

RTCA Special Committee 186, Working Group 3

ADS-B 1090 MOPS (DO-260), Revision B

Meeting #18

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Proposed Appendix to TSO C166 for 1090 ES

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SUMMARY
This Working Paper presents the proposed text for an Appendix that is proposed to be added to TSO C166, which itself is proposed for 1090 ES Transmitters complying with DO-260 and both Transmitters and Receivers complying with DO-260A. This Appendix is intended to detail those changes that are basically mandatory for implementation in a certified DO-260 or DO-260A avionics set.

APPENDIX 1. Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Service - Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz)

This Appendix prescribes the MPS for 1090 MHz Extended Squitter Transmitting and Receiving Subsystems, modified by the FAA in this TSO. The applicable standards are RTCA DO-260, “*Minimum Operational Performance Standards for 1090 MHz Automatic Dependent Surveillance – Broadcast (ADS-B)*,” September 13, 2000,” and RTCA DO-260A, “*Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B)*,” April 10, 2003, and are modified as follows:

- (1) In RTCA DO-260 replace paragraph 2.2.3.2.1.1.2, subparagraphs “c” and “d,” including Table 2-9A and Table 2-9B, with the following. In RTCA DO-260A replace paragraph 2.2.3.2.1.2, subparagraphs “c” and “d,” including Table 2-9 and Table 2-10, with the following.

c. Air/Ground Determination and Validation

1. If a transmitting ADS-B participant is not equipped with a means, such as a weight-on-wheels switch, to determine whether it is airborne or on the surface, and that participant’s Emitter Category (§2.2.3.2.5.2) is one of the following, then it **shall** set its Air/Ground State to “Airborne,” and broadcast the Airborne Position Message (§2.2.3.2.3):

- Unknown Emitter Category
- Light Aircraft
- Rotorcraft
- Glider or Sailplane
- Lighter Than Air
- Unmanned Aerial Vehicle
- Ultralight, Hang Glider or Paraglider
- Parachutist or Skydiver
- Point Obstacle
- Cluster Obstacle
- Line Obstacle

Notes:

1. *Because of the unique operating capabilities of “Lighter-Than-Air” vehicles, i.e., balloons, an operational “Lighter-Than-Air” vehicle will always report the “Airborne” State, unless the “ON-GROUND” State is specifically declared in compliance with subparagraphs “6” or “7” below.*
2. *Because of the fact that it is important for Fixed Ground or Tethered Obstacles to report altitude, such objects will always report the “Airborne” state.*
3. *Because of the unique capabilities of Rotorcraft, i.e., hover, etc., an operational Rotorcraft will always report the “Airborne” state unless the “ON-GROUND”*

state is specifically declared in compliance with subparagraphs “4” or “5” below.

2. If a transmitting ADS-B participant’s Emitter Category (§2.2.3.2.5.2) is one of the following, then that participant **shall** set its Air/Ground State to the “ON-GROUND” condition and broadcast the Surface Position Message (§2.2.3.2.4):
 - Surface Vehicle – Emergency
 - Surface Vehicle – Service

3. If a transmitting ADS-B participant is not equipped with a means, such as a weight-on-wheels switch, to determine whether it is airborne or on the surface, and its ADS-B Emitter Category (§2.2.3.2.5.2) is not one of those listed under tests 1, 2, or 3 above (i.e., Small, Large, High Vortex Large, Heavy, or Highly Maneuverable), then the following tests will be performed to determine whether to broadcast the Airborne or Surface Position Messages.
 - a. If the participant’s Radio Height (RH) parameter is available, and $RH < 50$ feet, and at least Ground Speed (GS) or Airspeed (AS) is available, and the available $GS < 100$ knots, or the available $AS < 100$ knots, then that participant **shall** broadcast the Surface Position Message (§2.2.3.2.4).

***Note:** If all three parameters are available, the decision to broadcast the Airborne or Surface Position Messages may be determined by the logical “AND” of all three parameters.*
 - b. Otherwise, if Radio Height (RH) is not available, and if the participant’s Ground Speed (GS) and Airspeed (AS) are available, and $GS < 50$ knots and $AS < 50$ knots, then that participant **shall** broadcast the Surface Position Message (§2.2.3.2.4).
 - c. Otherwise, the participant **shall** broadcast the Airborne Position Message (§2.2.3.2.3).

4. If a transmitting ADS-B participant is equipped with a means, such as a weight-on-wheels switch, to determine automatically whether it is airborne or on the surface, and that automatic means indicates that the participant is airborne, then that participant **shall** set its Air/Ground State to “Airborne” and broadcast the Airborne Position Message (§2.2.3.2.3).

***Note:** For aircraft with an automatic means of determining vertical status (i.e., weight-on-wheels, strut switch, etc.) the “CA” field reports whether the aircraft is airborne or on-the-ground. TCAS acquires aircraft using the*

acquisition squitters or Extended Squitters, both of which contain the “CA” field. If an aircraft reports that it is on-the-ground, then that aircraft will not be interrogated by TCAS in order to reduce unnecessary interrogation activity. The 1090 MHz ADS-B Message formatter may have information available to validate that an aircraft reporting the “ON-GROUND” State is actually on the surface.

5. If a transmitting ADS-B participant is equipped with a means, such as a weight-on-wheels switch, to determine automatically whether it is airborne or on the surface, and that automatic means indicates that the participant is on the surface, then the following additional tests **shall** be performed to validate the “ON-GROUND” condition:
 - a. If one or more of the following parameters is available to the transmitting ADS-B system:
 - Ground Speed (GS), or
 - Airspeed (AS), or
 - Radio Height (RH) from radio altimeterand of the following parameters that are available:
 - GS > 100 knots, or
 - AS > 100 knots, or
 - RH > 50 feet,then the participant **shall** set its Air/Ground State to “Airborne,” and broadcast the Airborne Position Message (§2.2.3.2.3).
 - b. Otherwise, the participant **shall** set its Air/Ground State to the “ON-GROUND” condition, and broadcast the Surface Position Message (§2.2.3.2.4).

(2) In RTCA Document DO-260A, add the following onto the end of the paragraph in section 2.2.3.2.7.1.3.5 and prior to Table 2-50.

In this version of these MOPS (RTCA DO-260A), the Vertical Mode Indicator **shall** be set to ZERO (binary 00).

Note: *Inconsistencies have been identified with how existing onboard data sources represent the data associated with the Vertical Mode Indicator parameter. Until these inconsistencies are resolved through a future update to these MOPS (RTCA DO-260A), this parameter must be encoded as all zeroes, indicating Unknown Mode or Information Unavailable.*

- (3) In RTCA Document DO-260A, add the following onto the end of the paragraph in section 2.2.3.2.7.1.3.10 and prior to Table 2-55.

In this version of these MOPS (RTCA DO-260A), the Horizontal Mode Indicator **shall** be set to ZERO (binary 00).

***Note:** Inconsistencies have been identified with how existing onboard data sources represent the data associated with the Vertical Mode Indicator parameter. Until these inconsistencies are resolved through a future update to these MOPS (RTCA DO-260A), this parameter must be encoded as all zeroes, indicating Unknown Mode or Information Unavailable.*

- (4) In RTCA Document DO-260A, section 2.2.3.2.7.2.11 in Table 2-74, the “Length Category” for decimal Aircraft/Vehicle Length/Wide Code 14 and 15 should be “L < 85” meters. Additionally, the “Width Category” for decimal Aircraft/Vehicle Length/Wide Code 15 should be “W < 90” meters. Add the following *Note* after Table 2-74:

***Note:** If the aircraft is longer than 85 meters, or wider than 90 meters, then use decimal Aircraft/Vehicle Length/Width Code 15.*

- (5) In RTCA Document DO-260A, section 2.2.17.4.6, replace the entire first paragraph with the following:

As TIS-B Messages are received, the information is reported to applications. All received information elements, other than position, **shall** be reported directly, including all reserved fields for the TIS-B fine format messages (§2.2.17.3.1 to §2.2.17.3.4) and the entire message content of any received TIS-B Management Message (Table 2-106, CF Value =4). The reporting format is not specified in detail, except that the information content reported **shall** be the same as the information content received. The report **shall** be issued within 0.5 seconds of the message.

- (6) In RTCA DO-260 replace paragraph 2.4.3.2.1.1.2.1, Step 4, with the following.

(TBD)

- (7) In RTCA DO-260 replace paragraph 2.4.3.2.1.1.2.1, Step 5, with the following.

(TBD)

- (8) In RTCA DO-260, paragraph 2.4.3.2.1.1.2.2, Step 3, rename the test Step “Air/Ground Status Determination – Input Data Variation” and replace Table 2-84 with the following.

Vertical Status Determination					
Test	Emitter Category / Coding	Ground Speed (knots)	Airspeed (knots)	Radio Altitude (feet)	Resulting Vertical Status
1	A/2 – 6, B/7	100	100	50	AIRBORNE
2	A/2 – 6, B/7	100	50	25	AIRBORNE
3	A/2 – 6, B/7	50	100	25	AIRBORNE
4	A/2 – 6, B/7	50	50	50	AIRBORNE
5	A/2 – 6, B/7	99	99	49	ON-GROUND
6	A/2 – 6, B/7	50	25	No Data	AIRBORNE
7	A/2 – 6, B/7	25	50	No Data	AIRBORNE
8	A/2 – 6, B/7	49	49	No Data	ON-GROUND
9	A/2 – 6, B/7	No Data	25	No Data	AIRBORNE
10	A/2 – 6, B/7	25	No Data	No Data	AIRBORNE
11	A/2 – 6, B/7	100	No Data	25	AIRBORNE
12	A/2 – 6, B/7	No Data	100	25	AIRBORNE
13	A/2 – 6, B/7	99	No Data	49	ON-GROUND
14	A/2 – 6, B/7	No Data	99	49	ON-GROUND
15	A/2 – 6, B/7	25	No Data	50	AIRBORNE
16	A/2 – 6, B/7	No Data	25	50	AIRBORNE
17	A/2 – 6, B/7	No Data	No Data	25	AIRBORNE
18	A/2 – 6, B/7	No Data	No Data	No Data	AIRBORNE

(9) In RTCA DO-260, paragraph 2.4.3.2.1.1.2.2, Step 4, rename the test step “Air/Ground Status Validation – ON-GROUND Override.” In the last sentence of the paragraph of Step 4, change the reference from Table 2-84 to Table 2-85, and replace Table 2-85 with the following.

ON-GROUND Override					
Test	Emitter Category / Coding	Ground Speed (knots)	Speed (knots)	Radio Altitude (feet)	Resulting Vertical Status
1	A/2 – 6, B/7	100	100	50	ON-GROUND
2	A/2 – 6, B/7	100	100	51	AIRBORNE
3	A/2 – 6, B/7	100	101	50	AIRBORNE
4	A/2 – 6, B/7	101	100	50	AIRBORNE
5	A/2 – 6, B/7	No Data	100	50	ON-GROUND
6	A/2 – 6, B/7	No Data	100	51	AIRBORNE
7	A/2 – 6, B/7	No Data	101	50	AIRBORNE
8	A/2 – 6, B/7	No Data	No Data	50	ON-GROUND
9	A/2 – 6, B/7	No Data	No Data	51	AIRBORNE
10	A/2 – 6, B/7	100	No Data	50	ON-GROUND
11	A/2 – 6, B/7	101	No Data	50	AIRBORNE
12	A/2 – 6, B/7	100	No Data	51	AIRBORNE
13	A/2 – 6, B/7	100	No Data	No Data	ON-GROUND
14	A/2 – 6, B/7	101	No Data	No Data	AIRBORNE
15	A/2 – 6, B/7	No Data	100	No Data	ON-GROUND
16	A/2 – 6, B/7	No Data	101	No Data	AIRBORNE
17	A/2 – 6, B/7	100	101	No Data	AIRBORNE
18	A/2 – 6, B/7	101	100	No Data	AIRBORNE
19	A/2 – 6, B/7	100	100	No Data	ON-GROUND
20	A/2 – 6, B/7	No Data	No Data	No Data	ON-GROUND

(10) In RTCA DO-260A replace paragraph 2.2.3.2.1.2.1, Step 3 with the following.

(TBD)

(11) In RTCA DO-260A replace paragraph 2.2.3.2.1.2.1, Step 4 with the following.

(TBD)

(12) In RTCA DO-260A, paragraph 2.2.3.2.1.2.2, Step 3, rename the test Step “Air/Ground Status Determination – Input Data Variation” and replace Table 2-124 with the following.

Vertical Status Determination					
Test	Emitter Category / Coding	Ground Speed (knots)	Airspeed (knots)	Radio Altitude (feet)	Resulting Vertical Status
1	A/2 – 6, B/7	100	100	50	AIRBORNE
2	A/2 – 6, B/7	100	50	25	AIRBORNE
3	A/2 – 6, B/7	50	100	25	AIRBORNE
4	A/2 – 6, B/7	50	50	50	AIRBORNE
5	A/2 – 6, B/7	99	99	49	ON-GROUND
6	A/2 – 6, B/7	50	25	No Data	AIRBORNE
7	A/2 – 6, B/7	25	50	No Data	AIRBORNE
8	A/2 – 6, B/7	49	49	No Data	ON-GROUND
9	A/2 – 6, B/7	No Data	25	No Data	AIRBORNE
10	A/2 – 6, B/7	25	No Data	No Data	AIRBORNE
11	A/2 – 6, B/7	100	No Data	25	AIRBORNE
12	A/2 – 6, B/7	No Data	100	25	AIRBORNE
13	A/2 – 6, B/7	99	No Data	49	ON-GROUND
14	A/2 – 6, B/7	No Data	99	49	ON-GROUND
15	A/2 – 6, B/7	25	No Data	50	AIRBORNE
16	A/2 – 6, B/7	No Data	25	50	AIRBORNE
17	A/2 – 6, B/7	No Data	No Data	25	AIRBORNE
18	A/2 – 6, B/7	No Data	No Data	No Data	AIRBORNE

- (13) In RTCA DO-260A, paragraph 2.2.3.2.1.2.2, Step 4, rename the test step “Air/Ground Status Validation – ON-GROUND Override.” In the last sentence of the paragraph of Step 4, change the reference from Table 2-124 to Table 2-125, and replace Table 2-125 with the following.

ON-GROUND Override					
Test	Emitter Category / Coding	Ground Speed (knots)	Speed (knots)	Radio Altitude (feet)	Resulting Vertical Status
1	A/2 – 6, B/7	100	100	50	ON-GROUND
2	A/2 – 6, B/7	100	100	51	AIRBORNE
3	A/2 – 6, B/7	100	101	50	AIRBORNE
4	A/2 – 6, B/7	101	100	50	AIRBORNE
5	A/2 – 6, B/7	No Data	100	50	ON-GROUND
6	A/2 – 6, B/7	No Data	100	51	AIRBORNE
7	A/2 – 6, B/7	No Data	101	50	AIRBORNE
8	A/2 – 6, B/7	No Data	No Data	50	ON-GROUND
9	A/2 – 6, B/7	No Data	No Data	51	AIRBORNE
10	A/2 – 6, B/7	100	No Data	50	ON-GROUND
11	A/2 – 6, B/7	101	No Data	50	AIRBORNE
12	A/2 – 6, B/7	100	No Data	51	AIRBORNE
13	A/2 – 6, B/7	100	No Data	No Data	ON-GROUND
14	A/2 – 6, B/7	101	No Data	No Data	AIRBORNE
15	A/2 – 6, B/7	No Data	100	No Data	ON-GROUND
16	A/2 – 6, B/7	No Data	101	No Data	AIRBORNE
17	A/2 – 6, B/7	100	101	No Data	AIRBORNE
18	A/2 – 6, B/7	101	100	No Data	AIRBORNE
19	A/2 – 6, B/7	100	100	No Data	ON-GROUND
20	A/2 – 6, B/7	No Data	No Data	No Data	ON-GROUND

- (14) In RTCA Document DO-260A, paragraph 2.4.3.2.7.1.3.5, replace the sentence after the “Purpose/Introduction” with the following:

In this version of these MOPS (RTCA DO-260A), the Vertical Mode Indicator **shall** be set to ZERO (binary 00).

- (15) In RTCA Document DO-260A, paragraph 2.4.3.2.7.1.3.5, replace test procedure Steps 1, 2 and 3 with the following:

Step 1: Verification of the “Vertical Mode Indicator” Set to Zero

TBD

- (16) In RTCA Document DO-260A, paragraph 2.4.3.2.7.1.3.10, replace the sentence after the “Purpose/Introduction” with the following:

In this version of these MOPS (RTCA DO-260A), the Horizontal Mode Indicator **shall** be set to ZERO (binary 00).

- (17) In RTCA Document DO-260A, paragraph 2.4.3.2.7.1.3.10, replace test procedure Steps 1, 2 and 3 with the following:

Step 1: Verification of the “Horizontal Mode Indicator” Set to Zero

TBD

- (18) In RTCA Document DO-260A, paragraph 2.4.17.4.6, replace the first paragraph of the “Purpose/Introduction” with the following:

As TIS-B Messages are received, the information is reported to applications. All received information elements, other than position, **shall** be reported directly, including all reserved fields for the TIS-B fine format messages (§2.2.17.3.1 to §2.2.17.3.4) and the entire message content of any received TIS-B Management Message (Table 2-106, CF Value =4). The reporting format is not specified in detail, except that the information content reported **shall** be the same as the information content received. The report **shall** be issued within 0.5 seconds of the message.

- (19) In RTCA Document DO-260A, paragraph 2.4.17.4.6, replace test procedure Steps 1 and 2 with the following:

TBD