International Civil Aviation Organization

FIFTEENH MEETING OF THE ADS-B STUDY AND IMPLEMENTATION TASK FORCE (ADS-B SITF/15)

Bangkok, Thailand, 18 - 20 April 2016

Agenda Item 4:   Review States' activities and interregional issues on implementation of ADS-B and multilateration.

U.S. ADS-B AVIONICS PERFORMANCE REPORT

(Presented by United States/Federal Aviation Administration)

SUMMARY

This paper describes a new reporting capability that the FAA is fielding to assist operators in understanding their aircraft's ADS-B avionics performance relative to the requirements of the U.S. ADS-B mandate.

1.   INTRODUCTION

1.1   This paper introduces a new ADS-B avionics performance report that FAA is making available to operators having aircraft equipped with DO-260B or DO-282B ADS-B Out equipment.

2.   DISCUSSION

2.1   This paper refers to an Attachment, which is the "User's Guide" for a new ADS-B avionics performance report that FAA is making available to operators this month at the URL: https://adsbperformance.faa.gov/PAPRRequest.aspx

2.2   This User's Guide both describes the report information available to an operator, and helps readers understand the scope of information that the FAA is collecting for all ADS-B Version 2 messages that are received by the FAA's ADS-B ground stations.

2.3   To obtain this information, the operator will need to know the aircraft's ICAO hexadecimal address and the date when their aircraft flew in U.S. airspace. If multiple flights occurred in a single day (as measured in the UTC date and time reference), then the information for the longest detected flight period will be returned to the requester.

3.   ACTION REQUIRED BY THE MEETING

3.1   The meeting is invited to:

    a) note the information contained in this paper; and

    b) discuss any relevant matters as appropriate.

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Attachment

Public ADS-B Performance Report (PAPR) User's Guide

Flight Standards Service
**Aircraft Maintenance Division,
Avionics Branch (AFS-360)**
July 7, 2016

Background – Public ADS-B Performance Report

The purpose of the Public ADS-B Performance Report (PAPR) is to provide requesting aircraft owners, operators, and avionics installers/maintainers with an additional method of verifying proper operation of ADS-B equipment.

The purpose of this user's guide is to provide information to aid in the interpretation of data associated with a PAPR and to provide general guidance to help resolve avionics issues identified within a PAPR.

PAPR data provides information on the performance of an aircraft's ADS-B system for a specific flight and will verify proper ADS-B system operation or identify specific parameters received by the FAA's ground system which failed to comply with established standards. ADS-B system performance data identified within a PAPR will be useful to aircraft avionics maintainers when performing post-installation compliance/configuration checks and fault isolation.

A PAPR is typically available 1 hour after flight termination at the following web address: https://adsbperformance.faa.gov/PAPRRequest.aspx. However, the availability of a PAPR may be delayed due to system maintenance or unexpected outages. In instances where a PAPR is not available from the above web address the user should send an email to the following address 9-AWA-AFS-300-ADSB-AvionicsCheck@faa.gov and include the following information:

1. Aircraft registration number (N-number) in subject line;
2. In the email body include:
    a. Flight identification code;
    b. Flight date and time;
    c. Make/model of ADS-B transmitter and GPS; and
    d. Any ADS-B avionics operating abnormalities observed or reported during the associated flight.

Note: When multiple flights are flown in a day, the longest flight (based on time duration) will be provided.

Part 1 – Public ADS-B Performance Report Explanation

The FAA collects data in the following flight phases by ADS-B link type (See Figure 1):

1. 1090 - Airborne
2. 1090 - Surface[1] (Outside RWY/Taxi area)
3. 1090 - Surface RWY/Taxi
4. UAT - Airborne
5. UAT - Surface (Outside RWY/Taxi area)
6. UAT - Surface RWY/Taxi

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[1] Surface information is only provided at U.S. locations where a surface service volume exists. As of this writing, this is limited to the 35 airports with an ASDE-X system and KSFO. Eight additional surface service volumes will be added as the Airport Surface Surveillance Capability (ASSC) is deployed.
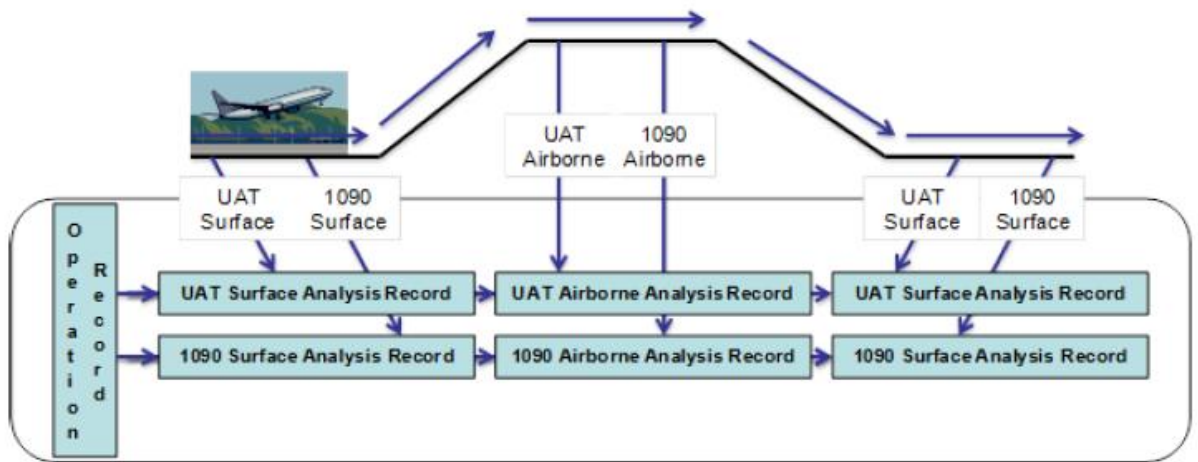
Illustration of how data is collected in operation and analysis records

Figure 1

Cover Page

The cover page contains basic information about the aircraft, flight date/time, and the type of ADS-B information received (1090, UAT, airborne/surface). Verify this information is correct.

U.S. Department of Transportation
Federal Aviation Administration
ADS-B Performance Monitor

Public ADS-B Performance Report

ICAO: AAABBB (12345678) **Tail Number:** NZZZZ   **Last Flight Id:** NZZZZ

Period: 11-28-2015 17:08:14 to 11-28-2015 18:__:14

ICAO code (Mode S address) received

Aircraft registration number corresponding to ICAO code

Last Flight Id received

Operation Analysis Overview

Flight date/time (UTC)

	Analysis
Airborne 1090	☑
Surface 1090	☐
Surface RWY/Taxi 1090	☐
Airborne UAT	☐
Surface UAT	☐
Surface RWY/Taxi UAT	☐

See Figure 1 for explanation

Prepared By

Surveillance and Broadcast Services (SBS) Program
ADS-B Performance Monitor

April 01, 2016

Note: Items high-lighted in red within this report indicate the ADS-B Out system installed on this aircraft failed to meet the corresponding performance requirement as specified in § 91.227.

For more information on this report, reference the User's Guide.

Each PAPR begins with an Operation Summary with specific information about the aircraft and flight.   An example of an Operation Summary Table and definitions are provided below.
Operation Summary Table Example

Operation Summary

Operation Id:	555555	**Start Time:**	11-26-2015 20:25:18
ICAO Reported:	AAABBB (12345678)	**End Time:**	11-26-2015 22:09:54
ICAO Assigned:	AAABBB(12345678)	**Duration:**	01:44:36 **Mod:** 01:32:36
Tail Number:	NZZZZ	**Total Reports:** 27806	**Best Msg:** 27679
Country:	United States - Civil	**Stationary:** No	**TIS-B Client %:** 0.0%

Detection: ☑Airborne ☑Surface

Link Version: 2	**Out Capability:** DUAL	**In Capability:** DUAL
Last Flight Id: NZZZZ		
Operator:		

Operation Summary Explanation Table

Operation Id: Unique number assigned to the flight record.		**Start Time:** Time flight was first monitored.
ICAO Reported & ICAO Assigned: The 24-bit ICAO address (hexadecimal & octal formats) received from the aircraft.		**End time:** Time flight was last monitored.
Tail Number: The N-number associated with the aircraft's reported ICAO code.	**Duration:** Duration of the monitored flight in hours, minutes, and seconds.	**Mod:** Flight duration minus any data gaps greater than 36 seconds.
Country: Country associated with aircraft registration (identified via received ICAO hexadecimal code).	**Total reports:** Number of ADS-B downlinks received during this operation.	**BestMSG**: Total reports minus any duplicate reports.
Detection: Flight mode(s) where aircraft was monitored (airborne and/or surface).	**Stationary Only:** "No" indicates aircraft was not stationary. "Yes" indicates aircraft was stationary for duration of this operation.	**TIS-B Client %:** Percentage of operation time TIS-B data was provided to the aircraft by the ADS-B ground system.
Link Version: Link version of ADS-B transmitter. Link Version 2 is required by 14 CFR 91.225 and 14 CFR 91.227.		
Last Flight Id: Last flight identification code received. This should be identical to the aircraft call sign used by ATC.	**Out Capability** Frequency used to transmit ADS-B data (i.e. 1090, 978/UAT, or Dual) or ADS-B OUT system type (UAT or 1090)	**In Capability:** Indication of capability to receive ADS-B data on specified link
Operator: Unique air operator identification code.		

Dual-Out Inconsistencies

If an aircraft is equipped with a 1090 and a UAT system and transmitting on both frequencies (referred to as Dual-Out) the following table will be provided to identify any differences in the data received from each system. In the table below, the FAA ground system is receiving length/width codes from the 1090 and UAT avionics that do not match (LWC field is

highlighted in red) for a Dual-Out equipped aircraft.   See Part 3 of this report for table header definitions.

Dual Out Inconsistencies:

Category	Emit Cat	Flight ID	Mode 3A	SAF	LWC	GPS Pos
% Fail	0.00%	0.00%	0.03%	0.00%	100.00%	100.00%
Max dT	00:00:00	00:00:00	00:00:04	00:00:00	00:02:56	00:02:56
MCF	0	0	4	0	338	338

Performance Analysis Summary Tables

Analysis Summary tables are presented in the PAPR for some, or all, of the following categories depending on the installed ADS-B avionics configuration (1090 only, UAT only, or Dual-Out), areas of operation, and availability of ADS-B coverage:
- Airborne - **1090**
- Surface - **1090** (Outside RWY/Taxi area)
- Surface RWY/Taxi - **1090**
- Airborne - **UAT**
- Surface - **UAT** (Outside RWY/Taxi area)
- Surface RWY/Taxi **UAT**

The following definitions apply to all tables in each performance assessment category:

Category	Definitions
% Fail	Percentage of flight that corresponding category element failed performance assessment.
Max dT	Total time during flight the message element failed performance assessment.
MCF	Maximum number of consecutive received ADS-B messages in which the element failed performance assessment.

An example of a Performance Analysis Summary table and summary term definitions are below.

Analysis Summary Example (Airborne 1090)

Airborne 1090 Analysis Summary

Start Time: 11-26-2015 20:25:18   **End Time:** 11-26-2015 22:06:55

Duration(s): 01:41:37   **Mod:** 01:24:47   **Processed Reports:** 13444   **Total Reports:** 13491

Link Version: 2   **Out Capability:** 1090   **In Capability:** UAT

Emitter Category: 1 - Light (<15,500lbs)   **Antenna(s):** 1 - Single

Last Flight Id: NZZZZ

Last Mode 3A: 4511

Exceptions:

NIC	NACp	NACv	SIL	SDA
Yes	Yes	Yes	Yes	No

Analysis Summary Explanation

Start Time: The start time of the flight as observed by ground monitoring.		**End Time:** The end time of the flight as observed by ground monitoring
Duration(s): Duration of flight in hours, minutes, and seconds	**Mod**: Duration minus any data gaps greater than 36 seconds.	**Processed Reports:** Number of reports processed by the ADS-B ground system.	**Total Reports:** Total reports including duplicates.
Link Version: Indicates which 1090/UAT standard the ADS-B equipment complies with e.g., for 1090 DO-260 = 0, DO-260A = 1, DO-260B = 2, etc.)	**Out Capability:** ADS-B OUT system type (UAT or 1090)		**In Capability:** ADS-B IN system type (UAT or 1090)
Emitter Category: Code associated with the aircraft's size, weight, or performance characteristics.	**Antenna(s):** Single or Dual (top and bottom) ADS-B antenna installed		
Last Flight Id: The last reported Flight ID received from the aircraft.			
Last Mode 3A: Last discrete Mode 3/A code received.			
Exceptions: **NIC/NAC/NACp/SIL/SDA Value:** Indicates if aircraft failed to meet performance requirements of identified parameter: **Yes = Fail No = Pass**			

Performance Assessment Tables

Following the Analysis Summary Table(s) are Performance Assessment Tables. ADS-B performance is divided into 4 major avionics assessment categories:

1. **Required Message Elements Checks (Missing Elements):** Check of 14 CFR §91.227 (d) specified message elements required for broadcast by ADS-B Out avionics.
2. **Integrity and Accuracy Checks:** Check of ADS-B Out NIC/NACp/NACv/SDA/SIL performance requirements specified by 14 CFR §91.227(c) (Ref. latest version of Advisory Circular (AC) 20-165 for additional information).

3. **Kinematics:** Includes reasonableness checks of changes in Baro/Geo altitude, horizontal position, and velocity.
4. **Other Checks:** Checks of specific message parameters for values outside an expected range or fields that are improperly formatted (ICAO address, Mode 3A, emitter category, etc.).

See Part 3 of this report for table header definitions.

1. **Missing Elements:** Missing elements will be highlighted in red by category if aircraft failed to meet performance requirements.

Missing Elements

Category	NACp	NACv	Vel	Flight Id	Mode 3A	Emit Cat	Baro Alt	Geo Alt
% Fail	0.00%	0.00%	0.00%	0.04%	0.00%	0.04%	0.00%	0.00%
Max dT	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00
MCF	0	0	0	1	0	1	0	0

2. **Integrity & Accuracy:** Failed Integrity & Accuracy categories will be highlighted in red if aircraft failed to meet performance requirements.

Integrity & Accuracy

Category	NIC	NACp	NACv	SIL	SDA
% Fail	100.00%	100.00%	100.00%	100.00%	0.00%
Max dT	01:36:25	01:36:25	01:36:25	01:36:25	00:00:00
MCF	13444	13444	13444	13444	0

Category	NIC	NACp	NACv	SIL	SDA
Avg	0.0	0.0	0.0	1.0	2.0
Min	0	0	0	1	2
Max	0	0	0	1	2

Note: If using an uncertified GPS (or portable transmitter) the system must report as SIL = 0 (zero). SIL=0 transmitters do not meet the requirements to become a TIS-B service Client.

3. **Kinematics:** A reasonableness check is made of changes in Baro/Geo Altitude, Position, and Velocity. Items highlighted in red were identified with position changes outside the range expected for normal aircraft performance.

Kinematics

	Velocity	Position Δ		Baro Alt	Baro Alt Δ	Geo Alt	Geo Alt Δ
% Fail	0.00%	0.00%		0.00%	0.00%	0.00%	0.00%
MCF	0	0		0	0	0	0

4. **Other Checks:** A percentage of the total operation (% Fail) and the maximum consecutive failures (MCF) that the ADS-B avionics failed to correctly broadcast these message elements.

Other Checks

	Emitter Cat	Mode 3A
% Fail	0.00%	0.00%
Max dT	00:00:00	00:00:00
MCF	0	0

	Flight ID	Mismatch	Non-US	No "N"	Only "N"	Partial	Spaces	All Spaces	Illegal Char	Unavail Char
% Fail	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Max dT	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00
MCF	0	0	0	0	0	0	0	0	0	0

	Air on Ground
% Fail	0.35
Max dT	00:00:29
MCF	25

Other Checks table header definitions (See Part 3 of this guide):

Emitter Category: Percent, total time, and max consecutive reports aircraft reported an Emitter Category = 0.

Mode 3A: Percent, total time, and max consecutive reports aircraft was flagged as having an invalid Mode 3/A. In the majority of cases, this indicates if the aircraft did not report Mode 3/A via ADS-B for some or all of the flight.

Flight Id: The received Flight ID code is assessed in the following ways:

1. **Flight ID** = Percent, total time, and max consecutive reports aircraft reported an incorrect Flight ID (any flight ID error)

2. **Mismatch** = Percent, total time, and max consecutive reports aircraft reported a N-Number Flight ID that doesn't match the N-Number derived from the ICAO (U.S. aircraft only) code.

3. **No-US** = Percent, total time, and max consecutive reports aircraft reported an N-Number Flight ID with an ICAO 24-bit address outside the U.S. block.

4. **No "N"** = Percent, total time, and max consecutive reports aircraft reported a N Number Flight ID without the leading "N".

5. **Only "N"** = Percent, total time, and max consecutive reports aircraft reported just "N" for flight ID.

6. **Partial** = Mostly for Air Carriers, percent, total time, and max consecutive reports aircraft reported a Flight ID missing the leading three letter identifier (e.g. 1234 vs JBU1234).

7. **Spaces** = Percent, total time, and max consecutive reports aircraft including a space within a Flight ID.

8. **All Spaces** = Percent, total time, and max consecutive reports aircraft reported a Flight ID with eight spaces.

9. **Illegal Character** = Percent, total time, and max consecutive reports aircraft reported a Flight ID with an Illegal Character.

10. **Unavail Character** = Percent, total time, and max consecutive reports aircraft reported a Flight ID with an Unavailable Character

Air on Ground: Percent, total time, and max consecutive reports the FAA ground system received airborne messages while the aircraft was on the ground.

Part 2 – Guidance for PAPR Faults

This section provides general guidance on common ADS-B performance issues and their possible causes. The information in this section is based on observations and feedback from avionics manufacturers, repair stations, and individual aircraft owner/operators. While the information is not specific to any make/model of ADS-B transmitter or GPS, users may find it helpful in determining a course of action to resolve issues identified within a PAPR.

PAPR Fault Table

PAPR Fault (red)	Possible Causes
Missing Elements and Integrity & Accuracy Category Problems	
NIC, NACv, NACp, SIL and/or SDA (100% fail)	• Component and/or software compatibility with position source • Improper system configuration
NIC, NACv, NACp, SIL and/or SDA (partial failure)	• Intermittent loss of GPS service • Antenna masking caused by maneuvering • Portion(s) of flight at fringe of ADS-B coverage • Component software issue
Flight Id (100% fail)	• Flight Id not configured in avionics
Flight Id missing (partial fail)	• Flight at fringe of ADS-B coverage
Mode 3/A (100% fail)	• Because the FAA ground system auto-populates ADS-B messages with 1200 when the Mode 3/A code is missing to prevent risk associated with potential ATC conflict alerts this

	field will always show as passed. Refer to "Other Checks" below for guidance on Mode 3/A issues.
Mode 3/A (partial failure)	• See "Other Checks" below
Baro Alt	• Loss of data from barometric pressure altitude source
Geo Alt	• Loss of geometric altitude data from GPS
Emitter Category (Missing and Other)	• Emitter category not configured into avionics
Flight Identification Code errors	• Flight Id not properly entered
Kinematics	
All parameters	• Component and/or software (version) compatibility
Other Checks	
Air on Ground (ADS-B system transmitting in Air mode while on the ground)	• Squat switch issue • GPS stall speed setting incorrect o Too low a stall speed will result in avionics transitioning to Air mode during high speed taxi or takeoff-roll o Avionics initializing in Air mode at startup

PAPR Fault Table (con't)

PAPR Fault (red)	Possible Causes
Other Checks (con't)	
Emitter Cat	• Inappropriate emitter category transmitted. e.g., many "Light" aircraft (<15,500 lbs) incorrectly transmit as "Small" aircraft (15,500 – 75K lbs).
Mode 3A (100% fail)	• Mode 3/A or Call-sign logic transmit function disabled (UAT specific) • Mode 3/A code input device not providing data to UAT system
Mode 3A (partial failure)	• Portion(s) of flight at fringes of ADS-B coverage • Improper pilot input (late turn on/early turn off of transponder)
No flight data found for specified date	• Aircraft transmitting wrong ICAO 24-bit address • Late day flight (flight times are recorded in UTC) • Flight with UAT system operated in anonymous mode. • Possible ADS-B service outage • Aircraft not transmitting ADS-B data

Part 3 - ADS-B TERMS, DESCRIPTIONS AND REFERENCES

Parameter Description

Field Name	Full name	Description
Airborne Msgs on Surface		Indication that airborne specific messages were received by the FAA ground system while aircraft was on the surface
All Spaces	Flight Id	Flight identification code contains all spaces
Anonymous		Indicates whether the unit is in Anonymous mode or not.
Baro Alt/ Baro Alt Δ	Barometric Altitude	Barometric altitude is sent and checked against aircraft performance criteria and flagged as invalid if determined to be incorrect or unreasonable. In general if the reported baro or geo alt is greater than 20,000 meters (65,616ft) or less than -200 meters (-656ft), the report is flagged for investigation. If there's a change in baro alt greater than 656 feet/sec (200m/s), then the report is flagged for investigation
Class A		Field marks classes of airspace the aircraft operated in during the flight. Part 91 Appendix D is a special class of airspace for certain airports.
Class B		
Class C		
Class D		
Class E		
Part 91AppD		
Country		Field Identifies the country of origin for the aircraft and the type of registration (e.g. United States- Civil, Military, etc.)
Dup ICAO	Duplicate ICAO	Each aircraft is assigned a unique ICAO 24-bit address. When two or more aircraft are monitored operating simultaneously with the same ICAO address both aircraft (correct & incorrect ICAO) will be flagged for Dup ICAO.
Dup ICAO Duration	Duration Dup ICAO operation occurred	This field marks the duration that a duplicate ICAO address is observed.
Duration		Total flight time measured in hours, minutes, and seconds.
Emitter Category		Indication of aircraft characteristics (type/size/weight/performance. Used by future ADS-B IN applications e.g., wake avoidance.

		Set A 0 = No ADS-B Emitter Category Information 1 = Light (< 15500 lbs) 2 = Small (15500 to 75000 lbs) 3 = Large (75000 to 300000 lbs) 4 = High Vortex Large (aircraft such as B-757) 5 = Heavy (> 300000 lbs) 6 = High Performance (> 5g acceleration and 400 kts) 7 = Rotorcraft
Flight ID	Flight Identification Code	This should match the aircraft call sign used in ATC communication. Must match the aircraft call sign in any filed flight plan.
Geo Alt/Geo Alt Δ	Geometric Altitude	Received geometric altitude is checked against aircraft performance criteria and flagged as invalid if determined to be incorrect or unreasonable. In general if the reported baro or geo alt is greater than 20,000 meters (65,616ft) or less than -200 meters (-656ft), the report is flagged. If there's a change in geo alt greater than 656 feet/sec (200m/s), this field will also be flagged.
ICAO Assigned		Unique six character ICAO 24-bit address assigned to an aircraft at registration. ICAO code is the same as the Mode S address.
ICAO Reported		Unique six character ICAO address transmitted by the aircraft.
Illegal Char	Flight ID illegal character	Flight ID contains an incorrect character (e.g., letter O in place of the number zero, etc.)
In capability		Indicates the link type transmitted for the ADS-B IN capability (1090/UAT).
Int/Acc	Integrity and Accuracy	Category of values including NIC, NACp, and NACv.
Kin	Kinematics	Category of exceptions that includes Baro Alt, Baro Alt Δ, Geo Alt, Geo Alt Δ, Velocity, Position Δ. Position error checks.
Length/Width Code		Code received that indicates the length and width of the aircraft.
Link Version		Field marking what version of ADS-B the transponder is using. §91.225 and §91.227 require Link Version 2.
MCF	Maximum Consecutive Failures	The number of non-performing reports received that occur in a row (consecutively). If an MCF exceeds its threshold, an MCF exception is identified for that parameter.
Mismatch		Percent, total time, and max consecutive reports aircraft reported a N-Number Flight ID that doesn't match the N-Number derived from the ICAO 24-bit address.
Missing report duration		Time period of flight segment that ADS-B data was not received from the aircraft. This can be caused by failure of the avionics or transiting in and out of ADS-B coverage.
Mode 3/A		Four digit code (ATC assigned or 1200) set by the pilot
NACp	Navigation Accuracy Category for	This field indicates the accuracy of the aircraft position being transmitted. §91.227 requires a minimum NACp of 8. A PAPR will be flagged red if the NACp of <8 duration exceeds

	Position	the allowable threshold.

Table A-13: Encoding of Navigation Accuracy Category for Position (NACp)

Coding (Binary)	Coding (Decimal)	Meaning = 95% Horizontal Accuracy Bounds (EPU)
0000	0	EPU ≥ 18.52 km (10 NM) - Unknown accuracy
0001	1	EPU < 18.52 km (10 NM) - RNP-10 accuracy
0010	2	EPU < 7.408 km (4 NM) - RNP-4 accuracy
0011	3	EPU < 3.704 km (2 NM) - RNP-2 accuracy
0100	4	EPU < 1852 m (1NM) - RNP-1 accuracy
0101	5	EPU < 926 m (0.5 NM) - RNP-0.5 accuracy
0110	6	EPU < 555.6 m (0.3 NM) - RNP-0.3 accuracy
0111	7	EPU < 185.2 m (0.1 NM) - RNP-0.1 accuracy
1000	8	EPU < 92.6 m (0.05 NM) - e.g., GPS (with SA)
1001	9	EPU < 30 m - e.g., GPS (SA off)
1010	10	EPU < 10 m - e.g., WAAS
1011	11	EPU < 3 m - e.g., LAAS
1100 - 1111	12 - 15	Reserved

NACp values < 8 will be flagged red.

NACv	Navigation Accuracy Category for velocity	(table and text below)

Navigation Accuracy Category for Velocity

Coding (Binary)	Coding (Decimal)	Horizontal Velocity Error
000	0	≥ 10 m/s
001	1	< 10 m/s
010	2	< 3 m/s
011	3	< 1 m/s
100	4	< 0.3 m/s

Navigation Accuracy Category for Velocity (NACv). NACv is based on design data provided by the position source manufacturer. The NACv may be updated dynamically from the position source, or set statically based on qualification of the position source.

(a) A NACv = 1 (< 10 m/s) may be permanently set at installation for GNSS equipment passing the tests identified in appendix 2, or may be set dynamically from velocity accuracy output of a position source qualified in accordance with the AC 20-165B appendix B guidance.

(b) A NACv = 2 (< 3 m/s) may be set dynamically from velocity accuracy output of a position source qualified in accordance with the appendix 2 guidance. NACv = 2 should not be permanently preset at installation, even if the position source has passed the tests identified in AC 20-165B appendix B.

A NACv = 3 or NACV = 4 should not be set based on GNSS velocity accuracy unless you can demonstrate to the FAA that the velocity accuracy actually meets the requirement.

NIC	Navigation Integrity Category	NIC encoding is used to indicate the radius of containment around the aircraft. §91.227 requires a minimum NIC of 7. NIC values of <7 will be flagged red within a PAPR when the MCF threshold is exceeded.

NIC Value	Radius of Containment (R$_C$)	Airborne			Surface		
		Airborne Position TYPE Code	NIC Supplement Codes A	B	Surface Position TYPE Code	NIC Supplement Codes A	C
0	R$_C$ unknown	0, 18 or 22	0	0	0, 8	0	0
1	R$_C$ < 20 NM (37.04 km)	17	0	0	N/A	N/A	N/A
2	R$_C$ < 8 NM (14.816 km)	16	0	0	N/A	N/A	N/A
3	R$_C$ < 4 NM (7.408 km)	16	1	1	N/A	N/A	N/A
4	R$_C$ < 2 NM (3.704 km)	15	0	0	N/A	N/A	N/A
5	R$_C$ < 1 NM (1852 m)	14	0	0	N/A	N/A	N/A
6	R$_C$ < 0.6 NM (1111.2 m)	13	1	1	8	0	1
	R$_C$ < 0.5 NM (926 m)	13	0	0	N/A	N/A	N/A
	R$_C$ < 0.3 NM (555.6 m)	13	0	1	8	1	0
7	R$_C$ < 0.2 NM (370.4 m)	12	0	0	8	1	1
8	R$_C$ < 0.1 NM (185.2 m)	11	0	0	7	0	0
9	R$_C$ < 75m	11	1	1	7	1	0
10	R$_C$ < 25m	10 or 21	0	0	6	0	0
11	R$_C$ < 7.5m	9 or 20	0	0	5	0	0
12	Reserved						
13	Reserved						
14	Reserved						
15	Reserved						

NIC Baro		NIC baro is a one bit field that is used to report if the altitude is being checked against another source of pressure altitude.

Coding	Meaning
0	The barometric altitude that is being reported in the Airborne Position Message is based on a Gilham coded input that has not been cross-checked against another source of pressure altitude
1	The barometric altitude that is being reported in the Airborne Position Message is either based on a Gilham code input that has been cross-checked against another source of pressure altitude and verified as being consistent, or is based on a non-Gilham coded source

No "N"		Percent, total time, and max consecutive reports aircraft reported a N Number Flight ID without the leading "N"
Non-US		Percent, total time, and max consecutive reports aircraft reported a N Number Flight ID and a ICAO 24-bit address outside the U.S. block
Operation Id		Unique flight identification number that is shown in the report to allow users to return to that operation to look at it again.
Other Checks		Category of checks that looks at assorted issues such as illegal characters in your flight ID, improper/missing Mode 3/A code, and Duplicate ICAO addresses. See Other Checks section in Part 1 of this document.
Only "N"		Percent, total time, and max consecutive reports aircraft reported just "N" for flight ID
Out Capability		Indicates the type of ADS-B Out link the transmitter operates on i.e., 1090, UAT, Dual (both links)
Partial		Mostly for Air Carriers, percent, total time, and max consecutive reports aircraft reported a Flight ID missing the leading three letter identifier
Processed reports		Number of ADS-B reports actually processed by the FAA ground system
Rule		This overall category fails is you fail any of the categories mandated. If this box is labeled no, the test was a success.
SDA	System Design Assurance	Measures the likelihood of bad data being sent. Pass for values 2 and 3

SDA Value (decimal)	SDA Value (binary)	Supported Failure Condition [Note 2]	Probability of Undetected Fault causing transmission of False or Misleading Information [Note 3,4]	Software & Hardware Design Assurance Level [Note 1,3]
0	00	Unknown/ No safety effect	$> 1 \times 10^{-3}$ per flight hour or Unknown	N/A
1	01	Minor	$\leq 1 \times 10^{-3}$ per flight hour	D
2	10	Major	$\leq 1 \times 10^{-5}$ per flight hour	C
3	11	Hazardous	$\leq 1 \times 10^{-7}$ per flight hour	B

SIL	Source Integrity Level	Measurement of the probability of not being within the containment radius. Pass for value 3 only

SIL Coding (Binary)	SIL Coding (Decimal)	Probability of Exceeding the NIC Containment Radius (R_C)
00	0	Unknown or $> 1 \times 10^{-3}$ per flight hour or per sample
01	1	$\leq 1 \times 10^{-3}$ per flight hour or per sample
10	2	$\leq 1 \times 10^{-5}$ per flight hour or per sample
11	3	$\leq 1 \times 10^{-7}$ per flight hour or per sample

Term	Name	Description
SILs	Source Integrity Level Supplement	This is a one bit field that informs the system if the SIL is being given on a per hour or a per sample basis, assigned as 0 or 1 respectively
SQL	Signal Quality Level	Measure of integrity of data sent. Not used to determine if an operation makes it onto the exception list
Stationary only		Field that marks if the recorded flight was stationary (ground only)
Tail Number		Number assigned to the aircraft at registration (N-number)
TIS-B Client %		% of flight time that the aircraft was provided TIS-B data.
Total reports		Total reports broadcast by the ADS-B transmitter
Type Registration		Type of registration associated with aircraft e.g. civil, military, etc.
UAT Only above 18k		When flagged, indicates UAT-Only equipped aircraft operating in Class A airspace (above 18K feet) where 1090 ADS-B equipment is required by 91.225.
Unavail Char		Percent, total time, and max consecutive reports aircraft reported a Flight ID with an Unavailable Character
Vel/ Position Δ	Velocity & Position delta	Velocity is encoded in ADS-B messages. The performance monitor checks these values against aircraft performance and flags an PAPR if the velocity is greater than 300 meters/sec (583 knots or a position is greater than 1,312 feet/sec (400m/s).
Vertical Velocity		Vertical Velocity is encoded in ADS-B messages. The performance monitor checks these values against aircraft performance and flags any unusual or unreasonable values

Additional information about ADS-B can be found in the following documents:
1. Advisory Circular (AC) 90-114(current version),, Automatic Dependent Surveillance-Broadcast (ADS-B) Operations
2. AC 20-165(current version), Airworthiness Approval of Automatic Dependent Surveillance – Broadcast (ADS-B) OUT Systems in Aircraft (guidance on ADS-B system design, certification, and installation).
3. Aeronautical Information Manual
4. 14 CFR §91.225 and 91.227