3.3 Broadcast Information Elements Requirements

The ADS-B system **shall** (242AR2.3) be capable of transmitting messages and issuing reports containing the information specified in the following subsections. This MASPS does not specify a particular message structure or encoding technique. The information specified in the following subparagraphs can be sent in one or more messages in order to meet the report update requirements specified in Section §3.2.1.4.3.1.

3.3.1 Time of Applicability (TOA)

The time of applicability (TOA) of ADS-B reports indicates the time at which the reported values were valid. Time of applicability **shall** (242AR2.4) be provided in all reports. Requirements on the accuracy of the time of applicability are addressed in Section §3.5.

Note: The required resolution of the Time of Applicability value is a function of the Report Type.

3.3.2 Identification

The basic identification information to be conveyed by ADS-B **shall** (242AR2.5) include the following elements:

- Call Sign (§3.3.2.1)
- Participant Address (§3.3.2.2.1) and Address Qualifier (§3.3.2.2.2)
- ADS-B Emitter Category (§3.3.2.3)
- Mode 3/A Code (§3.3.2.4)

3.3.2.1 Call Sign

ADS-B **shall** (242AR2.6) be able to convey an aircraft call sign of up to 8 alphanumeric characters in length [6]. For aircraft/vehicles not receiving ATS services and military aircraft the call sign is not required.

Note: The call sign is reported in the Mode-Status (MS) report (§3.5.4 and §3.5.4.4).

3.3.2.2 Participant Address and Address Qualifier

The ADS-B system design **shall** (242AR2.7) include a means (e.g., an address) to (a), correlate all ADS-B messages transmitted from the A/V and (b), differentiate it from other A/Vs in the operational domain.

Those aircraft requesting ATC services may be required in some jurisdictions to use the same 24 bit address for all CNS systems. Aircraft with Mode-S transponders using an ICAO 24 bit address **shall** (242AR2.8) use the same 24 bit address for ADS-B. All aircraft/vehicle addresses **shall** (242AR2.9) be unique within the applicable operational domain(s).

The ADS-B system design **shall** (242AR2.10) accommodate a means to ensure anonymity whenever pilots elect to operate under flight rules permitting an anonymous mode.

Notes

1. *Some flight operations do not require one to fully disclose either the A/V call sign or address. This feature is provided to encourage voluntary equipage and operation of ADS-B by ensuring that ADS-B messages will not be traceable to an aircraft if the operator requires anonymity.*
2. *Correlation of ADS-B messages with Mode S transponder codes will facilitate the integration of radar and ADS-B information on the same aircraft during transition.*

3.3.2.2.1 Participant Address

The Participant Address field **shall** (242AR2.11) be included in all ADS-B reports. This 24-bit field contains either the ICAO 24-bit address assigned to the particular aircraft about which the report is concerned, or another kind of address that is unique within the operational domain, as determined by the Address Qualifier field.

3.3.2.2.2 Address Qualifier

The Address Qualifier field **shall** (242AR2.12) be included in all ADS-B reports. This field consists of one or more bits and describes whether or not the Address field contains the 24-bit ICAO address of a particular aircraft, or another kind of address that is unique within the operational domain.

Notes:

1. *The particular encoding used for the Address Qualifier is not specified in this MASPS, but is left for specification in lower level documents, such as the MOPS for a particular ADS-B data link. Experience in developing the MOPS for several proposed ADS-B data links suggests that 4 bits is sufficient for the Address Qualifier field.*
2. *Surface vehicles for a given airport need to have unique addresses only within range of the airport; vehicle addresses may be reused at other airports.*
3. *A participant's address and address qualifier are included as parts of all reports about that participant.*

3.3.2.3 ADS-B Emitter Category

An ADS-B participant's "emitter category" is conveyed in the Mode-Status report (§3.5.4 and §3.5.4.5). The emitter category describes the type of A/V or other ADS-B participant. The ADS-B system **shall** (242AR2.13) provide for at least the following emitter categories:

- Light (ICAO) – 7,000 kg (15,500 lbs) or less
- Small aircraft – 7,000 kg to 34,000 kg (15,500 lbs to 75,000 lbs)
- Large aircraft – 34,000 kg to 136,000 kg (75,000 lbs to 300,00 lbs)
- High vortex large (aircraft such as B-757)
- Heavy aircraft (ICAO) – 136,000 kg (300,000 lbs) or more
- Highly maneuverable (> 5g acceleration capability) and high speed (> 400 knots cruise)

- Rotorcraft
- Glider/Sailplane
- Lighter-than-air
- Unmanned Aerial vehicle
- Space/Trans-atmospheric vehicle
- Ultralight / Hang glider / Paraglider
- Parachutist/Skydiver
- Surface Vehicle – emergency vehicle
- Surface Vehicle – service vehicle
- Point obstacle (includes tethered balloons)
- Cluster obstacle
- Line obstacle

Notes:

1. *ICAO Medium aircraft – 7,000 to 136,000 kg (15,500 to 300,000 lbs) can be represented as either small or large aircraft as defined above.*
2. *Obstacles can be either fixed or movable. Movable obstacles would require a position source.*
3. *Weights given for determining participant categories are maximum gross weights, not operating weights.*
4. *The following category code assignments should be considered for aircraft operating in the United States national air space (NAS).*

Light :	*Less than 7,000 kg (15,500 lb)*
Small:	*≥15,500 and < 41,000 lb*
Large:	*≥41,000 lb and < 255,000 lb and not in "High Vortex Large" category*
High Vortex Large:	*Certain other aircraft, including B-757*
Heavy:	*≥255,000 lb*

3.3.2.4 Mode 3/A Code

Since the Mode 3/A code is utilized by many Ground ATC systems for aircraft identification, it may be necessary for ADS-B participants in certain airspace to transmit the Mode 3/A code. ADS-B **shall** (New Reqmt) have the capability to transmit the Mode 3/A code.

3.3.3 A/V Length and Width Codes

The A/V length and width codes describe the amount of space that an aircraft or ground vehicle occupies and are components of the Mode-Status report (§3.5.4, §3.5.4.6). The aircraft length and width codes are not required to be transmitted by all ADS-B participants all of the time. However, they *are* required (§3.5.4.6) to be transmitted by aircraft above a certain size, at least while those aircraft are in the airport surface movement area.

3.3.4 Position

Position information **shall** (242AR2.14) be transmitted in a form that can be translated, without loss of accuracy and integrity, to latitude, longitude, geometric height, and barometric pressure altitude. The position report elements may be further categorized as geometric position and barometric altitude.

- The geometric position report elements are horizontal position (latitude and longitude), and geometric height. All geometric position elements **shall** (242AR2.15) be referenced to the WGS-84 ellipsoid.
- Barometric pressure altitude **shall** (242AR2.16) be reported referenced to standard temperature and pressure.

For any ADS-B participant that sets the "reporting reference point position" CC code (in MS report element #7g, §3.5.4.9.7) to ONE, the position that is broadcast in ADS-B messages as that participant's nominal position **shall** (242AR2.17) be the position of that participant's ADS-B position reference point (§3.3.4.1 below).

For any ADS-B participant that sets the "reporting reference point position" CC code (in MS report element #7g, §3.5.4.9.7) to ZERO, the position that is broadcast in ADS-B messages is not corrected from the position as given by the participant's navigation sensor to the position of that participant's ADS-B position reference point.

Note: ~~*It is likely that future*~~ *Surface movement and runway incursion applications will require high NAC_P values. To obtain those high values, it may be necessary to correct the reported position to that of the ADS-B Position Reference Point (§3.3.4.1) if the antenna of the navigation sensor is not located in very close proximity to the ADS-B reference point.*

3.3.4.1 ADS-B Position Reference Point

The nominal location of a transmitting ADS-B participant – the position that is reported to user applications in SV reports about that participant – is the location of the participant's ***ADS-B Position Reference Point***.

Note 1: The "reporting reference point position" CC code (in MS report element #7g) indicates whether a transmitting ADS-B participant has corrected the position given by its navigation sensor (e.g., the position of the antenna of a GPS receiver) to the location of its ADS-B position reference point. (The process of correcting the position to that of the position reference point need not be done in the transmitting ADS-B subsystem; it might be applied in the navigation sensor, or in another device external to the ADS-B transmitting subsystem.) (See the description of MS report element #7g, §3.5.4.9.7)

The *ADS-B position reference point* of an A/V **shall** (242AR2.18) be defined as the center of a rectangle (the "defining rectangle for position reference point") that has the following properties:

a. The defining rectangle for position reference point **shall** (242AR2.18-A) have length and width as defined in Table 3.3.4.1a below for the length and width codes that the participant is transmitting in messages to support the MS report.

b. The defining rectangle for position reference point **shall** (242AR2.18-B) be aligned parallel to the A/V's heading.

c. The ADS-B position reference point (the center of the defining rectangle for position reference point) **shall** (242AR2.18-C) lie along the axis of symmetry of the A/V. (For an asymmetrical A/V, the center of the rectangle should lie midway between the maximum port and starboard extremities of the A/V.)

d. The forward extremity of the A/V **shall** (242AR2.18-D) just touch the forward end of the defining rectangle for position reference point.

Table 3.3.4.1a: Dimensions of Defining Rectangle for Position Reference Point.

A/V – L/W Code (Decimal)	Length Code (binary)			Width Code (binary)	Upper-Bound Length and Width for Each Length/Width Code	
					Length (meters)	Width (meters)
0	0	0	0	0	No Data or Unknown	
1	0	0	0	1	15	23
2	0	0	1	0	25	28.5
3				1		34
4	0	1	0	0	35	33
5				1		38
6	0	1	1	0	45	39.5
7				1		45
8	1	0	0	0	55	45
9				1		52
10	1	0	1	0	65	59.5
11				1		67
12	1	1	0	0	75	72.5
13				1		80
14	1	1	1	0	85	80
15				1		90

Note 2: The lengths and widths given in Table 3.3.4.1a are least upper bounds for the possible lengths and widths of an aircraft that reports the given length and width code as specified in Table TBD (§3.5.4.6). An exception, however, is made for the largest length and width codes, since there is no upper bound for the size of an aircraft that broadcasts those largest length and width codes.

Figure 3.3.4.1a illustrates the location of the ADS-B reference point, for an example aircraft of length 31 m and width 29 m. Such an aircraft will have length code 2 (L < 35 m) and width code 0 (W < 33m). The ADS-B position reference point is then the center of a rectangle that is 35 m long and 33 m wide and positioned as given in the requirements just stated. As required in §2.1.2.3, this is the position that a transmitting ADS-B participant broadcasts when its "reporting reference point position" CC code is ONE.

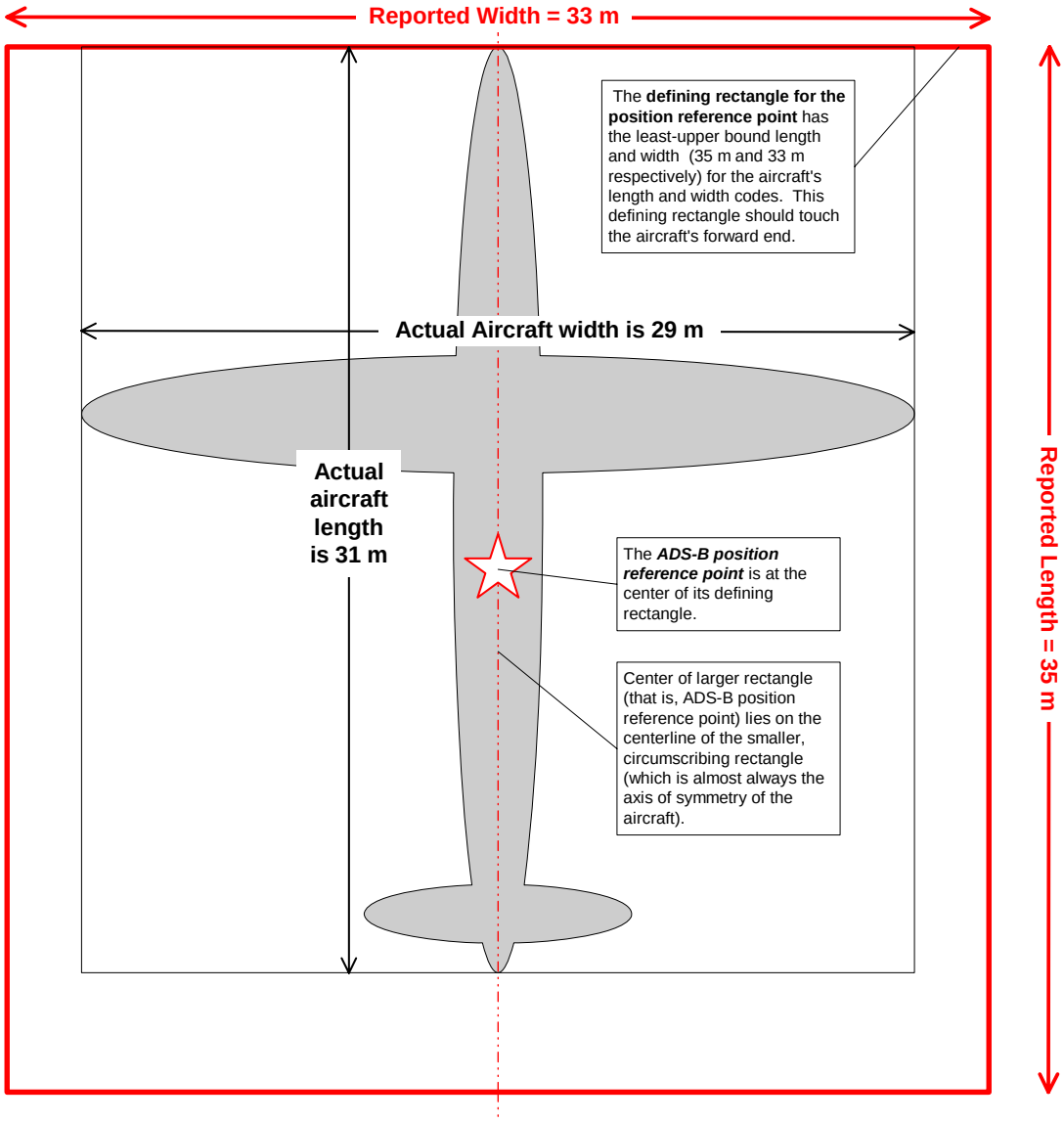

Figure 3.3.4.1a: Position Reference Point Definition.

Note 3: *When on the surface, the ability to correct for inaccuracies due to offsets in position between the navigation sensor and the ADS-B position reference point must be provided. If the navigation sensor or the transmitting ADS-B participant does not correct for this offset, the lateral distance from the lateral axis of the aircraft and the longitudinal distance from the nose of the aircraft must be conveyed so that the ADS-B application can account for this offset. A means to indicate that the position is corrected to the ADS-B reference point must be provided.* ~~*ADS-B position reference point must be announced by setting the "reporting reference point position" CC code to ZERO (242AR3.109 in §TBD) and be accounted for in determining the NAC$_p$ code that the transmitting participant position broadcasts (242AR2.32 in below).*~~ ➔ ***Editor's Note:*** *Add reference to the GPS Antenna Offset section below.*

Note 4: *There are operational applications where the ADS-B position being reported needs to be related to the extremities of large aircraft; such as, runway incursion alerting and other future surface applications. Therefore, for the aircraft size codes and NAC$_p$ codes defined, the position being broadcast must be translated to a common reference point on the aircraft. The translation calculation on position sensor source data may be performed outside of the ADS-B transmitting subsystem, therefore, specific requirements for this function are not defined in this MASPS.*

3.3.4.2 Altitude

Both barometric pressure altitude and geometric altitude (height above the WGS-84 ellipsoid) **shall** (242AR2.19) be provided, if available, to the transmitting ADS-B subsystem. Some applications may have to compensate if only one source is available. However, when an A/V is operating on the airport surface, the altitude is not required to be reported, provided that the A/V indicates that it is on the surface.

Altitude **shall** (242AR2.20) be provided with a range from -1,000 ft up to +100,000 ft. For fixed or movable obstacles, the altitude of the highest point should be reported.

3.3.4.2.1 Pressure Altitude

ADS-B link equipment **shall** (242AR2.21) support a means for the pilot to indicate that the broadcast of altitude information from pressure altitude sources is invalid. This capability can be used at the request of ATC or when altitude is determined to be invalid by the pilot. Pressure Altitude

Barometric pressure altitude is the reference for vertical separation within the NAS and ICAO airspace. Barometric pressure altitude is reported referenced to standard temperature and pressure.

Pressure altitude, which is currently reported by aircraft in SSR Mode C and Mode S, will also be transmitted in ADS-B messages and reported to client applications in SV reports. The pressure altitude reported **shall** (242AR2.22) be derived from the same source as the pressure altitude reported in Mode C and Mode S for aircraft with both transponder and ADS-B.

3.3.4.2.2 Geometric Altitude

Geometric altitude is defined as the shortest distance from the current aircraft position to the surface of the WGS-84 ellipsoid, known as Height Above Ellipsoid (HAE). It is positive for positions above the WGS-84 ellipsoid surface, and negative for positions below that surface.

3.3.5 Horizontal Velocity

There are two kinds of velocity information:

- "Ground-referenced" or "geometric" velocity is the velocity of an A/V relative to the earth, or to a coordinate system (such as WGS-84) that is fixed with respect to the earth. Ground-referenced velocity is communicated in the SV report (§TBD).
- Air-referenced velocity is the velocity of an aircraft relative to the air mass through which it is moving. Airspeed, the *magnitude* of the air-referenced velocity vector, is communicated in the ARV report, §**TBD.** The ARV report also includes heading (§2.1.2.7), which is used in that report as an estimate of the *direction* of the air-referenced velocity vector. Conditions for when the broadcast of ARV data is required are specified in §TBD.

ADS-B geometric velocity information **shall** (242AR2.23) be referenced to WGS-84 [7]. Transmitting A/Vs that are not fixed or movable obstacles **shall** (242AR2.24) provide ground-referenced geometric horizontal velocity.

Note: In this context, a "movable obstacle" means an obstacle that can change its position, but only slowly, so that its horizontal velocity may be ignored.

3.3.6 Vertical Rate

Transmitting A/Vs that are not fixed or movable obstacles and that are not known to be on the airport surface **shall** (242AR2.25) provide vertical rate.

Note 1: In this context, a "movable obstacle" means an obstacle that can change its position, but only slowly, so that its vertical rate may be ignored.

Vertical Rate **shall** (242AR2.26) be designated as climbing or descending and **shall** (242AR2.27) be reported up to 32,000 feet per minute (fpm). Barometric altitude rate is defined as the current rate of change of barometric altitude. Likewise, geometric altitude rate is the rate of change of geometric altitude. At least one of the two types of vertical rate (barometric and geometric) **shall** (242AR2.28) be reported.

If only one of these two types of vertical rate is reported, it **shall** (242AR2.29) be obtained from the best available source of vertical rate information. (1) Inertial filtered barometric altitude rate will be the preferred source of altitude rate information. (2) If differentially corrected GPS (WAAS, LAAS, or other) is available, geometric altitude rate as derived from the GPS source should be transmitted. (3) If differentially corrected GPS is not available, unaugmented GNSS vertical rate should be used. (4) Pure barometric rate.

➔ **Question:** Is there a requirement to have vertical rate from the same source as the altitude broadcast??

Note 2: Future versions of this MASPS are expected to include requirements on the accuracy and latency of barometric altitude rate.

Note 3: Vertical rate is reported in the SV report (§TBD).

3.3.7 Heading

Heading indicates the orientation of an A/V, that is, the direction in which the nose of the aircraft is pointing. Heading is described as an angle measured clockwise from true north or magnetic north. The heading reference direction (true north or magnetic north) is conveyed in the Mode-Status report (§TBD).

Heading occurs not only in the SV report (§TBD) for participants on the airport surface, but also in the ARV report (§TBD) for airborne participants.

3.3.8 Capability Class (CC) Codes

Capability class codes are used to indicate the capability of a participant to support engagement in various operations. Known specific capability class codes are listed below. However, this is not an exhaustive set and provision should be made for future expansion of available class codes, including appropriate combinations thereof.

Airborne Capability Class Codes

- TCAS/ACAS operational (§TBD)
- 1090ES IN & UAT IN
- ARV report capability (§TBD)
- TS report capability (§TBD)
- TC report capability level (§TBD)
- Other capabilities, to be defined in later versions of this MASPS

Surface Capability Class Codes

- 1090ES IN & UAT IN
- Service Level of the transmitting A/V (B2 Low) (§TBD)(unique to 1090ES)
- NACv (§TBD)
- Other capabilities, to be defined in later versions of this MASPS

Note: *Capability Class (CC) codes are conveyed in the MS report (§TBD).*

3.3.9 Operational Mode (OM) Codes

Operational Mode (OM) codes are used to indicate the current operational mode of transmitting ADS-B participants. Specific operational mode codes are listed below. Unless noted, these parameters **shall** (New Reqmt) be broadcast in both airborne and surface operational status messages. However, this is not an exhaustive set and provision should be made for future expansion of available OM codes, including appropriate combinations thereof.

- TCAS/ACAS resolution advisory active (§TBD).
- IDENT switch active flag (§TBD)
- Reserved for Receiving ATC services (§TBD)
- Single Antenna Flag
- GPS Antenna Offset (Surface OM Messages Only, §3.3.17)
- Other operational modes, to be defined in later versions of this MASPS.

3.3.10 Navigation Integrity Category

The Navigation Integrity Category (NIC) is reported so that surveillance applications may determine whether the reported geometric position has an acceptable integrity containment region for the intended use. The NIC parameter described in this subsection is intimately associated with the SIL (Source Integrity Level) parameter described in §0 below. The NIC parameter specifies an integrity containment region. The SIL parameter specifies the probability of the reported horizontal exceeding the containment radius defined by the NIC without alerting, assuming no avionics faults.

Note: "NIC" and "NAC_P" as used in the current version (DO-242A) of this MASPS replace the earlier term, "NUC_P", used in the first edition (DO-242) of this MASPS.

The Navigation Integrity Category is reported in the State Vector (SV) report (§TBD).

Table 3.3.10a defines the navigation integrity categories that transmitting ADS-B participants **shall** (242AR2.30) use to describe the integrity containment radius, R_C, associated with the horizontal position information in ADS-B messages from those participants.

Table 3.3.10a: Navigation Integrity Categories (NIC).

NIC (Notes 1, 2)	Horizontal Containment Bounds		Notes
0	R_C Unknown		
1	R_C < 37.04 km (20 NM)		6
2	R_C < 14.816 km (8 NM)		3, 6
3	R_C < 7.408 km (4 NM)		6
4	R_C < 3.704 km (2 NM)		6
5	R_C < 1852 m (1 NM)		6
6	R_C < 1111.2 m (0.6 NM)		6
6 w/Supp	Rc < 555.6 m (0.3 NM)		6
7	R_C < 370.4 m (0.2 NM)		6
8	R_C < 185.2 m (0.1 NM)		6
9	R_C < 75 m		4, 5
10	R_C < 25 m		4, 5
11	R_C < 7.5 m		4, 5

➔ **Editor's Question:** Is it appropriate to revise the NIC Table above to represent the NIC Supplements as they were defined in either DO-260B or DO-282B? DCM Proposal: Add the new "common" NIC = 6 w/Supplement Bit / Rc < 0.3 NM (Is in both DO-260B and DO-282B) Do not include NIC = 6 / Rc < 0.5 NM – this value is unique to DO-260B. (Research lost Note #6 and add a Note for Rc < 0.3 NM) ←

Notes for Table 3.3.10a:

1. *NIC is reported by an aircraft because there will not be a uniform level of navigation equipage among all users. Although GNSS is intended to be the primary source of navigation data used to report ADS-B horizontal position, it is anticipated that during initial uses of ADS-B or during temporary GNSS outages an alternate source of navigation data may be used by the transmitting A/V for ADS-B position information.*
2. *"NIC" in this column corresponds to "NUC_P" of Table 2-1(a) in the first version of this MASPS, DO-242, dated February 19, 1998.*
3. *The containment radius for NIC = 2 has been changed (from the corresponding radius for NUC_P = 2 in the first edition of this MASPS) so as to correspond to the RNP-4 RNAV limit of DO-236A, rather than the RNP-5 limit of the earlier DO-236. This is because RNP-5 is not a recognized ICAO standard RNP value.*
4. *HIL/HPL may be used to represent R_C for GNSS sensors.*
5. *If geometric altitude is not being reported then the VPL tests are not assessed.*

It is recommended that the coded representations of NIC should be such that:

a. Equipment that conforms to the current edition of this MASPS ("version 2" equipment) or to the previous, DO-242A, edition ("version 1" equipment) will recognize the equivalent NUC_P codes from the first edition of this MASPS, and

b. Equipment that conforms to the initial, DO-242, edition of this MASPS ("version 0" equipment) will treat the coded representations of NIC coming from version 1 or 2 equipment as if they were the corresponding "NUC_P" values from the initial, DO-242, version of this MASPS.

3.3.11 Navigation Accuracy Category for Position (NAC_P)

The Navigation Accuracy Category for Position (NAC_P) is reported so that surveillance applications may determine whether the reported geometric position has an acceptable level of accuracy for the intended use.

Table 3.3.11a defines the navigation accuracy categories that **shall** (242AR2.31) be used to describe the accuracy of positional information in ADS-B messages from transmitting ADS-B participants. ~~The NAC_P value broadcast from an ADS-B participant **shall** (242AR2.32) include any inaccuracies in the reported horizontal position due to the transmitting participant's not correcting the horizontal position from the navigation sensor to that of the ADS-B position reference point (see §0).~~

Notes:

1. *"NIC" and "NAC_P" as used in this MASPS replace the earlier term, "NUC_P", used in the initial, DO-242, edition of this MASPS .*
2. *It is likely that ~~future~~ surface movement and runway incursion applications will require high NAC_P values. To obtain those high values, it may be necessary to correct the reported position to that of the ADS-B Position Reference Point (§3.3.4.1) if the antenna of the navigation sensor is not located in very close proximity to the ADS-B reference point.*

~~3. The processing to determine the degraded position accuracy reported in NAC_P may be performed outside the ADS-B transmitting subsystem when the reported position of an A/V is not corrected to that of the ADS-B Position Reference Point (i.e. the "reporting reference point position" CC code is set to ZERO).~~

4. *The Estimated Position Uncertainty (EPU) used in Table 3.3.11a is a 95% accuracy bound on horizontal position. EPU is defined as the radius of a circle, centered on the reported position, such that the probability of the actual position being outside the circle is 0.05. When reported by a GPS or GNSS system, EPU is commonly called HFOM (Horizontal Figure of Merit).*

5. *The EPU limit for NAC_P = 2 has been changed (from the corresponding limit for NUC_P = 2 in the first edition of this MASPS) so as to correspond to the RNP-4 RNAV limit of DO-236A, rather than the RNP-5 limit of the earlier DO-236. This is because RNP-5 is not an ICAO standard RNP value.*

Table 3.3.11a: Navigation Accuracy Categories for Position (NAC_P).

NAC_P	95% Horizontal Accuracy Bounds (EPU)		Notes
0	EPU ≥ 18.52 km (10 NM)		
1	EPU < 18.52 km (10 NM)		1
2	EPU < 7.408 km (4 NM)		1
3	EPU < 3.704 km (2 NM)		1
4	EPU < 1852 m (1NM)		1
5	EPU < 926 m (0.5 NM)		1
6	EPU < 555.6 m (0.3 NM)		1
7	EPU < 185.2 m (0.1 NM)		1
8	EPU < 92.6 m (0.05 NM)		1
9	EPU < 30 m		2
10	EPU < 10 m		2
11	EPU < 3 m		2

Notes for Table 3.3.11a:

1. *RNP accuracy includes error sources other than sensor error, whereas horizontal error for NAC_P only refers to horizontal position error uncertainty.*

2. *A non-excluded satellite failure requires that the NAC_P and NAC_V parameters be set to ZERO along with R_C being set to Unknown to indicate that the position accuracy and integrity have been determined to be invalid. Factors such as surface multi-path, which has been observed to cause intermittent setting of Label 130 bit 11, should be taken into account by the ADS-B application and ATC.*

3.3.12 Navigation Accuracy Category for Velocity (NAC_V)

The velocity accuracy category of the least accurate velocity component being supplied by the reporting A/V's source of velocity data **shall** (242AR2.33) be as indicated in Table 3.3.12a.

Notes:

1. *NAC_V is another name for the parameter that was called NUC_R in the initial (DO-242) version of this MASPS.*
2. *Navigation sources, such as GNSS and inertial navigation systems, provide a direct measure of velocity which can be significantly better than that which could be obtained by position differences.*
3. *Refer to Appendix TBD for guidance material on determination of NAC_V. Appendix TBD describes the manner in which GNSS position sources, which do not output velocity accuracy, can be characterized so that a velocity accuracy value associated with the position source can be input into ADS-B equipment as part of the installation process.*

Table 3.3.12a: Navigation Accuracy Categories for Velocity (NAC_V).

NAC_V	Horizontal Velocity Error (95%)
0	Unknown or ≥ 10 m/s
1	< 10 m/s
2	< 3 m/s
3	< 1 m/s
4	< 0.3 m/s

Notes for Table 3.3.12a:

1. *When an inertial navigation system is used as the source of velocity information, error in velocity with respect to the earth (or to the WGS-84 ellipsoid used to represent the earth) is reflected in the NAC_V value.*
2. *When any component of velocity is flagged as not available the value of NAC_V will apply to the other components that are supplied.*
3. *A non-excluded satellite failure requires that the R_C be set to Unknown along with the NAC_V and NAC_P parameters being set to ZERO.*

3.3.13 Source Integrity Level (SIL)

The Source Integrity Level (SIL) defines the probability of the reported horizontal position exceeding the containment radius defined by the NIC (§3.3.10 above), without alerting, assuming no avionics faults. Although the SIL assumes there are no unannunciated faults in the avionics system, the SIL must consider the effects of a faulted Signal-in-Space, if a Signal-in-Space is used by the position source. The probability of an avionics fault causing the reported horizontal position to exceed the radius of containment defined by the NIC, without alerting, is covered by the System Design Assurance (SDA) parameter. The Source Integrity Limit encoding **shall** (242AR2.34) be as indicated in Table 3.3.13a. The SIL probability can be defined as either "per sample" or "per hour."

Note: *It is assumed that SIL is a static (unchanging) value that depends on the position sensor being used. Thus, for example, if an ADS-B participant reports a NIC code of 0 because four or fewer satellites are available for a GPS fix, there would be no need to change the SIL code until a different navigation source were selected for the positions being reported in the SV report.*

Table 3.3.13a: Source Integrity Level (SIL) Encoding.

SIL	Probability of Exceeding the NIC Containment Radius
0	Unknown or > 1×10^{-3} per flight hour or per sample
1	1×10^{-3} per flight hour or per sample
2	1×10^{-5} per flight hour or per sample
3	1×10^{-7} per flight hour or per sample

3.3.14 Barometric Altitude Integrity Code (NIC_{baro})

The Barometric Altitude Integrity Code, NIC_{baro}, is a one-bit flag that indicates whether or not the barometric pressure altitude provided in the State Vector Report has been cross-checked against another source of pressure altitude.

Note: *NIC_{baro}, the barometric altitude integrity code, is reported in the Mode-Status report (§TBD.).*

3.3.15 Emergency/Priority Status

The ADS-B system **shall** (242AR2.36) be capable of supporting broadcast of emergency and priority status. Emergency/priority status is reported in the MS report (§TBD) and the emergency states are defined in the following Table 3.3.15a.

Table 3.3.15a Emergency State Encoding

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

3.3.16 System Design Assurance (SDA)

The System Design Assurance parameter is the probability of an undetected position transmission chain fault that would cause false or misleading position information to be transmitted. The position transmission chain includes the ADS-B transmission equipment, ADS-B processing equipment, position source and any other equipment that processes the position data and position quality metrics that will be transmitted.

3.3.17 GPS Antenna Offset

The GPS Antenna Offset is an encoded representation of the longitudinal and lateral position of the GNSS antenna referenced to the nose and centerline of the aircraft. The broadcast of these parameters allows the receiving systems in conjunction with the broadcast length/width code to determine the ADS-B position reference point of the reported position.

3.3.18 Geometric Vertical Accuracy (GVA)

The Geometric Vertical Accuracy parameter is an encoded representation of the 95% accuracy estimate of the geometric altitude (HAE) as output by the GNSS position source. In some GNSS position sources this output parameter is known as the Vertical Figure of Merit (VFOM).

3.3.19 TCAS Resolution Advisory (RA) Data Block – ~~Unique for 1090ES Messages~~

For those aircraft equipped with TCAS, in addition to the TCAS Resolution Advisory Active broadcast flag, the RA Message Block is also required to be broadcast during an active RA and following termination so that ADS-B receiving systems can sense the termination of the RA. The message subfields are the data elements that are specified in RTCA DO-185B §2.2.3.9.3.2.3.1.1.