TCAS interface. b. In one second, interrogate the transponder with ten UF=16 interrogations, each containing a TCAS Broadcast Message (UDS1=3, UDS2=2, and interrogation address all ONEs), each containing a unique “own” Mode S address (i.e., ten different Mode S addresses). Verify that the MU data for each interrogation is correctly output on the transponder/TCAS interface. c. Interrogate the transponder at the rate of 10 per second or less with 255 UF=16 interrogations addressed to the transponder with UDS values from 0 to 255 except for UDS=48. Verify that the transponder does not output the messages over the transponder/TCAS interface. d. Interrogate the transponder at the rate of 10 per second or less with 255 UF=16 broadcast interrogations with UDS values from 0 to 255 except for UDS=50. Verify that the transponder does not output the messages over the transponder/TCAS interface.	5.5.8.39 p 243 PROCEDURE #35 ACAS Broadcast Message (Paragraph 3.23.1.3) This test verifies that the transponder accepts incoming UF=16 interrogations containing an ACAS Broadcast Message and passes all necessary information to the ACAS unit. In one second, interrogate the transponder with ten UF=16 interrogations, each containing an ACAS Broadcast Message (UDS1=3, UDS2=2, and interrogation address=all 1's), each containing a unique "own" Mode S address (i.e., ten different Mode S addresses). Show that incoming information is correctly output on the transponder/ACAS interface.		To be discuss whether ED is to be aligned on DO. RM to check the text and confirm whether the DO text can be re-used in ED.

Non selective lockout

#	Do-181	ED-73	Comment	Proposal
S-43	2.5.4.4.2 p 189 Required Negative Tests a. PC Discrimination The interrogation patterns are: UF = 4, 5, 20, 21. PC = 0 and DI≠3, PC = 0 and DI=3 and LSS=1 and SIS=0, PC = 1 and DI=3, PC = 2, 3, 4, 5, 6. 7. Total number of patterns = 36. With the transponder not in non-selective lockout state, interrogate with all of the above patterns consecutively. Verify that, after the sequence, the non-selective lockout state does not exist.	5.5.8.4 p 199/200 PROCEDURE #4 - Non-Selective Lockout Tests (Paragraph 3.20.2.4) b. Required Negative Tests (1) PC Discrimination The interrogation patterns are: UF = 4, 5, 20, 21. PC = 0, 2, 3, 4, 5, 6, 7. Total number of patterns = 28. With the transponder not in non-selective lockout state, interrogate with all of the above patterns consecutively. Verify that the non-selective lockout state never exists during this test sequence.		WG49 to align ED on DO
S-44	2.5.4.5 p 191 Procedure #5 Selective Lockout Tests Pattern Definition for Level 1 Transponders … Total Interrogation Patterns Per Timer UF: 2 codes. DI: 2 codes with LOS=0,1; 1 code with LSS=0, 1 5 codes with SD field bits 23 & 26 = 1 Total: 20 possible patterns for II timers, 18 possible patterns for SI timers. Positive test patterns: 2 or 4. Negative test patterns: 16.	5.5.8.5 p 201 PROCEDURE #5 Selective Lockout Tests (Paragraph 3.20.2.5) 5.5.8.5.1 Pattern Definition a. Level 1 Transponders … Total Interrogation Patterns per Timer UF: 4, 5 (2 codes). DI: 0,1,2,3,4,5,6,7 (8 codes). LOS: 0, 1 (2 codes). LSS: 0, 1 (2 codes). Positive test patterns: 6. Negative test patterns: 58. Total: 64 possible patterns per timer.	Clarify if level 1 transponder can be SI capable, if not a modification in Annex 10 vol IV is needed. It seems that some less credible negative tests are not included in DO, whereas the ED applies a systematic policy all the combinations which does not correspond to a positive test shall be tested as a negative test.	EP check with ICAO SI code on level 1 transponder. WG49 and SC209 to agree the negative test patterns Correct total number of test should be 128 = 6 + 122 (according to the test procedure) if II + SI code but this is only for one code. It shall be repeated for all possible II and SI codes.

#	Do-181	ED-73	Comment	Proposal
S-45	2.5.4.5 p 191 Procedure #5 Selective Lockout Tests … Pattern Definition of All Other Transponder Designs … Total Interrogation Patterns Per Timer UF: 4 codes. DI: 2 codes with LOS= 0,1; 1 code with LSS=0,1; 5 codes with SD field bits 23 & 26 = 1 Total: 40 possible patterns for II timers, 36 possible patterns for SI timers. Positive test patterns: 4 or 8. Negative test pattern: 32. *Note: The 8 negative test patterns per UF code are as follows: For each value of DI (0 – 7) set the IIS or SIS code correctly. For DI code values where there is no IIS or SIS subfield within the SD field, set the corresponding bits (bits 17-20 for IIS or 17-22 for SIS). If DI=1 or 7, set LOS=0, for all other values of DI, set bit 26=1. If DI=3, set LSS=0, for all other values of DI, set bit 23=1.*	5.5.8.5 p 201 PROCEDURE #5 Selective Lockout Tests (Paragraph 3.20.2.5) 5.5.8.5.1 Pattern Definition … b. Pattern Definition of All Other Transponder Designs The patterns below are a list of possible patterns that can be used to run the tests in this procedure for Level 2 Transponders and above. … Total Interrogation Patterns per Timer UF: 4, 5, 20, 21 (4 codes). DI: 0,1,2,3,4,5,6,7 (8 codes). LSS: 1 (1 code). Positive test patterns: 12. Negative test patterns: 116 Total: 128 patterns.	It seems that some less credible negative tests are not included in DO, whereas the ED applies a systematic policy all the combinations which does not correspond to a positive test shall be tested as a negative test.	Same as S44 Replace in ED the line LSS: 1 (1 code) with the 2 following lines: LOS: 0, 1 (2 codes). LSS: 0, 1 (2 codes). Correct total number of test should be 256 = 12 + 244 (according to the test procedure) but this is only for one code. It shall be repeated for all possible II and SI codes.

<table>
<tr><th>#</th><th>Do-181</th><th>ED-73</th><th>Comment</th><th>Proposal</th></tr>
<tr><td>S-46</td>
<td>2.5.4.5 p 192
Procedure #5 Selective Lockout Tests
…
Principle of Test Sequence
…
Test #1 Multisite, TL Timer and Lockout: Timer Duration and Insensitivity to Non-Valid Signals (All Transponders)
<table>
<tr><th>Time (sec)</th><th>Action</th></tr>
<tr><td>0.0</td><td>Start timer with UF=4.</td></tr>
<tr><td>0.02</td><td>Verify lockout to timer’s II or SI with UF=11.</td></tr>
<tr><td>0.04 to 1.62</td><td>Verify non-lockout to all other non-locked out IIS and SIS (times 0.9 and 1.1 will be used for the last 2 steps of the sequence for timers started previously with interlace, see note below).</td></tr>
<tr><td>2.0</td><td>Start next timer for interlace.</td></tr>
<tr><td>3.64</td><td>Try timer restart with correct IIS or SIS and incorrect DI-LOS and DI-LSS combinations (DI:0 – 7 = 8 combinations) (see note above).</td></tr>
<tr><td>16.9</td><td>Verify lockout to timer’s II or SI with UF=11.</td></tr>
<tr><td>19.1</td><td>Verify non-lockout.</td></tr>
</table>
If the last test fails, the timer either runs too long or has been restarted by a non-valid signal.
Note: Test #1 provides the basic timing of a test sequence that satisfies the principles of the test procedure while maintaining a maximum of 50 interrogations per second. Because the test sequence calls for interlacing multisite lockout timers (in this case one is started every 2 seconds), the above sequence will need to accommodate the critical timer verifications that occur at 16.9 and 19.1 seconds relative to the start of each timer. When the test sequence reaches 16.9 and 19.1 seconds after the start of each timer it will be 0.9 and 1.1 after the start of a new timer. Priority is given to verify the lockout of the earlier timer at the correct time, while the verification of non-lockout to all other timers is scheduled around these critical measurements.</td>
<td>5.5.8.5 p 202/203
PROCEDURE #5 Selective Lockout Tests (Paragraph 3.20.2.5)
…
5.5.8.5.3 Principle of Test Sequence
…
a. Test #1 - Multisite, TL Timer and Lockout: Timer Duration and Insensitivity to Non-Valid Signals (All Transponders)
(1) run test for each IIS related TL timer
<table>
<tr><th>Time (sec)</th><th>Action</th></tr>
<tr><td></td><td></td></tr>
<tr><td>0.00</td><td>Start timer with UF=4, DI= 1, LOS = 1</td></tr>
<tr><td>0.02</td><td>Verify lockout to timer's II with UF=11.</td></tr>
<tr><td>0.04 to 9.90</td><td>Verify non-lockout to all other IIS and SIS.</td></tr>
<tr><td>10.0</td><td>Try timer restart with correct IIS and incorrect DI - LOS combinations (DI= 0, 2, 3, 4, 5, 6 and Bit 26 (location of LOS)=0,1; DI = 1, 7 and LOS = 0 (14 combinations))</td></tr>
<tr><td>13.3</td><td>Try timer restart with correct IIS and all DI-LSS combinations (DI=0, 1, 2, 3, 4, 5, 6, 7 and Bit 23 (location of LSS)=0,1 (16 combinations)).</td></tr>
<tr><td>16.9</td><td>Verify lockout to timer's II with UF=11.</td></tr>
<tr><td>19.1</td><td>Verify non-lockout with UF=11.</td></tr>
</table>
If the last test fails, the timer either runs too long or has been restarted by a non-valid signal.
(2) run test for each SIS related TL timer
<table>
<tr><th>Time (sec)</th><th>Action</th></tr>
<tr><td></td><td></td></tr>
<tr><td>0.00</td><td>Start timer with UF=4, DI = 3, LSS =1.</td></tr>
<tr><td>0.02</td><td>Verify lockout to timer's SI with UF=11.</td></tr>
<tr><td>0.04 to 9.90</td><td>Verify non-lockout to all other IIS and SIS.</td></tr>
<tr><td>10.0</td><td>Try timer restart with correct SIS and all DI-LOS combinations (DI=0, 1, 2, 3, 4, 5, 6, 7 and Bit 26 (location of LOS)=0,1 (16 combinations))</td></tr>
<tr><td>13.3</td><td>Try timer restart with correct SIS and incorrect DI-LSS combinations (DI=0, 1, 2, 4, 5, 6, 7 and LSS=0,1; DI=3 and Bit 23 (location of LSS) = 0 (15 combinations)).</td></tr>
<tr><td>16.9</td><td>Verify lockout to timer's SI with UF=11.</td></tr>
<tr><td>19.1</td><td>Verify non-lockout with UF=11.</td></tr>
</table>
If the last test fails, the timer either runs too long or has been restarted by a non-valid signal.</td>
<td>The policy for negative test in DO and ED is different which is explaining the differences in the procedure.</td>
<td>DO and ED shall specify that the procedure is repeated for each type UF and each possible II and SI codes.
In the last step of the DO it is proposed to add “ with UF 11” to be consistent with previous step and to be consistent with ED.

Same test in principle but more detailed in ED
WG49 to justify why additional details were added
SC209 to consider addition of UF 11 in the last step</td></tr>
</table>

<table>
<tr><th>#</th><th>Do-181</th><th>ED-73</th><th>Comment</th><th>Proposal</th></tr>
<tr><td>S-47</td><td>2.5.4.5 p 193
Procedure #5 Selective Lockout Tests
…
Principle of Test Sequence
…
Test #2 Multisite TL Timer and Lockout: Restart Capability and Sensitivity to All Valid Formats (All Transponder)
Time (sec) Action
0.0 Start timer with UF=4.
0.02 Verify lockout to timer’s II or SI.
4.5 Restart timer with UF=5.
21.4 Verify lockout for timer’s II or SI.
23.6 Verify non-lockout for timer’s II or SI.
Interlace all timers in approximately 0.3-second intervals.
For Level 2 transponders and above, alternate using UF=4 and UF=20 interrogations to start the timers, and alternate using UF=5 and UF=21 interrogations to restart timers.
If the test at 21.4 seconds fails, the timer has not been restarted.</td><td>5.5.8.5 p 202/203
PROCEDURE #5 Selective Lockout Tests (Paragraph 3.20.2.5)
…
5.5.8.5.3 Principle of Test Sequence
…
b. Test #2 - Multisite TL Timer and Lockout: Restart Capability and Sensitivity to Valid Formats (All Transponders)
(1) run test for each IIS related TL timer, using DI=1
<table><tr><th>Time (sec)</th><th>Action</th></tr><tr><td></td><td></td></tr><tr><td>0.00</td><td>Start timer with UF=4, DI = 1, LOS = 1</td></tr><tr><td>0.02</td><td>Verify lockout to timer's II with UF = 11.</td></tr><tr><td>4.5</td><td>Restart timer with UF=5, DI = 1, LOS = 1.</td></tr><tr><td>21.4</td><td>Verify lockout for timer's II with UF = 11.</td></tr><tr><td>23.6</td><td>Verify non-lockout for timer's II with UF = 11.</td></tr></table>Interlace all timers in approximately 0.3 second intervals.
If the test at 21.4 seconds fails, the timer has not been restarted.
(2) run test for each IIS related TL timer, using DI=7
<table><tr><th>Time (sec)</th><th>Action</th></tr><tr><td></td><td></td></tr><tr><td>0.00</td><td>Start timer with UF=5, DI=7, LOS=1.</td></tr><tr><td>0.02</td><td>Verify lockout to timer's II with UF = 11.</td></tr><tr><td>4.5</td><td>Restart timer with UF=4, DI=7, LOS=1.</td></tr><tr><td>21.4</td><td>Verify lockout for timer's II with UF = 11.</td></tr><tr><td>23.6</td><td>Verify non-lockout for timer's II with UF = 11.</td></tr></table>Interlace all timers in approximately 0.3 second intervals.
If the test at 21.4 seconds fails, the timer has not been restarted
(3) run test for each SIS related TL timer, using DI=3
<table><tr><th>Time (sec)</th><th>Action</th></tr><tr><td></td><td></td></tr><tr><td>0.00</td><td>Start timer with UF=4, DI=3, LSS=1.</td></tr><tr><td>0.02</td><td>Verify lockout to timer's SI with UF = 11.</td></tr><tr><td>4.5</td><td>Restart timer with UF=5, DI=3, LSS=1.</td></tr><tr><td>21.4</td><td>Verify lockout for timer's SI with UF = 11.</td></tr><tr><td>23.6</td><td>Verify non-lockout for timer's SI with UF = 11.</td></tr></table>Interlace all timers in approximately 0.3 second intervals.
If the test at 21.4 seconds fails, the timer has not been restarted.</td><td>ED test are more detailed and clearly details the different case for each type of interrogation (DI = 1 and 7 with LOS = 1 and DI = 3 LSS = 1). Further more for the second type of interrogation UF5 followed by UF4 is proposed in ED whereas DO is always using UF4 followed by UF5. Same comment for Test #3 with UF20/21.</td><td>SC-209 : should consider to use the Eurocae test procedures (SI and II should be tested)</td></tr>
</table>

#	Do-181	ED-73	Comment	Proposal
S-48		5.5.8.5 p 202/203 PROCEDURE #5 Selective Lockout Tests (Paragraph 3.20.2.5) … *5.5.8.5.3 Principle of Test Sequence* … d. Test #4 - Broadcast Discrimination related to IIS … e. Test #5 - Broadcast Discrimination related to SIS …	No equivalent test steps in DO	SC- 209 to consider to add this test.

Squitter

#	Do-181	ED-73	Comment	Proposal
S-49	2.5.4.6.1 p 193/194 Acquisition Squitter Verification The following test shall verify proper transmission of Acquisition squitters when the transponder is not transmitting Extended Squitters. The following tests shall be conducted with no external data input to the Extended Squitter GICB registers. Step 1: Setup the transponder to airborne status. The Acquisition squitter transmission shall be verified to be uniformly distributed between 0.8 and 1.2 seconds with a time quantization less than or equal to 15 milliseconds. The test setup will require measuring the time difference between successive Acquisition squitters. The time interval measured between successive Acquisition squitters shall be counted in individual 15 millisecond bins between 0.8 and 1.2 seconds. Validation of the proper quantization is achieved upon receipt of at least one Acquisition squitter in each 15 millisecond time bin between 0.8 and 1.2 seconds. Improper times are those occurring outside of the time bins between 0.8 and 1.2 seconds. Verify that the Acquisition squitters are uniformly distributed over the interval between 0.8 and 1.2 seconds. Step 2: Verify the content of the CA, AA and PI fields. For diversity transponders, verify that the squitters occur alternately from both channels. For transponders that are designed for aircraft installations with automatic means of determining on-the-ground condition, when the transponder is in on-the-ground status, verify that Acquisition squitters occur on the top antenna only at the prescribed rate.	-	Squitter to be reviewed in ED. The tests corresponding to the requirements defined in 3.20.2.6 and 3.21.2.6 shall be defined.	Eurocae WG49 to add this test in ED 73 (5.5.8.6) and to update the requirements (3.20.2.6) => see following item (S-50)

#	Do-181	ED-73	Comment	Proposal
S-50	2.54.6.2 p 194 Extended Squitter Verification Extended squitters occur randomly at rates determined by internal states of the transponder. Each Extended Squitter type must be separately verified for content, rate and antenna selection which are dependent upon transponder air/ground state and Extended Squitter ground station interrogations. The selection of airborne or surface position formats are dependent upon determination of on-the-ground status and ground station control via interrogation content. The following tests shall be performed to verify proper operation of the transponder Extended Squitter functions. The external data sources for Extended Squitter loading shall be connected via the appropriate interfaces. …	5.5.8.6 p 205 PROCEDURE #6 Squitter Verification (Paragraphs 3.20.2.6 and 3.21.2.6) The squitter transmissions function of transponders cannot be externally disabled. Squitters will occur randomly at approximately one-second intervals during all test procedures. As a result, squitter transmissions will be noted by the reply receiver and the test controller as unsolicited replies. Software or hardware provisions shall be made in the test setup so that squitter transmissions are recognized as such, and it should be noted that they occur in the specified random manner. The following is recommended: If an unsolicited reply is detected, the processor shall delay the next scheduled interrogation so that it doesn't overlap the squitter transmissions and remain undetected by the transponder. When squitter transmissions are detected, their content shall be verified observing the CA, AA and PI fields of the transmissions. For diversity transponders, it shall be verified that squitters are transmitted alternately from both channels. For tests of the squitter function, refer to paragraph 5.4.11.2.	Extended squitter to be discussed in EUROCAE	WG-49 : To reuse the procedure from DO181 2.5.4.6 (2.5.4.6.1 and 2.5.4.6.2) and add random transmission test in extended squitter procedure. SC209 to consider the add of random transmission test in extended squitter test procedure (2.5.4.6.2)
S-51	2.5.4.9 p 205 Procedure #9 Address Tests This test procedure verifies that the address set into the address interface of the transponder is only accepted during power-up or unit reset, that the accepted address set is actually the address to which the transponder responds, and that the accepted address is the only address which the transponder reports in DF=11. It is also verified that this accepted address pattern is used in generating the AP field of replies and that the transponder does reply only to this address.	5.5.8.9 p 207 PROCEDURE #9 Address Tests *5.5.8.9.1 Pattern Selection* Because more than 16 million addresses are possible, exhaustive testing is not practical. Address test patterns must be chosen so that the most likely failure modes (incorrect wiring of the interface connector, register malfunction, etc.) can be found. As a minimum the 276 address patterns consisting of two ONEs and 22 ZEROs (Pattern group A) and the 276 patterns having two ZEROs and 22 ONEs (Pattern group B) shall be used for verification.	To check why this pattern + if inputs bit to configure	WG-49 ED : take the DO text. And add that this test should be done with the two following address patterns AAAAAA and 555555. SC209 : To consider the same amendment (AAAAAA and 555555).

Page 16: [1] Comment [rhs14] **rhsaffel** **7/17/2007 2:56:00 PM**

I agree that DO-181D can be clarified to make it look like both specifications are saying the same. However, when interpreted as a whole, DO-181 does specify both minimum and maximum rise and fall times.
First, in section 2.2.4.1.4, it provides:
"2.2.4.1.4 ATCRBS Reply Pulse Shape

All reply pulses and SPI pulses shall be 0.45 +/- 0.10 microsecond duration and have rise times of from 0.05 to 0.1 microsecond and decay times of from 0.05 to 0.2 microsecond. The rise and decay time may be less, providing the sideband radiation is no greater than that which would be produced theoretically by a trapezoidal wave having the stated rise and decay time. The Mode S reply spectrum requirement of section 2.2.4.2.3.d is an acceptable specification for meeting ATCRBS minimum rise and fall time requirements.

The Pulse amplitude variation of one pulse, with respect to any other pulse in a reply train, shall not exceed 1 dB.

Note: *The above characteristics for ATCRBS reply pulse shapes are compatible with characteristics for Mode S reply pulse shapes (see section 2.2.4.2.3)."*

Then, DO-181D provides the Mode-S requirements as shown in 2.2.4.23 and stated above. As the pulse requirements for ATCRBS meet those of Mode-S, one is not going to design two different RF Power Amplifiers and Modulator stages, so to this individual, the requirements for Mode-S are intrinsic.

Page 16: [2] Comment [rhs15] **rhsaffel** **7/17/2007 3:34:00 PM**

All the way up through DO-181C, the measurement procedure required:

"Connect the equipment as shown in Figure 2-32. Set the transponder to the 7777 identification code. Interrogate the transponder with a Standard Mode S Surveillance Identity Interrogation and observe the spectral response of the reply."

This was a good test as it forced the "ID" field to all "ONES" which results in the transmitted pulse either rising or falling at each half of the bit time which also forces the transmitter to work the most.

Then, for some reason, DO-181D drops the requirement to set the 4096 code to "7777" which is an ERROR on the part of DO-181D and should be fixed.

ED-73B/C Sets the 4097 Code to "7777" and interrogates with a Mode-A interrogation in what is probably an attempt to check the ATCRBS spectrum. This test is valid and very close to what DO-181C attempted to do with an UF=5/DF=5 transaction cycle.

ED-73B/C then interrogates with a Mode-S All Call interrogation which is going to result in a DF=11 which cannot be guaranteed to be maximizing transmitter pulse activity since you cannot set the reply field to a maximum of all ZERO's or All ONE's since a Mode-S S Address of all Zero's or All One's is NOT Valid.

As the original DO-181C test maximizes leading edge / trailing edge pulse activity and provides more pulses than does the Mode-A reply of ED-73B/C, the DO-181C test should be maintained as it accurately tests the transmitter capability under both ATCRBS and Mode-S conditions. Actually Mode-S conditions which exceed the required ATCRBS conditions in this case.