



The European Organisation for Civil Aviation Equipment
L'Organisation Européenne pour l'Équipement de l'Aviation Civile

Minimum Operational Performance Standards for Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment

Change 1

DRAFT Version 1

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ED-73C, Change 1

MM DD, 20xx

Modifies EUROCAE ED-73C

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Foreword

1. This document, prepared jointly by EUROCAE Working Group 49 and RTCA SC-209, was accepted by the Council of EUROCAE in **MONTH 20xx**.
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3. The findings of EUROCAE are resolved after discussion among its members and in co-operation with RTCA Inc., Washington DC, USA and/or the Society of Automotive Engineers (SAE), Warrendale PA, USA through their appropriate committees.
4. This Change document modifies ED-73C "*Minimum Operational Performance Specification for Secondary Surveillance Radar Mode S Transponders*," published September 2008.
5. Where applicable, EUROCAE and RTCA documents reflect ICAO standards and documents providing more detail and including test procedures to support equipment implementation. ED-73C/DO-181D is consistent with Annex 10 Vol. IV and ICAO Doc 9871 "Technical Provisions for Mode S Services and Extended Squitter."
6. The Minimum Operation Performance Specifications are recommendations only. EUROCAE is not an official body of the European Governments therefore its recommendations are valid as statements of official policy only when adopted by a particular government or conference of governments.
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Executive Summary

The update to the *Minimum Operational Performance Specification for Secondary Surveillance Radar Mode S Transponders*, published by EUROCAE in December 2008 as EUROCAE ED-73C, is contained herein as **Change 1 to EUROCAE ED-73C**, and has been produced to reflect changes that have resulted in requirements for airborne transponder equipment.

This **Change 1 to EUROCAE ED-73C** xxxxxxxxxxxxxxxxxxxxxxxx.

With the publication of this document as “**Change 1 to ED-73C**” several changes are being made to EUROCAE ED-73C, that are identified as necessary since the time of the publication of ED-73C. These changes include, but are not limited to:

1. Clarification;
2. Additional;
3. Changes; and
4. Other changes related to correcting additional typographical and paragraph reference errors.

Since the publication of ED-73C in December 2008, ICAO has also been in the process of updating the ICAO SARPs to include those requirements identified in ED-73C.

XX

Change 1 to EUROCAE ED-73C

Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment

This Change document prescribes the Minimum Performance Standards (MPS) for airborne transponder equipment, modified as described in this document. The applicable standards basis for those changes requested in this document is EUROCAE ED-73C, “*Minimum Operational Performance Specification for Secondary Surveillance Radar Mode S Transponders*,” issued December, 2008.

Change 1 to ED-73C will use change numbers such as (1.1) through (1.xxx), in this document to describe specific changes made to EUROCAE ED-73C.

In the following requested changes, for those items where existing text is requested to change, the new text is underlined and highlighted in blue, and deleted text is presented in ~~strikethrough and red text~~. In those changes where a totally new section or text is inserted, all the text is presented in underline and highlighted in blue. Some simple typographical changes have been represented with text highlighted in **yellow**.

- (1.1) In EUROCAE ED-73C, in section §3.14.2, replace the contents of subparagraph “a” with the following edited text:
- a. A squitter monitor **shall** be provided to verify that the Mode S transponder generates short and Extended Squitters correctly (e.g., low power, corrupt data) and at their nominal rates (see §3.22.2.6 and §3.28). Event Driven Squitter rates are not required to be monitored to meet this requirement.
- (1.2) In EUROCAE ED-73C, in section §3.18.4.5, in order to comply with the ICAO SARPs changes to provide ground control of aircraft to the “on-the-ground” status, primarily for aircraft without a squat switch, revise the last paragraph below the “CA” code definitions as follows:

When the conditions for CA code 7 are not satisfied, aircraft with Level 2 or above transponders in installations that 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 when on-the-ground, and 5 when airborne. Aircraft with, or without, automatic on-the-ground determination shall use CA=4 when commanded to set and report the “on-the-ground” status via the TCS subfield (§3.28.7). Data link capability reports (see §3.23.1.12.e) **shall** be available from aircraft installations that set CA codes 4, 5, 6 or 7.
→ Whether or not this change stays depends on discussions during the Paris TSG ←

- (1.3) In EUROCAE ED-73C, in section §3.22.2.7, as specified in TSG Working Paper TSG09-03, for bullet “c” make the following revisions in order to comply with the ICAO SARPs changes to provide ground control of aircraft to the “on-the-ground” status, primarily for aircraft without a squat switch:

c. Validation of declared on-the-ground status

NOTE 1: *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.*

For Aircraft with an automatic means for determining the on-the-ground condition, transponders that have access to at least one of the following parameters (ground speed, radio altitude, airspeed) **shall** perform the following validation check:

If the automatically determined air/ground condition is not available, or is “airborne,” and the transponder is reporting the airborne type of Extended Squitter, no validation **shall** be performed.

If the automatically determined air/ground condition is available, and the “on-the-ground” condition is being reported, or the transponder has been commanded to report the surface type Extended Squitter and inhibit replies to ATCRBS and Mode S All-Call interrogations via the TCS subfield (§3.28.7), then the air/ground condition shall be overridden and changed to “airborne” and the TCS command to report the surface format and inhibit replies to ATCRBS and Mode S All-Call interrogations shall be terminated, if:

Ground Speed > 100 knots OR Airspeed > 100 knots OR Radio Altitude > 50 feet

NOTE 2: *For Extended Squitter installations, the on-the-ground validation is optional for Aircraft reporting ADS-B Emitter Category Set “A” codes 0, 1 or 7 as defined in the latest version of EUROCAE ED-102A [RTCA DO-260B], §2.2.3.2.1.2.*

NOTE 3: *Modern aircraft with integrated avionics suites commonly contain sophisticated algorithms for determining the air/ground state based on multiple aircraft sensors. These algorithms are customized to the airframe and designed to overcome individual sensor failures. These algorithms are an acceptable means to determine the air/ground state and do not require additional validation. → The content of this note is open for discussion ←*

(1.4) In EUROCAE ED-73C, in section §3.23.1, replace the contents of bullets “a,” “b,” and “c” with the following edited text:

- a. Process uplink and downlink formats [DF=16](#), UF=DF=~~16~~, 20 and 21 (Figure 2-14). The formats UF=~~DF~~=16 ~~are~~ [is](#) optional:
- b. Receive broadcast transmissions from sensors (§3.23.1.11).
- c. Follow the protocols for:
 - Comm-A (see §3.23.1.10).
 - Comm-B (see §3.23.1.12).
 - Comm-U/V (air-air) (see §3.23.1.16) ~~(optional)~~.
 - Multisite message operation (see §3.23.2).
 - Report Codes 4 through 7 in the CA field (see §3.18.4.5).
 - [ACAS crosslink capability \(see §3.23.1.18\)](#).

(1.5) In EUROCAE ED-73C, in section §3.23.1.11, in the first sentence of the paragraph, in order to correct a bad reference:

Change §3.23.1.1 to §3.23.1

(1.6) In EUROCAE ED-73C, in section §3.23.1.18, in order to correct a bad paragraph reference, and also make revisions related to the GICB revisions discussed in Working Paper TSG WP08-02R1, revise the paragraph as follows:

In response to a UF=0 with RL=1 (see §3.18.4.31) and DS≠0 (see §3.18.4.11), the transponder **shall** reply with a DF=16 reply in which the MV field **shall** contain the contents of the ground-initiated Comm-B register designated by the DS value. [If the requested Register is not supported by the aircraft installation, then the transponder shall reply with an MV field containing ALL ZEROS.](#) In response to a UF=0 with RL=1 and DS=0, the transponder **shall** reply with a DF=16 with an MV field of ALL ZEROS. Receipt of a UF=0 with DS≠0, but RL=0 **shall** have no associated TCAS crosslink action, [and the transponder shall reply per §3.18.4.31.](#)

(1.7) In EUROCAE ED-73C, in section §3.28.2, replace bullets “e” through “i” with the following in order to define the Target Status and Status, and the Aircraft Operational Status Messages as Periodic Status Messages and not included any further as “Event-Driven” Messages.

[e. Target State and Status Message. The Target State and Status Extended Squitter shall use format DF=17 with the contents of GICB Register 62₁₆ inserted in the ME field.](#)

[NOTE: A GICB request \(see §3.23.1.12\) containing RR=22 \(16 HEX\), DI=7 and RRS=2 will cause the resulting reply to contain the Target State and Status report in its MB field.](#)

f. Aircraft Operational Status Message. The Aircraft Operational Status Extended Squitter **shall** use format DF=17 with the contents of GICB Register 65₁₆ inserted in the ME field.

NOTE: A GICB request (see §3.23.1.12) containing RR=22 (16 HEX), DI=7 and RRS=5 will cause the resulting reply to contain the Aircraft Operational Status report in its MB field.

g. Event-driven Squitter. The event-driven Extended Squitter type **shall** use format DF=17 with the contents of GICB Register 0A₁₆ inserted in the ME field.

NOTE: A GICB request (see §3.23.1.12) containing RR=16, DI=7 and RRS=0A will cause the resulting reply to contain the event-driven report in its MB field.

- (1.8) In EUROCAE ED-73C, in section §3.28.3, in order to harmonize this section with the requirements specified in RTCA DO-181D, §2.2.23.1.3, replace the first paragraph with the following:

At power up initialization, the transponder shall commence operation in a mode in which it broadcasts only acquisition squitters (Paragraph 3.22.2.6). The transponder shall initiate the broadcast of extended squitters for airborne position, surface position, airborne velocity and aircraft identification when data are inserted into GICB registers 05, 06, 09 and 08 {HEX} respectively. This determination shall be made individually for each squitter type. The insertion of altitude data into register 05 by the transponder (Paragraph 3.28.8) shall not satisfy the minimum requirement for initialisation of broadcast of the airborne position squitter.

NOTE 1: This suppresses the transmission of Extended Squitters from aircraft that are unable to report position, velocity or identity information.

If input to Register 05₁₆ and 06₁₆ stops for 60 seconds, broadcast of that Extended Squitter type will be discontinued until data insertion is resumed. The insertion of altitude by the transponder shall satisfy the minimum requirement for continuing to broadcast the airborne position squitter. After timeout (see §3.28.4), this squitter type may contain an ME field of ALL ZEROs.

NOTE 2: Continued transmission for 60 seconds is required so that receiving aircraft will know that the data source for the message has been lost.

When extended squitters are broadcast, transmission rates shall be as indicated in the following paragraphs. Acquisition squitters shall be reported in addition to extended squitters unless the acquisition squitter is inhibited (Paragraph 3.22.2.6). Acquisition squitters shall always be reported if extended position or velocity squitters are not reported.

- (1.9) In EUROCAE ED-73C, in section §3.28.3, in order to comply with the changes in transmission rates made in RTCA DO-260B/EUROCAE ED-102A for Periodic Status and Event-Driven Messages, replace the existing second paragraph and the initial Note 1 and 2 with the following:

The maximum rate for the total number of extended squitter messages transmitted by the transponder shall not exceed 6.2 messages per second averaged over any 60 second interval.

NOTE 13: *Transponders are limited to no more than 2 Event Driven messages per second. Therefore, the average of 2 Airborne Position, 2 Airborne Velocity, 0.2 Identification, and 2 Periodic Status and Event Driven messages per second, averaged over any 60 second interval, yields ~~a maximum of the required~~ 6.2 messages per second.*

NOTE 24: *The transmission of extended squitters from aircraft that are unable to report position, velocity or identity is suppressed.*

- (1.10) In EUROCAE ED-73C, in section §2.2.23.1.3, in order to establish transmission rates for the Periodic Status Messages, delete existing bullets “f,” “g,” “h,” and “i.” Insert new bullets “e” and “f” to define the Target State and Status, and the Aircraft Operational Status squitters, which are not included any further as “Event-Driven” squitters. Re-label and edit the old bullet “e” to become new bullet “g” as shown below, and re-label the old bullet “j” (Delayed Transmission) to become new bullet “h.” In existing bullets “a,” “b,” “c,” and “d” at the end of each subparagraph, change the reference for subparagraph “j” to subparagraph “h.”

e. Target State and Status Squitter Rate. The Target State and Status squitter shall be initiated only when the aircraft is airborne and when target state information is available and valid as a minimum. The Target State and Status squitter shall be transmitted at random intervals that are uniformly distributed over the range of 1.2 to 1.3 seconds relative to the previous Target State and Status squitter for as long as valid data is available, with the exceptions as specified in subparagraph “h.”

f. Aircraft Operational Status Squitter Rate. The Aircraft Operational Status squitter shall be transmitted at the rates as specified in §2.2.3.3.1.4.2 of RTCA DO-260B/EUROCAE ED-102A, with the exceptions as specified in subparagraph “h.”

g. Event-driven Squitter Rate. The event-driven squitter shall be transmitted once, each time that GICB register 0A {HEX} is loaded, while observing the delay conditions specified in subparagraph ~~f~~ h. The maximum transmission rate for the event-driven squitter shall be limited by the transponder to twice per second. If a message is inserted in the event-driven register and cannot be transmitted due to rate limiting, it shall be held and transmitted when the rate limiting condition has cleared. If a new message is received before transmission is permitted, it shall overwrite the earlier message.

NOTE: *The squitter transmission rate and the duration of squitter transmissions is application dependent. Choices made should be the minimum rate and duration consistent with the needs of the application.*

- (1.11) In EUROCAE ED-73C, in section §3.28.4, in order to clarify the termination of squittering, replace the entire section with the following edited section:

The transponder **shall** clear all 56-bits of the airborne position, and surface position, ~~squitter status and velocity~~ GICB Registers 05₁₆, and 06₁₆, ~~07₁₆ and 09₁₆~~ if these registers are not updated with data received external to the transponder within two seconds of the previous update. This timeout **shall** be determined separately for each of these registers. The internal insertion of data by the transponder into these registers (altitude and surveillance status) shall not qualify as a register update for the purposes of this timeout condition.

The transponder shall clear all 56-bits of the velocity squitter, GICB Register 09₁₆ if input data necessary to update the subfields of the velocity squitter, other than the Intent Change Flag, is not available for a period of 2.6 seconds.

NOTE 1: *These registers are cleared to prevent the reporting of outdated position, velocity and squitter rate information.*

~~**NOTE 2:** *The internal insertion of data by the transponder into these registers (e.g. altitude and surveillance status) does not qualify it as a register update for the purposes of this timeout condition.*~~

NOTE 3 2: *The Identification Register 08₁₆, is not cleared since it contains data that rarely changes in flight and less frequently updated. The event-driven Register, 0A₁₆ does not need to be cleared since its contents are only used once each time that the register is loaded.*

Transponder data insertion and squitter transmission **shall not** be affected by a register timeout event, except as specified in §3.28.3. → **Need to talk about this** ←

NOTE 3: *During a register timeout event, the ME field of the Extended Squitter may contain all zeroes, except for any data inserted by the transponder.*

- (1.12) In EUROCAE ED-73C, in section §3.28.7, as specified in TSG Working Paper TSG09-03, in order to comply with the ICAO SARPs changes to provide ground control of aircraft to the “on-the-ground” status, primarily for aircraft without a squat switch, make revisions to the TCS paragraph and TCS coding description table as follows:

The SD field contains the following information if the DI code is 2:

TCS, the 3-bit (bits 21 – 23) Type Control Subfield in SD **shall** control the position type reported by the transponder and its response to ATCRBS and Mode S All-Call interrogations. These commands **shall** only affect the format type reported, they **shall not** change the aircraft determination of its on-the-ground condition. The commands for codes 1 and 2 **shall** be able to refreshed for a new period before timeout of the prior period.

NOTE 1: Thus aircraft without the means to set the on-the-ground condition will continue to report code 6 in the CA field, and an aircraft with the means to set the on-the-ground condition that has determined that it is in the airborne state will continue to set code 5, independent of the Extended Squitter format that is emitted.

The following TCS codes have been assigned:

TCS Codes	Description
0	No position type command
1	Use surface position type and inhibit replies to ATCRBS and Mode S ALL-Call interrogations for the next 15 seconds
2	Use surface position type and inhibit replies to ATCRBS and Mode S ALL-Call interrogations for the next 60 seconds
3	Cancel surface type command
4 – 7	Not assigned

(1.13) In EUROCAE ED-73C, in section §3.29.3.2.2, in order to account for the changes that are being made in the ADS-B MOPS (RTCA DO-260B/EUROCAE ED-102A) and subsequent equivalent changes in ICAO Doc 9871, Edition 2, the Mode S Subnetwork Version Number will have to change accordingly. Replace Table 3-2 with the following:

➔ THIS ISSUE IS TO BE DISCUSSED AND THIS CHANGE MAY BE REVISED ◀

Version Number	Year of ICAO Annex 10 Amendment	Edition of ICAO Doc 9871	Comment
0	Mode S Subnetwork Not Available		
1	1996	-----	
2	1997	-----	
3	2002	-----	Annex 10, Amendment 77
4	2007	Edition 1	Annex 10, Amendment 82
5	2013	Edition 2	Annex 10, Amendment 86
6 -127	Not Assigned		

(1.14) In EUROCAE ED-73C, there are numerous occasions where the phrase “Minimum Update Interval” has been incorrectly used, and where the phrase “Maximum Update Interval” should have been used instead. In the requirements description at some of these locations, reference has also been made to the Register Allocation Table in Appendix B, which is incorrectly referenced as Table B-1, and should have been referenced as Table B-2-1. In each of the following paragraph references, updates must be made to **change** “Minimum Update Interval” **into** “Maximum Update Interval, and, if necessary, **change** Table B-1 **into** Table B-2-1.

§3.29.3.3	§3.30.1.3	§3.30.6.3	§5.7.1.3
§3.29.5.3	§3.30.2.2.7	§3.30.7.3	§5.7.2.2.7
§3.29.6.3	§3.30.3.3	§3.30.8.3	§5.7.3.3
§3.29.7.3	§3.30.5.3	§3.31.3	§5.8.3

- (1.15) In EUROCAE ED-73C, in section §3.29.6.2.1, in order to resolve the coordination of documents with regard to the issue of timeout issues related to Registers 08₁₆ and 20₁₆ initially raised by Kevin Wilson of Honeywell and discussed in Working Paper SC209-WP10-04 by Bob Saffell of Rockwell Collins, insert the following *Note* after the initial introductory sentence and prior to bullet “a”:

NOTE: Aircraft Registration Data may also be used in Register 08₁₆ when Extended Squitter is implemented. As such, the Data Selection requirements inferred below will also apply to Register 08₁₆ when Extended Squitter is implemented.

- (1.16) In EUROCAE ED-73C, in section §3.29.6.2.1.b, to correct a minor typographical error, in the *Note* following subparagraph “b”:

Replace “(Data Link Capability Report)” **with** “(Data Link Capability Report)”

- (1.17) In EUROCAE ED-73C, in section §3.29.6.2.1.c, in order to resolve the coordination of documents with regard to the issue of timeout issues related to Registers 08₁₆ and 20₁₆ initially raised by Kevin Wilson of Honeywell and discussed in Working Paper SC209-WP10-04 by Bob Saffell of Rockwell Collins, insert the following *Note* after bullet “c”:

NOTE: Register 08₁₆ is not cleared when Extended Squitter is implemented since this Register is used to provide Flight Identification information for the ADS-B environment.

- (1.18) In EUROCAE ED-73C, in section §3.29.6.4.2, in order to correct a cut-and-paste error in a bit reference, replace the only sentence in the section with the following correction:

“Correct servicing of the character fields of Register 20₁₆ **shall** be reported in Register 17₁₆ via bit ~~33~~ 7 as defined in §3.29.4.2.1.”

- (1.19) In EUROCAE ED-73C, in section §3.31.3, in order to correct references to the “maximum update interval” as detailed in Appendix B, Table B-2-1, and to also correct the specific references to the actual Table in Appendix B, make the changes identified below in **yellow** to replace the word “minimum” with the word “maximum,” and replace the Table reference with “Table B-2-1” as described below:

- a. The **maximum** update interval at which a data field in a Register will be reloaded with valid data is defined for each register in **Table B-2-1** in Appendix B.
- b. The transponder will load valid data into the related transponder Register as soon as it becomes available at the Mode S Specific Services entity.

- c. The time between availability of data that causes a change in a data-field of a Register and the time that the change is made to the Register will be less than the **maximum** update interval specified in **Table B-2-1** in Appendix B.
- d. If a data-field field cannot be updated with valid data within twice the specified **maximum** update interval defined for the Register, or 2 seconds (whichever is the greater), then the Status Bit (if specified) of the field will be set to ZERO (0) (INVALID) and that data field will be ZEROed.

(1.20) In EUROCAE ED-73C, in section §5.5.8.6.2.2, replace the second paragraph with the following:

Verify the content of the CA, AA and PI fields of all Extended Squitter replies. For the following test, connect the transponder to the appropriate source that provides altitude code input to the transponder. Also, as required, setup to provide Extended Squitter data to ground initiated Comm-B Registers 05₁₆, 06₁₆, 07₁₆, 08₁₆, 09₁₆ , ~~and~~ 0A₁₆ , ~~62₁₆ and 65₁₆~~ through an external interface as specified in §2.2.13.2.

(1.21) In EUROCAE ED-73C, in section §5.5.8.6.2.2, in bullet “c,” STEP 3, make the following changes in the first three lines of the test procedure:

- c. STEP 3 - Provide Extended Squitter updates to the transponder at a ~~rate~~ maximum update interval as specified in Appendix B, Table B-2-1. Include updates to GICB Registers 05₁₆, 06₁₆, 07₁₆, 08₁₆ ~~and~~ 09₁₆, ~~62₁₆ and 65₁₆~~.

(1.22) In EUROCAE ED-73C, in section §5.5.8.6.2.2, in bullet “d,” STEP 4, first paragraph, make the following changes:

- d. STEP 4 - Set up the transponder as in STEP 3 with Extended Squitter updates to the transponder at a ~~rate~~ maximum update interval as specified in Appendix B, Table B-2-1. Place the transponder in the airborne state. Stop updates of all Extended Squitter data, except altitude information, to the transponder for GICB Registers 05₁₆, 06₁₆, 07₁₆, 08₁₆, ~~and~~ 09₁₆, ~~62₁₆ and 65₁₆~~. Verify that after 2 seconds, ~~all subsequent the~~ Extended Squitter ME fields ~~for~~ (GICB Registers 07₁₆, ~~and~~ 09₁₆) ~~62₁₆ and 65₁₆~~ are ZERO with the exception of the ACS field in the airborne position squitter (GICB Register 05₁₆) and the airborne identification squitter (GICB Register 08₁₆). Verify that after 2.6 seconds the airborne velocity squitter is not being transmitted. Place the transponder in the ground state and verify that the surface position Extended Squitter ME field (GICB Register 06₁₆) is ZERO. Repeat the setup as in STEP 3 with Extended Squitter updates to the transponder at a one half second rate. Place the transponder in the airborne state. Interrogate the transponder with RR=17 and DI=7 and verify that the SCS subfield of the data link capability report is one. After all updates (except altitude information) have ceased for 10 seconds, interrogate to extract the data link capability report and verify that the SCS subfield is ZERO. Interrogate the transponder with ground initiated Comm-B requests with RR=16, DI=7 and RRS=5, 6, 7, 8 and 9 respectively. Verify that the MB fields are ZERO with the exception of the ACS field in the airborne position squitter (GICB Register 05₁₆) and the airborne identification squitter (GICB Register

08₁₆). After all updates (except altitude information) have ceased for 60 seconds, verify that airborne identification ~~and airborne velocity~~ Extended Squitters are no longer transmitted. Place the transponder in the ground state and verify that the surface position Extended Squitter (GICB Register 06₁₆) is no longer transmitted. Return the transponder to the airborne state. Verify that the acquisition squitter and airborne position squitter are broadcast. Set the ALT switch to the "off" position. Verify that the ME field of the airborne position squitter is ZERO. After 60 seconds, verify that the transponder no longer broadcasts airborne position squitters.

(1.23) In EUROCAE ED-73C, in section §5.5.8.6.2.2, in bullet "e," STEP 5, make the following changes in the first three lines of the test procedure:

- e. STEP 5 - Set the ALT switch to the "on" position and provide altitude code input to the transponder. Provide Extended Squitter updates to the transponder at a ~~rate~~ maximum update interval as specified in Appendix B, Table B-2-1.

(1.24) In EUROCAE ED-73C, in section §5.5.8.6.2.2, in bullet "f," STEP 6, make the following changes:

- f. STEP 6 -Set the ALT switch to the "on" position and provide altitude code input to the transponder. Provide Extended Squitter updates to the transponder at a ~~rate~~ maximum update interval as specified in Appendix B, Table B-2-1. Include updates to GICB Registers 05₁₆, 06₁₆, 07₁₆, 08₁₆ and 09₁₆. Verify that the ME fields of the airborne position, velocity and aircraft identification squitters match the data input. Stop updates of Extended Squitter data to the transponder for GICB Registers 08₁₆ and 09₁₆ only. After 2.6 seconds, verify that the ~~ME field of the~~ airborne velocity squitter is ~~ZERO~~ no longer transmitted. Interrogate with RR=16, DI=7 and RRS=5, 6, 8 and 9 and verify that the MB fields match the ME fields in the corresponding Extended Squitter reply. After 10 seconds, interrogate to extract the data link capability report and verify that SCS is one. After 60 seconds, verify that airborne position reports are still transmitted and that aircraft identification and airborne velocity squitters are not transmitted.

(1.25) In EUROCAE ED-73C, in section §5.5.8.6.2.2, in bullet "g," STEP 7, make the following changes:

- g. STEP 7 - Configure the transponder to inhibit Acquisition squitters when Extended Squitters are broadcast. Prior to providing Extended Squitter updates, verify that Acquisition squitters are broadcast. Provide Extended Squitter updates at a ~~rate~~ maximum update interval as specified in Appendix B, Table B-2-1 to GICB Registers 05₁₆, 06₁₆ and 08₁₆ and provide altitude code input to the transponder. Verify that Extended Squitters are broadcast and Acquisition squitters are not broadcast. Verify that airborne position and aircraft identification squitters are broadcast at the proper rate and alternately on the top and bottom antenna ports as specified for airborne state if antenna diversity is supported. Additionally provide updates to GICB Register 09₁₆. Verify the broadcast of airborne position squitters, aircraft identification squitters and airborne velocity squitters at the proper rate and the ME

data content matches the data stored in GICB Registers 05₁₆, 08₁₆ and 09₁₆, respectively. Verify that the transponder does not broadcast Acquisition squitters.

Set the ALT switch to the “off” position and stop update to GICB Registers 05₁₆, 06₁₆, 08₁₆ and 09₁₆. After 2 seconds, verify that the ME fields of the airborne position ~~and airborne velocity~~ squitters ~~are~~ is ZERO. After 2.6 seconds, verify that the airborne velocity squitter is no longer transmitted. Interrogate with UF=4, RR=16, DI=7 and RRS=5, 6, 8 and 9, respectively. Verify that the MB fields of the replies match the data of the corresponding Extended Squitter reply. After 60 seconds, verify that Extended Squitter airborne position squitter transmissions stop and the transponder resumes Acquisition squitter broadcast.

Repeat above sequence except stop update to GICB Registers 05₁₆ and 06₁₆ only. After 2 seconds, verify that the ME field of the airborne position report is ZERO. After 60 seconds, verify that the transponder no longer broadcasts airborne position squitters and continues to broadcast airborne velocity and aircraft identification squitters. Verify that the transponder continues to inhibit the broadcast of Acquisition squitters.

Repeat above except stop update to GICB Register 09₁₆ only. After 2.6 seconds, ~~Again,~~ verify that ~~after 2 seconds the ME field of~~ the airborne velocity squitter is ZERO no longer transmitted, and after 60 seconds, ~~both airborne velocity and~~ verify that the Acquisition squitters are not transmitted.

(1.26) In EUROCAE ED-73C, in section §2.5.4.6.2.2, in bullet “h,” STEP 8, make the following changes:

- h. STEP 8 - Provide data to the transponder to trigger data to be loaded into GICB Register 0A₁₆. Verify that an Event-Driven Extended Squitter is generated with the proper data content. ~~Repeat for all supported Event-Driven Extended Squitter Message types.~~ Event-Driven Extended Squitter Messages include BDS 6,1, ~~BDS 6,2 and BDS 6,5~~; the Extended Squitter Aircraft Status, ~~the Target State and Status, and the Aircraft Operational Status Messages, respectively.~~ Verify that the data contained in the GICB Register corresponding to the Event-Driven Extended Squitter Message type matches the data contained in the transmitted Extended Squitter. Update GICB Register 0A₁₆ at a rate less than twice every second. Verify that an Event-Driven Extended Squitter is generated subsequent to each update with the proper data content. Vary the data content provided externally to the transponder and verify that the data content subsequent to update of the Event-Driven report is correct. Increase the update rate to exceed twice per second. Verify that the Event-Driven Extended Squitter rate does not exceed twice per second, and that the data content reflects the most recent update contents.

For the following steps, for those transponders that support automatic detection of on-the-ground status, change the transponder to on-the-ground status. Configure the transponder to not inhibit Acquisition squitters when Extended Squitters are broadcast.

- (1.27) In EUROCAE ED-73C, in section §3.27.1.2.b.(2) in order to correct a statement concerning bit 48 which was not updated during the revision of the document to “C” level, replace the third paragraph below §3.27.1.2.b.(2) with the following:

When Bit 48 is set to ONE ~~and Bit 71 is set to ONE~~ the ACAS unit is operational ~~using the formats for ACAS~~ and the transponder is receiving ACAS RI=2, 3 or 4.

- (1.28) In EUROCAE ED-73C, in section §5.5.8.6.2.2, in bullet “j,” STEP 10, make the following changes in the initial lead-in paragraph:

j. STEP 10 - Provide Extended Squitter updates to the transponder at a rate as specified in Appendix B, Table B-2-1. Include updates to GICB Registers 05₁₆, 06₁₆, 08₁₆ ~~and~~ 09₁₆ , 62₁₆ and 65₁₆. Use other than ZERO or all ONES for the surface position report and the aircraft identification report. Set TRS to ZERO. For transponders that support automatic on-the-ground detection, perform the following:

- (1.29) In EUROCAE ED-73C, in section §5.8.4, in bullets “a” and “b,” in order to correct a problem with Table references in Appendix B, make the following changes identified below in **yellow**:

- a. Verify that the servicing of Register **XX**₁₆ during the power-on cycle of the transponder is properly reported in Registers 18₁₆ through 1C₁₆ as required in Appendix B, **Table B-3-24 to Table B-3-28**.
- b. Verify that the real-time (not just since power-on) servicing of Register **XX**₁₆ is properly reported in Register 17₁₆ (see Appendix B, **Table B-3-23**) if such reporting is required for Register **XX**₁₆.

- (1.30) In EUROCAE ED-73C, in Appendix A, section §A.1, add the following acronyms:

QFE – Aviation “Q” Code for “Field Elevation”
QNE – Aviation “Q” Code for “Nautical Height” for Enroute
QNH – Aviation “Q” Code for “Nautical Height”

(1.31) In EUROCAE ED-73C, in Appendix A, section §A.2, edit and add the following definitions:

Event-Driven – Messages that are broadcast periodically for a duration of the operational condition. Examples of Event-Driven Messages include the [Extended Squitter Aircraft Status Message with the Emergency/Priority Status and TCAS RA Broadcast subtypes](#), ~~Operational Status and Target State and Status Messages~~ (ref. RTCA/DO-260A/B/EUROCAE ED-102A).

Periodic Status – Status Messages that are broadcast independently in the same manner as the Airborne Position, Surface Position, Airborne Velocity and Aircraft Identification Messages. Examples of Periodic Status Messages include the Target State and Status and the Aircraft Operational Status (ref. RTCA DO-260B/EUROCAE ED-102A).

QFE – Local station barometric pressure setting which provides an altimeter reading of indicated altitude of the airplane above the station, whether airborne or on the ground.

QNE – The barometric pressure used for the standard altimeter setting (29.92 inches Hg).

QNH – Local station barometric pressure setting which provides an altimeter reading of indicated altitude of the airplane above mean sea level, whether airborne or on the ground.

(1.32) In EUROCAE ED-73C in Appendix B, there are several references to ICAO Doc 9871, Edition 1. There are specific paragraph references to guidance materials in Doc 9871, Edition 1, Appendix C, which will change to Appendix D in Doc 9871, Edition 2. In the titles of the following subparagraphs in Appendix B, make the specified changes to the paragraph reference in ICAO Doc 9871, Edition 2:

In the title of §B.4.1 **change** §C.2.4.1 to §D.2.4.1
In the title of §B.4.2 **change** §C.2.4.2 to §D.2.4.2
In the title of §B.4.3 **change** §C.2.4.3 to §D.2.4.3
In the title of §B.4.4 **change** §C.2.4.4 to §D.2.4.4
In the title of §B.4.5 **change** §C.2.4.5 to §D.2.4.5
In the title of §B.4.6 **change** §C.2.4.6 to §D.2.4.6

- (1.33) In EUROCAE ED-73C, in section §B.3 just prior to Table B-3-7 there is an un-numbered table containing references to “ADS-B Registers.” Because of the changes in RTCA DO-260B and EUROCAE ED-102A defining the ADS-B Periodic Status Messages and removing them from being broadcast by the Event-Driven protocol, edit the text, the un-numbered table and the Note just prior to Table B-3-7 as follows:

For additional information on the following ADS-B Registers, please reference RTCA/DO-260A [B/EUROCAE ED-102A](#):

Table B-3-5	BDS Code 0,5	Extended Squitter Airborne Position
Table B-3-6	BDS Code 0,6	Extended Squitter Surface Position
Table B-3-7	BDS Code 0,7	Extended Squitter Status (see Note)
Table B-3-8	BDS Code 0,8	Extended Squitter Aircraft Identification and Category
Table B-3-9a	BDS Code 0,9	Extended Squitter Airborne Velocity (Subtypes 1 and 2 – Velocity Over Ground)
Table B-3-9b	BDS Code 0,9	Extended Squitter Airborne Velocity (Subtypes 3 and 4 – Airspeed and Heading)
Table B-3-10	BDS Code 0,A	Extended Squitter Event-Driven Information
Table B-3-97-1	BDS Code 6,1	Extended Squitter Aircraft Status (see Note) (Subtype =1 – Emergency/Priority Status)
Table B-3-97-2	BDS Code 6,1	Extended Squitter Aircraft Status (see Note) (Subtype=2 – TCAS RA Broadcast)
Table B-3-98	BDS Code 6,2	Target State and Status
Table B-3-101	BDS Code 6,5	Extended Squitter Aircraft Operational Status

Note: *The 1090 Extended Squitter Status Registers are actually provided in this section since they are not squittered and intended to be accessed through GICB protocols.*

- (1.34) In EUROCAE ED-73C, in section §B.2.1, in order to resolve the coordination of documents with regard to the issue of timeout issues related to Registers 08₁₆ and 20₁₆ initially raised by Kevin Wilson of Honeywell and discussed in Working Paper SC209-WP10-04 by Bob Saffell of Rockwell Collins, add the following Note directly after the first paragraph in section §B.2.1, prior to Table B-2-1:

NOTE: *If Extended Squitter is implemented, then Register 08₁₆ is not be cleared or ZEROed once either Flight Identification or Aircraft Registration data has been loaded into the Register during the current power-on cycle. Register 08₁₆ is not cleared since it provides information that is fundamental to track file management in the ADS-B environment.*

- (1.35) In EUROCAE ED-73C, in section §B.3, Table B-3-16 describes the format for Register 10₁₆. In order to account for the changes that were made in the ADS-B MOPS (RTCA DO-260B/EUROCAE ED-102A) and subsequent corresponding changes being proposed in ICAO Doc 9871, Edition 2, the following additional reference should be added in Note #1 of Table B-3-16:

- 1) Annex 10 Volume IV, §3.1.2.6.10.2 [and §4.3.8.4.2.2.2](#).

(1.36) In EUROCAE ED-73C, in section §B.3, Table B-3-16 describes the format for Register 10₁₆. In order to account for the changes that are being made in the ADS-B MOPS (RTCA DO-260B/EUROCAE ED-102A) and subsequent corresponding changes in ICAO Doc 9871, Edition 2, RTCA DO-181D and EUROCAE ED-73C, the Mode S Subnetwork Version Number will have to change accordingly. Replace the description of the Mode S Subnetwork Version Number field, Bits 17 through 23, in Table B-3-16 with the following:

➔ THIS ISSUE IS TO BE DISCUSSED AND THIS CHANGE MAY BE REVISED ◀

Version Number	Annex 10 amendment (Year and Edition)		RTCA	EUROCAE
0	Mode-S subnetwork not available			
1	1996	---		
2	1998	---		
3	2002	---		
4	2007	Doc 9871, Edition 1	DO-181D	ED-73C
<u>5</u>	<u>2013</u>	<u>Doc 9871, Edition 2</u>	<u>DO-181D Change 1</u>	<u>ED-73C Change 1</u>
<u>6</u> - 127	Unassigned			

(1.37) In EUROCAE ED-73C, in section §B.3, Table B-3-23, in order to harmonize the naming of the Extended Squitter Identification and Category Message across all documents, in the definition table for Register 17₁₆, make the following changes for bit #4:

0,8 Extended Squitter ~~Type and~~ Identification and Category

(1.38) In EUROCAE ED-73C, in section §B.3, Table B-3-48, Note 1 has an incorrect reference:

In Note 1 of Table B-3-48 **replace** §2.2.22.1.2.1.3 **with** §2.2.22.1.2.1

(1.39) In EUROCAE ED-73C, in section §B.3, Table B-3-97-1 it is necessary to reflect the addition of the Mode A Code to the format for the Aircraft Status Message for Subtype=1 broadcasting the Emergency/Priority status and the Mode A Code. Replace Table B-3-97-1 with:

1	MSB	FORMAT TYPE CODE = 28	PURPOSE: To provide additional information on aircraft status. Subtype shall be coded as follows: 0 = No information 1 = Emergency/priority status and Mode A Code 2 = TCAS RA Broadcast 3 to 7 = Reserved																		
2																					
3																					
4																					
5	LSB	SUBTYPE CODE = 1																			
6	MSB																				
7																					
8	LSB																				
9	MSB	EMERGENCY STATE	Emergency state shall be coded as follows: <table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>No emergency</td> </tr> <tr> <td>1</td> <td>General emergency</td> </tr> <tr> <td>2</td> <td>Lifeguard/Medical</td> </tr> <tr> <td>3</td> <td>Minimum fuel</td> </tr> <tr> <td>4</td> <td>No communications</td> </tr> <tr> <td>5</td> <td>Unlawful interference</td> </tr> <tr> <td>6</td> <td>Downed aircraft</td> </tr> <tr> <td>7</td> <td>Reserved</td> </tr> </tbody> </table>	Value	Meaning	0	No emergency	1	General emergency	2	Lifeguard/Medical	3	Minimum fuel	4	No communications	5	Unlawful interference	6	Downed aircraft	7	Reserved
Value	Meaning																				
0	No emergency																				
1	General emergency																				
2	Lifeguard/Medical																				
3	Minimum fuel																				
4	No communications																				
5	Unlawful interference																				
6	Downed aircraft																				
7	Reserved																				
10																					
11	LSB																				
12	MSB																				
13																					
14																					
15																					
16																					
17		MODE A (4096) CODE																			
18																					
19																					
20																					
21																					
22																					
23																					
24	LSB																				
25		1) Message delivery shall be accomplished using the Event-Driven protocol as specified in EUROCAE ED-102A, §2.2.3.3.1.4.3. 2) Termination of emergency state shall be detected by coding in the surveillance status field of the airborne position message. 3) Subtype 2 message broadcast shall take priority over subtype 1 message broadcast. 4) Emergency State value 1 shall be set when Mode A code 7700 is provided to the transponder. 5) Emergency State value 4 shall be set when Mode A code 7600 is provided to the transponder. 6) Emergency State value 5 shall be set when Mode A code 7500 is provided to the transponder. 7) The Mode A Code shall be coded as defined in ICAO Annex 10 Volume IV, §3.1.2.6.7.1.																			
26																					
27																					
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30																					
31																					
32																					
33																					
34																					
35																					
36																					
37																					
38																					
39																					
40	RESERVED																				
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- (1.40) In EUROCAE ED-73C, in section §B.3, Table B-3-97-2 in order to harmonize with changes made in RTCA DO-260B/EUROCAE ED-102A, make the following changes to Note #3 in the register description of the Aircraft Status Message with Subtype=2:
- 3) RA Broadcast shall be terminated ~~40~~ 24 +/-1 seconds after the RAT flag (Annex 10, Volume IV, §4.3.8.4.2.2.1.3) transitions from ZERO to ONE.

(1.41) In EUROCAE ED-73C, in section §B.3, Table B-3-98 it is necessary to reflect the revised definition of the Register 62₁₆ Target State and Status Information for Subtype=1 as defined in DO-260B/ED-102A for ADS-B Version = 2. Replace Table B-3-98 with the following:

1	
2	
3	FORMAT TYPE CODE = 29
4	
5	
6	MSB SUBTYPE CODE = 1
7	LSB
8	SIL SUPPLEMENT (0=Per Hour, 1=Per Sample)
9	SELECTED ALTITUDE TYPE (0=MCP/FCU, 1=FMS)
10	MSB = 32768 feet
11	MCP / FCU SELECTED ALTITUDE
12	(when Selected Altitude Type = 0)
13	FMS SELECTED ALTITUDE
14	(when Selected Altitude Type = 1)
15	Coding: 111 1111 1111 = 65472 feet
16	*** **
17	000 0000 0010 = 32 feet
18	000 0000 0001 = 0 feet
19	000 0000 0000 = No data or Invalid
20	LSB = 32 feet
21	MSB = 204.8 millibars
22	BAROMETRIC PRESSURE SETTING (MINUS 800 millibars)
23	Range = [0, 408.0] Resolution = 0.8 millibars
24	Coding: 1 1111 1111 = 408.00 millibars
25	* **
26	0 0000 0010 = 0.800 millibars
27	0 0000 0001 = 0.000 millibars
28	0 0000 0000 = No Data or Invalid
29	LSB = 0.8 millibars
30	STATUS (0=Invalid, 1=Valid)
31	Sign (0=Positive, 1=Negative)
32	MSB = 90.0 degrees
33	
34	SELECTED HEADING
35	Range = [+/- 180] degrees, Resolution = 0.703125 degrees
36	(Typical Selected Heading Label = "101")
37	
38	
39	LSB = 0.703125 degrees (180/256)
40	MSB
41	NAVIGATION ACCURACY CATEGORY FOR POSITION (NAC_P)
42	
43	LSB
44	NAVIGATION INTEGRITY CATEGORY FOR BARO (NIC_{BARO})
45	MSB
46	LSB SOURCE INTEGRITY LEVEL (SIL)
47	STATUS OF MCP / FCU MODE BITS (0 = Invalid, 1 = Valid)
48	AUTOPILOT ENGAGED (0 = Not Engaged, 1 = Engaged)
49	VNAV MODE ENGAGED (0 = Not Engaged, 1 = Engaged)
50	ALTITUDE HOLD MODE (0 = Not Engaged, 1 = Engaged)
51	Reserved for ADS-R Flag (see §2.2.18.4.6)
52	APPROACH MODE (0 = Not Engaged, 1 = Engaged)
53	TCAS OPERATIONAL (0 = Not Operational, 1 = Operational)
54	LNAV MODE (0 = Not Engaged, 1 = Engaged)
55	MSB
56	LSB RESERVED

PURPOSE: To provide aircraft state and status information.

Note: This Barometric Pressure Setting data can be used to represent QFE or QNH/QNE, depending on local procedures. It represents the current value being used to fly the aircraft.

(1.42) In EUROCAE ED-73C, in section §B.3, Table B-3-101 it is necessary to reflect the revised definition of the Extended Squitter Aircraft Operational Status as defined in DO-260B/ED-102A for ADS-B Version = 2. Replace Table B-3-101 with the following:

1	MSB	
2	FORMAT TYPE CODE = 31	
3		
4		
5		
6	MSB	MSB
7	SUBTYPE CODE = 0	SUBTYPE CODE = 1
8	LSB	LSB
9	MSB	MSB
10	AIRBORNE CAPABILITY CLASS (CC) CODES	SURFACE CAPABILITY CLASS (CC) CODES
11		
12		
13		
14		
15		
16		
17		
18	LSB	
19		
20		
21		MSB
22		LENGTH/WIDTH CODES
23		
24		LSB
25	MSB	MSB
26	AIRBORNE OPERATIONAL MODE (OM) CODES	SURFACE OPERATIONAL MODE (OM) CODES
27		
28		
29		
30		
31		
32		
33		
34		
35		
36		
37		
38		
39		
40		
41	MSB	
42	ADS-B VERSION NUMBER	
43	LSB	
44	NIC SUPPLEMENT-A	
45	MSB	
46	NAVIGATIONAL ACCURACY CATEGORY – POSITION	
47	(NAC _p)	
48	LSB	
49	GVA	RESERVED
50	LSB	
51	MSB	
52	SOURCE INTEGRITY LEVEL (SIL)	
53	NIC _{BARO}	TRK/HDG
54	HRD	
55	SIL SUPPLEMENT	
56	RESERVED for ADS-R	

PURPOSE: To provide the capability class and current operational mode of ATC-related applications and other operational information..

Subtype Coding:

- 0 = Airborne Status Message
- 1 = Surface Status Message
- 2 – 7 = Reserved

(1.43) In EUROCAE ED-73C, section §B.4.1.3 describes the Mode S Subnetwork Version Number. In order to account for the changes that were made in the ADS-B MOPS (RTCA DO-260B/EUROCAE ED-102A) and subsequent corresponding changes being proposed in ICAO Doc 9871, Edition 2, the definition of the Mode S Subnetwork Version Number in RTCA DO-181D and EUROCAE ED-73C will have to change accordingly. At the beginning of §B.4.1.3, replace the definition of Bits 17 – 23 for the Mode S Subnetwork Version Number with the following:

Bits 17 – 23 reflect the Mode S Subnetwork Version Number.

0	=	Mode S subnetwork not available
1	=	Version No. 1 (1996)
2	=	Version No. 2 (1998)
3	=	Version No. 3 (2002)
4	=	Version No. 4 (2007), ICAO Doc 9871, Edition 1
<u>5</u>	<u>=</u>	<u>Version No. 5 (2013), ICAO Doc 9871, Edition 2</u>
5 6 - 127	=	Unassigned

→ We will need to discuss what to do with the remainder of §B.4.1.3, which is a cut-and-paste copy of Doc 9871 Edition 2, §D.2.4.1.3 and contains references to the specific Amendments and Effective Year of ICAO SARPs that correspond to the Mode S Subnetwork Version Number. ←