In Response to GPS/GNSS FDE Satellite Exclusion Issues;

Delete the existing Note 4.(b) that follows Table 2-16.
Then Add the following:

2.2.3.2.3.1.5 TYPE Code During Fault Detection and Exclusion (FDE) Conditions (Airborne)

Under normal operating conditions, the R_C can be directly determined from Horizontal Protection Limit (HPL) or Horizontal Integrity Limit (HIL) inputs to the ADS-B Transmitting Subsystem from the GPS/GNSS receiver. However, there are times when the Fault Detection and Exclusion (FDE) function of the GPS/GNSS receiver has detected a satellite failure but has not excluded the satellite from the navigation data solution. For the purposes of these MOPS, the condition just described will be referred to as an "FDE Fault" which is typically annunciated by the GPS/GNSS receiver by an appropriate method. For example, ARINC 743A compliant GPS/GNSS receivers will set Label "130" bit "11" to ONE (1) to indicate the "FDE Fault." If an "FDE Fault" does not exist, then bit "11" is set to ZERO (0). Of import is the situation that even though an "FDE Fault" indication has been set, the GPS/GNSS typically continues to provide HPL or HIL data as well as Latitude, Longitude, and Velocity data while continuing to declare them to be valid on the interface. As the "FDE Fault" condition represents a condition where the position and accuracy data cannot be guaranteed by the GPS/GNSS receiver, the ADS-B Transmitting Subsystem shall apply the following process upon detection of the "FDE Fault" annunciation:

Note: *If position sources can be demonstrated to overcome this degraded state of integrity when the "FDE Fault" condition occurs, the following requirements do not apply.*

a. The "TYPE" code of Airborne Position Messages (TYPE=5) **shall** be set to either "**18**" or "**22**", whichever is applicable in order to indicate that R_C is UNKNOWN.

   Note: *The "TYPE" code is not required to be set to ZERO (0), as to do so would indicate that there is NO Position Data which will result in the ADS-B Transmitting Subsystem declaring an ADS-B Function Failure (see §2.2.11.6).*

b. Valid Latitude and Longitude Position data **shall** continue to be processed and reported in the Airborne Position Message (TYPE=5) as required.

c. The NIC Supplement-**B** subfield in the Airborne Position Message (TYPE=5) **shall** be set to ZERO (0) in accordance with Table 2-70 for a NIC Value of ZERO (0) when "TYPE" code is set to either "**18**" or "**22**".

d. The NIC Supplement-**A** subfield in the Airborne Aircraft Operational Status Message (TYPE=31, Subtype=0) **shall** be set to ZERO (0) in accordance with Table 2-70 for a NIC Value of ZERO (0) when "TYPE" code is set to either "**18**" or "**22**".

e. The NAC_P subfield in the Aircraft Operational Status Message (TYPE=31, Subtype 0) **shall** be set to ZERO (0) in accordance with Table 2-71 in order to specify that the accuracy is UNKNOWN.

f. The NAC_V subfield in the Airborne Velocity Message (TYPE=19) **shall** be set to ZERO (0) in accordance with §2.2.3.2.6.1.5 and Table 2-25.

Note: *Factors such as surface multi-path have been observed to cause intermittent annunciation of "FDE Faults" by the GPS/GNSS receiver. Such occurrences will result in the intermittent settings of the subfields addressed in subparagraphs a, c and d above These intermittent conditions should be taken into account by ADS-B and Air Traffic Services that are using the data provided by the ADS-B Transmitting Subsystems.*

2.2.3.2.4.1.5 TYPE Code During Fault Detection and Exclusion (FDE) Conditions (Surface)

Under normal operating conditions, the R_C can be directly determined from Horizontal Protection Limit (HPL) or Horizontal Integrity Limit (HIL) inputs to the ADS-B Transmitting Subsystem from the GPS/GNSS receiver. However, there are times when the Fault Detection and Exclusion function of the GPS/GNSS receiver has detected a satellite failure but has not excluded the satellite from the navigation data solution. For the purposes of these MOPS, the condition just described will be referred to as an "FDE Fault" which is typically annunciated by the GPS/GNSS receiver by an appropriate method. For example, ARINC 743A compliant GPS/GNSS receivers will set Label "130" bit "11" to ONE (1) to indicate the "FDE Fault". If an "FDE Fault" does not exist, then bit "11" is set to ZERO (0). Of import is the situation that even though an "FDE Fault" indication has been set, the GPS/GNSS typically continues to provide HPL or HIL data as well as Latitude, Longitude, and Velocity data while continuing to declare them to be valid on the interface. As the "FDE Fault" condition represents a condition where the position and accuracy data cannot be guaranteed by the GPS/GNSS receiver, the ADS-B Transmitting Subsystem shall apply the following process upon detection of the "FDE Fault" annunciation:

Note: If position sources can be demonstrated to overcome this degraded state of integrity when the "FDE Fault" condition occurs, the following requirements do not apply.

a. The "TYPE" code of Surface Position Messages (TYPE=6) **shall** be set to **"8"** in order to indicate that R_c is UNKNOWN.

   Note: *The "TYPE" code is not required to be set to ZERO (0), as to do so would indicate that there is NO Position Data which will result in the ADS-B Transmitting Subsystem declaring an ADS-B Function Failure (see §2.2.11.6).*

b. Valid Latitude and Longitude Position data **shall** continue to be processed and reported in the Surface Position Message (TYPE=6) as required.

c. The NIC Supplement-**A** and NIC Supplement-**C** subfields in the Surface Aircraft Operational Status Message (TYPE=31, Subtype=1) **shall** be set to ZERO (0) in accordance with Table 2-70 for a NIC Value of ZERO (0) when "TYPE" code is set to "**8**".

d. The NAC_P subfield in the Surface Aircraft Operational Status Message (TYPE=31, Subtype=1) **shall** be set to ZERO (0) in accordance with Table 2-71 in order to specify that the accuracy is UNKNOWN.

e. The NAC_V CC subfield in the Surface Aircraft Operational Status Message (TYPE=31, Subtype=1) **shall** be set to ZERO (0) in accordance with §2.2.3.2.7.2.3.9 and Table 2-25.

Note: *Factors such as surface multi-path have been observed to cause intermittent annunciation of "FDE Faults" by the GPS/GNSS receiver. Such occurrences will result in the intermittent settings of the subfields addressed in subparagraphs a, c and d above. These intermittent conditions should be taken into account by ADS-B and Air Traffic Services that are using the data provided by the ADS-B Transmitting Subsystems.*

2.4.3.2.3.1.5 Verification of TYPE Code During Fault Detection and Exclusion (FDE) Conditions (Airborne) (§2.2.3.2.3.1.5)

Purpose/Introduction:

These test procedures verify that an "FDE Fault" annunciated by the GPS/GNSS receiver is properly detected by the ADS-B Transmitting Subsystem and results in:

a. The "TYPE" code and NIC Supplement-B in Airborne Position Messages (Type 5) being set to indicate that the R_C is UNKNOWN,

b. The NIC Supplement-A in Airborne Aircraft Operational Status Messages (Type 31, Subtype 0) being set to indicate that the R_C is UNKNOWN,

c. The NAC_P in Airborne Aircraft Operational Status Messages (Type 31, Subtype 0) being set to indicate that the accuracy is UNKNOWN,

d. The latitude and longitude position information continues to be properly reported in the Airborne Position Messages (Type 5), and

e. NAC_V subfield in Airborne Velocity Messages (Type 19) being set to ZERO (0).

Measurement Procedure:

Step 1: Initialization

Configure the ADS-B Transmitting Subsystem to transmit Airborne Position Messages (Type) and Airborne Aircraft Operational Status Messages (Type 31, Subtype 0).

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with appropriate data such that:

a. Valid latitude and longitude position is being reported in the Airborne Position Messages (Type 5)

b. "TYPE" code in the Airborne Position Messages (Type 5) is set to "11",

c. NIC Supplement-B subfield in the Airborne Position Messages (Type 5) is set to ONE (1),

d. NIC Supplement-A subfield in the Airborne Aircraft Operational Status Messages (Type 31, Subtype 0) is set to ONE (1), and

e. NAC_P subfield in the Airborne Aircraft Operational Status Messages (Type 31, Subtype 0) is set to any value between "**1**" and "**11**".

f. NAC_V subfield in the Airborne Velocity Messages (Type 19) is set to any value between "**1**" and "**4**".

Via the appropriate interface, ensure that an "FDE Fault" is **NOT** being annunciated to the ADS-B Transmitting Subsystem.

Step 2: Set an "FDE Fault"

Via the appropriate interface, provide appropriate indication to the ADS-B Transmitting Subsystem that an "FDE Fault" has been set.

Step 3: Verification of "FDE Fault" response

Verify that the ADS-B Transmitting Subsystem provides the following transmissions:

a. Airborne Position Messages (Type 5) with the "TYPE" code ("ME" bits 1 – 5, Message Bits 33 – 37) set to a decimal code value of "**18**",

b. Airborne Position Messages (Type 5) containing valid CPR Encoded Latitude ("ME" bits 23 – 39, Message bits 55 – 71) and valid CPR Encoded Longitude ("ME" bits 40 – 56, Message bits 72 – 88),

c. Airborne Position Messages (Type 5) having NIC Supplement-B ("ME" bit 8, Message bit 40) set to ZERO (0),

d. Airborne Aircraft Operational Status Messages (Type 31, Subtype 0) having NIC Supplement-A ("ME" bit 44, Message bit 76) set to ZERO (0), and

e. Airborne Aircraft Operational Status Messages (Type 31, Subtype 0) having NAC_P ("ME" bits 45 – 48, Message bits 77 – 80) set to all ZERO (0).

f. Airborne Velocity Messages (Type 19) having NAC_V ("ME" bits 11 – 13, Message bits 43 – 45) set to all ZERO (0).

Step 4: Clear the "FDE Fault"

Via the appropriate interface, remove the indication to the ADS-B Transmitting Subsystem that an "FDE Fault" has been set.

Step 5: Verification of "FDE Fault" clear response

Verify that the ADS-B Transmitting Subsystem provides the transmissions required in Step 1.

2.4.3.2.4.1.5 Verification of TYPE Code During Fault Detection and Exclusion (FDE) Conditions (Surface) (§2.2.3.2.4.1.5)

Purpose/Introduction:

These test procedures verify that an "FDE Fault" annunciated by the GPS/GNSS receiver is properly detected by the ADS-B Transmitting Subsystem and results in:

a. The "TYPE" code and NIC Supplement-B in Surface Position Messages (Type 6) being set to indicate that the R_C is UNKNOWN,

b. The NIC Supplement-A in Surface Aircraft Operational Status Messages (Type 31, Subtype 1) being set to indicate that the R_C is UNKNOWN,

c. The NAC_P in Surface Aircraft Operational Status Messages (Type 31, Subtype 1) being set to indicate that the accuracy is UNKNOWN, and

d. The latitude and longitude position information continues to be properly reported in the Surface Position Messages (Type 6).

e. The NACv CC subfield in the Surface Aircraft Operational Status Messages (Type 31, Subtype 1) being set to ZERO (0).

Measurement Procedure:

Step 1: Initialization

Configure the ADS-B Transmitting Subsystem to transmit Airborne Position Messages (Type) and Airborne Aircraft Operational Status Messages (Type 31, Subtype 0).

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with appropriate data such that:

a. Valid latitude and longitude position is being reported in the Surface Position Messages (Type 6)

b. "TYPE" code in the Surface Position Messages (Type 6) is set to "**8**",

c. NIC Supplement-C subfield in the Surface Aircraft Operational Status Messages (Type 31, Subtype 1) is set to ONE (1),

d. NIC Supplement-A subfield in the Surface Aircraft Operational Status Messages (Type 31, Subtype 1) is set to ONE (1), and

e. NAC_P subfield in the Surface Aircraft Operational Status Messages (Type 31, Subtype 1) is set to any value between "**1**" and "**11**".

f. NAC_V CC subfield in the Surface Aircraft Operational Status Messages (Type 31, Subtype 1) is set to any value between "**1**" and "**4**"

Via the appropriate interface, ensure that an "FDE Fault" is **NOT** being annunciated to the ADS-B Transmitting Subsystem.

Step 2: Set an "FDE Fault"

Via the appropriate interface, provide appropriate indication to the ADS-B Transmitting Subsystem that an "FDE Fault" has been set.

Step 3: Verification of "FDE Fault" response

Verify that the ADS-B Transmitting Subsystem provides the following transmissions:

a. Surface Position Messages (Type 6) with the "TYPE" code ("ME" bits 1 – 5, Message Bits 33 – 37) set to a decimal code value of "**8**",

b. Surface Position Messages (Type 5) containing valid CPR Encoded Latitude ("ME" bits 23 – 39, Message bits 55 – 71) and valid CPR Encoded Longitude ("ME" bits 40 – 56, Message bits 72 – 88),

c. Surface Aircraft Operational Status Messages (Type 31, Subtype 1) having NIC Supplement-A ("ME" bit 44, Message bit 76) set to ZERO (0),

d. Surface Aircraft Operational Status Messages (Type 31, Subtype 1) having NIC Supplement-C ("ME" bit 20, Message bit 52) set to ZERO (0), and

e. Surface Aircraft Operational Status Messages (Type 31, Subtype 1) having NAC_P ("ME" bits 45 – 48, Message bits 77 – 80) set to all ZERO (0).

f. Surface Aircraft Operational Status Messages (Type 31, Subtype 1) having NAC_V ("ME" bits 17 – 19, Message bits 49 – 51) set to all ZERO (0).

Step 4: Clear the "FDE Fault"

Via the appropriate interface, remove the indication to the ADS-B Transmitting Subsystem that an "FDE Fault" has been set.

Step 5: Verification of "FDE Fault" clear response

Verify that the ADS-B Transmitting Subsystem provides the transmissions required in Step 1.

Step 6: Change Surface Position Message TYPE Code

Via the appropriate interface, provide the ADS-B Transmitting Subsystem with appropriate data such that the "TYPE" code in the Surface Position Messages (Type 6) is set to "**7**".

Step 7: Set an "FDE Fault"

Repeat Step 2.

Step 8: Verification of "FDE Fault" response

Repeat Step 3.

Step 9: Clear the "FDE Fault"

Repeat Step 4.

Step 10: Verification of "FDE Fault" clear response

Verify that the ADS-B Transmitting Subsystem provides the transmissions required in Step 6.