

Public ADS-B Performance Report (PAPR)

User's Guide



Flight Standards Service

ADS-B Focus Team

Aircraft Maintenance Division

Avionics Branch

March 2020

Background – Public ADS-B Performance Report

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

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 - Surface¹ (Outside RWY/Taxi area)
3. 1090 - Surface RWY/Taxi
4. UAT - Airborne
5. UAT - Surface (Outside RWY/Taxi area)
6. UAT - Surface RWY/Taxi

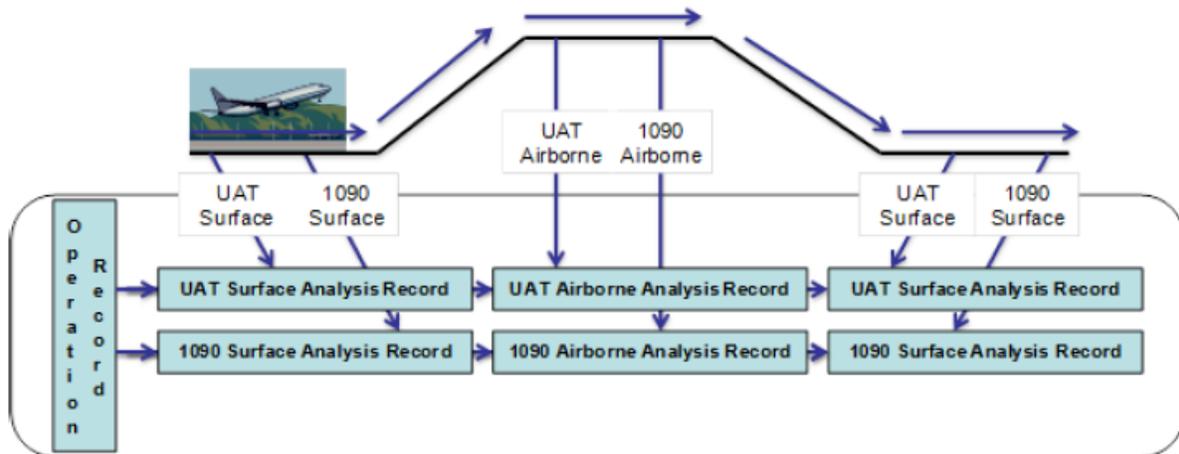


Illustration of how data is collected in operation and analysis records

Figure 1

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.

PAPR 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: AD5FE9 (12345678)
Period: 09/12/2017 05:47:51 to 09-12-2017 05:47:51

Tail Number: NZZZZ

Last Flight Id: NZZZZ

ICAO code (Mode S address) received

Aircraft registration number corresponding to ICAO code

Last Flight Id received

Aircraft is on No Services List. Please Review [Federal Register Notice](#)

Operation Analysis Overview

	Analysis
Airborne 1090	<input checked="" type="checkbox"/>
Surface 1090	<input type="checkbox"/>
Surface RWY/Taxi 1090	<input type="checkbox"/>
Airborne UAT	<input type="checkbox"/>
Surface UAT	<input type="checkbox"/>
Surface RWY/Taxi UAT	<input type="checkbox"/>

Flight date/time (UTC)

Aircraft is on the No Services Aircraft List (See Page 12)

See Figure 1 on previous page for explanation

Prepared By

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

October 12, 2017

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](#).

OMB Control No. 2120-0728 | Expiration Date 4/30/2017

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: 55555555	Start Time: 09-12-2017 05:47:51	
ICAO Reported: AAABBB (12345678)	End Time: 09-12-2017 07:10:22	
ICAO Assigned: AAABBB (12345678)	Duration: 01:22:31	Mod: 01:22:31
Tail Number: NZZZZ	Reports: 10419	Best Msg: 9033
Country: United States - Civil	Stationary: No	Baro Alt (ft): 36975 - 37000
Detection: <input checked="" type="checkbox"/> Airborne <input type="checkbox"/> Surface		
Link Version: 2	Out Capability: 1090	In Capability:
Last Flight Id: NZZZZ		
Operator: ABC		

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 24-bit 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).	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.	Baro Alt (ft): The minimum and maximum Barometric Pressure altitude reported by the aircraft.	Rule: Time spent within ADS-B Out Rule Airspace. Rule Airspace is defined in 14 CFR Part 91.225.
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)	
Operator: Unique air operator identification code.		In Capability: Indication of capability to receive ADS-B data on specified link

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 PAPER 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.

Note: An example of a Performance Analysis Summary table and summary term definitions are provided on the next page.

Performance Assessment Tables

ADS-B equipment performance is divided into the following 4 major 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 (24-bit 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
% Fail	0.00%	0.00%	27.15%	0.00%	0.00%	0.00%
Max dT	00:00:00	00:00:00	00:01:13	00:00:00	00:00:00	00:00:00
MCF	0	0	68	0	0	0

2. **Integrity & Accuracy:** Failed Integrity & Accuracy categories will be highlighted in red if aircraft failed to meet performance requirements. The FAA has not approved, or otherwise evaluated, any ADS-B position source with the horizontal velocity accuracy performance required to transmit a NACv value greater than 2 (NACv of 2 = Estimated Velocity Uncertainty <3 m/s). When NACv MIN and/or AVG are highlighted yellow in the Integrity & Accuracy table of the report (i.e. transmitted NACv MIN/AVG is 3 or 4) you are advised to contact your installer and/or applicable ADS-B avionics manufacturer for guidance on how to change the NACv value to that approved by the FAA at certification, or for non-certified equipment, a NACv value not to exceed 2 without FAA evaluation.

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

Integrity & Accuracy 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	
% Fail	0.00%	0.00%	
MCF	0	0	

Baro Alt	Baro Alt Δ	Geo Alt	Geo Alt Δ
0.00%	0.00%	0.00%	0.00%
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	Tail # Mismatch	Non-US	No "N"	Only "N"	Partial	Spaces	All Spaces	Illegal Char	Unavail Char	FP ID Mismatch
% Fail	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.13%	0.00%	0.13%	0.00%	0.00%
Max dT	00:00:02	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:02	00:00:00	00:00:02	00:00:00	
MCF	2	0	0	0	0	0	2	0	2	0	

	Air on Ground
% Fail	0.00%
Max dT	00:00:00
MCF	0

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. **Tail # 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 24-bit 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 24-bit ICAO address outside the U.S. block.

4. **No “N”** = Percent, total time, and max consecutive reports aircraft reported an N Number Flight ID without the leading “N” (e.g., 123AB vs N123AB).
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.
11. **FP ID Mismatch** = Percent of total flight the aircraft's transmitted Flight ID did not match the aircraft identification information filed on the applicable flight plan.
Note: The FP ID Mismatch field can be disregarded when no flight plan was filed for the flight associated with the PAPR.
12. **Air on Ground** = Percent, total time, and max consecutive reports the FAA ground system received airborne formatted 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 Field)	Possible Causes
Missing Elements and Integrity & Accuracy Category Problems	
NIC, NACv, NACp, SIL and/or SDA (100% fail)	<ul style="list-style-type: none"> • Component and/or software compatibility with position source • Improper system configuration
NIC, NACv, NACp, SIL and/or SDA (partial failure)	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • Flight ID not configured in avionics or Flight ID transmit is inhibited
Flight ID missing (partial fail)	<ul style="list-style-type: none"> • Flight at fringe of ADS-B coverage
Mode 3/A (100% fail)	<ul style="list-style-type: none"> • 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 should always show as passed. Refer to “Other Checks” below for guidance on Mode 3/A issues.
Mode 3/A (partial failure)	<ul style="list-style-type: none"> • See “Other Checks” below
Baro Alt	<ul style="list-style-type: none"> • Loss of data from barometric pressure altitude source (encoder)
Geo Alt	<ul style="list-style-type: none"> • Loss of geometric altitude data from GPS
Emitter Category (Missing and Other)	<ul style="list-style-type: none"> • Emitter category not configured into avionics or misconfigured
Flight Identification Code errors	<ul style="list-style-type: none"> • Flight ID not properly entered
Kinematics	
All parameters	<ul style="list-style-type: none"> • Component and/or software (version) compatibility
Other Checks	
Air on Ground (ADS-B system transmitting in Air mode while on the ground)	<ul style="list-style-type: none"> • Squat switch issue • GPS stall speed setting incorrect <ul style="list-style-type: none"> ○ Too low a stall speed will result in avionics transitioning to Air mode during high speed taxi or takeoff-roll ○ Avionics initializing in Air mode at startup

PAPR Fault Table (continued)	
PAPR Fault (red)	Possible Causes
Other Checks (continued)	
Emitter Cat	<ul style="list-style-type: none"> • Inappropriate emitter category transmitted. e.g., many “Light” aircraft (<15,500 lbs) incorrectly transmit as “Small” aircraft (15,500 – 75K lbs). • Rotorcraft transmitting fixed-wing emitter category
Mode 3A (100% fail)	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Aircraft transmitting wrong 24-bit ICAO 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

ADS-B No Services Aircraft List (NSAL) Information

Background: Reference FAA Notice Docket Number: FAA-2017-1194. To reduce the potential hazard presented by ADS-B non-performing equipment (NPE) aircraft, the FAA began filtering individual 24-bit ICAO address codes (also known as Mode S codes) for certain NPE aircraft from the FAA's operational ADS-B network on January 2, 2018. The filtering process is managed through an exclusion list referred to as the No Services Aircraft List (NSAL) which prevents processing of data within ATC systems transmitted by aircraft contained on the list. Aircraft on the NSAL cannot be provided ATC services (via ADS-B data) and are excluded from the provision of TIS-B services. If authorized by ATC, traffic services for aircraft on the NSAL may be supported via the backup transponder/radar surveillance system. The NSAL has no impact on an ADS-B equipped aircraft's air-to-air capabilities.

Aircraft on the NSAL are identified by “Aircraft is on No Services List” on the cover page of an applicable PAPR. Since aircraft on the NSAL cannot be detected by ATC via their transmitted ADS-B data, each operation conducted in §91.225 airspace by aircraft on the NSAL must be authorized by ATC before flight. ATC authorization can be requested for flights to verify ADS-B system corrective actions by completing the ADS-B Deviation Authorization Preflight Tool (ADAPT) web form, selecting “unequipped” for both the ADS-B Position Source TSO and ADS-B Link TSO options in Block 11 and submitting the form. From the SAPT results page click “Request an Authorized Deviation for this flight” located at the bottom of the page and complete the deviation request form selecting “NSAL Verification Flight” from the Reason for Request dropdown menu and include any pertinent information about the flight in the comments section (e.g., flight is to verify ADS-B system performance following corrective action, etc) and click submit. Follow the guidance provided on the request results screen.

Procedures for removal of aircraft from the NSAL: The FAA provides written notice of NPE aircraft (with applicable NSAL information) to the person/entity and address associated with the aircraft's registration. Owner/operators receiving an NPE notification should contact the FAA representative identified on the letter as soon as possible. When a PAPR indicates an aircraft is on the NSAL but a NPE notification letter has not been

received by the owner/operator, contact the FAA at the following email address: 9-AWA-AFS-300-ADSB-AvionicsCheck@faa.gov providing the PAPER associated with the aircraft's most recent flight. An FAA representative will contact you as soon as possible to discuss details associated with the performance of subject ADS-B equipment.

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 24-bit ICAO address. When two or more aircraft are monitored operating simultaneously with the same 24-bit ICAO address both aircraft (correct & incorrect 24-bit ICAO) will be flagged for Dup ICAO.
Dup ICAO Duration	Duration Dup ICAO operation occurred	This field marks the duration that a duplicate 24-bit 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. <u>Set A</u> 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 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 24-bit ICAO 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 Position	<p>This field indicates the accuracy of the aircraft position being transmitted. §91.227 requires a minimum NACp of 8. A PAPER will be flagged red if the NACp of <8 duration exceeds the allowable threshold.</p> <p>Table A-13: Encoding of Navigation Accuracy Category for Position (NACp)</p> <table border="1"> <thead> <tr> <th colspan="2">Coding</th> <th rowspan="2">Meaning = 95% Horizontal Accuracy Bounds (EPU)</th> </tr> <tr> <th>(Binary)</th> <th>(Decimal)</th> </tr> </thead> <tbody> <tr> <td>0000</td> <td>0</td> <td>EPU ≥ 18.52 km (10 NM) - Unknown accuracy</td> </tr> <tr> <td>0001</td> <td>1</td> <td>EPU < 18.52 km (10 NM) - RNP-10 accuracy</td> </tr> <tr> <td>0010</td> <td>2</td> <td>EPU < 7.408 km (4 NM) - RNP-4 accuracy</td> </tr> <tr> <td>0011</td> <td>3</td> <td>EPU < 3.704 km (2 NM) - RNP-2 accuracy</td> </tr> <tr> <td>0100</td> <td>4</td> <td>EPU < 1852 m (1NM) - RNP-1 accuracy</td> </tr> <tr> <td>0101</td> <td>5</td> <td>EPU < 926 m (0.5 NM) - RNP-0.5 accuracy</td> </tr> <tr> <td>0110</td> <td>6</td> <td>EPU < 555.6 m (0.3 NM) - RNP-0.3 accuracy</td> </tr> <tr> <td>0111</td> <td>7</td> <td>EPU < 185.2 m (0.1 NM) - RNP-0.1 accuracy</td> </tr> <tr> <td>1000</td> <td>8</td> <td>EPU < 92.6 m (0.05 NM) - e.g., GPS (with SA)</td> </tr> <tr> <td>1001</td> <td>9</td> <td>EPU < 30 m - e.g., GPS (SA off)</td> </tr> <tr> <td>1010</td> <td>10</td> <td>EPU < 10 m - e.g., WAAS</td> </tr> <tr> <td>1011</td> <td>11</td> <td>EPU < 3 m - e.g., LAAS</td> </tr> <tr> <td>1100 - 1111</td> <td>12 - 15</td> <td>Reserved</td> </tr> </tbody> </table> <p>NACp values < 8 will be flagged red.</p>	Coding		Meaning = 95% Horizontal Accuracy Bounds (EPU)	(Binary)	(Decimal)	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
Coding		Meaning = 95% Horizontal Accuracy Bounds (EPU)																																												
(Binary)	(Decimal)																																													
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																																												
NACv	Navigation Accuracy Category for velocity	<table border="1"> <thead> <tr> <th colspan="3">Navigation Accuracy Category for Velocity</th> </tr> <tr> <th colspan="2">Coding</th> <th rowspan="2">Horizontal Velocity Error</th> </tr> <tr> <th>(Binary)</th> <th>(Decimal)</th> </tr> </thead> <tbody> <tr> <td>000</td> <td>0</td> <td>≥ 10 m/s</td> </tr> <tr> <td>001</td> <td>1</td> <td>< 10 m/s</td> </tr> <tr> <td>010</td> <td>2</td> <td>< 3 m/s</td> </tr> <tr> <td>011</td> <td>3</td> <td>< 1 m/s</td> </tr> <tr> <td>100</td> <td>4</td> <td>< 0.3 m/s</td> </tr> </tbody> </table> <p>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.</p> <p>(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.</p> <p>(b) A NACv = 2 (< 3 m/s) may be set dynamically from velocity accuracy output of a position source qualified in accordance with the</p>	Navigation Accuracy Category for Velocity			Coding		Horizontal Velocity Error	(Binary)	(Decimal)	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																																														
Coding		Horizontal Velocity Error																																												
(Binary)	(Decimal)																																													
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																																												

		<p>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.</p> <p>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.</p>																																																																																																																																																																
NIC	Navigation Integrity Category	<p>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.</p> <table border="1"> <thead> <tr> <th rowspan="3">NIC Value</th> <th rowspan="3">Radius of Containment (R_c)</th> <th colspan="3">Airborne</th> <th colspan="3">Surface</th> </tr> <tr> <th rowspan="2">Airborne Position TYPE Code</th> <th colspan="2">NIC Supplement Codes</th> <th rowspan="2">Surface Position TYPE Code</th> <th colspan="2">NIC Supplement Codes</th> </tr> <tr> <th>A</th> <th>B</th> <th>A</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>R_c unknown</td> <td>0, 18 or 22</td> <td>0</td> <td>0</td> <td>0, 8</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>R_c < 20 NM (37.04 km)</td> <td>17</td> <td>0</td> <td>0</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>2</td> <td>R_c < 8 NM (14.816 km)</td> <td>16</td> <td>0</td> <td>0</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>3</td> <td>R_c < 4 NM (7.408 km)</td> <td>16</td> <td>1</td> <td>1</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>4</td> <td>R_c < 2 NM (3.704 km)</td> <td>15</td> <td>0</td> <td>0</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>5</td> <td>R_c < 1 NM (1852 m)</td> <td>14</td> <td>0</td> <td>0</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td rowspan="2">6</td> <td>R_c < 0.6 NM (1111.2 m)</td> <td>13</td> <td>1</td> <td>1</td> <td>8</td> <td>0</td> <td>1</td> </tr> <tr> <td>R_c < 0.5 NM (926 m)</td> <td>13</td> <td>0</td> <td>0</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td rowspan="2">7</td> <td>R_c < 0.3 NM (555.6 m)</td> <td>13</td> <td>0</td> <td>1</td> <td>8</td> <td>1</td> <td>0</td> </tr> <tr> <td>R_c < 0.2 NM (370.4 m)</td> <td>12</td> <td>0</td> <td>0</td> <td>8</td> <td>1</td> <td>1</td> </tr> <tr> <td>8</td> <td>R_c < 0.1 NM (185.2 m)</td> <td>11</td> <td>0</td> <td>0</td> <td>7</td> <td>0</td> <td>0</td> </tr> <tr> <td>9</td> <td>R_c < 75m</td> <td>11</td> <td>1</td> <td>1</td> <td>7</td> <td>1</td> <td>0</td> </tr> <tr> <td>10</td> <td>R_c < 25m</td> <td>10 or 21</td> <td>0</td> <td>0</td> <td>6</td> <td>0</td> <td>0</td> </tr> <tr> <td>11</td> <td>R_c < 7.5m</td> <td>9 or 20</td> <td>0</td> <td>0</td> <td>5</td> <td>0</td> <td>0</td> </tr> <tr> <td>12</td> <td></td> <td colspan="6">Reserved</td> </tr> <tr> <td>13</td> <td></td> <td colspan="6">Reserved</td> </tr> <tr> <td>14</td> <td></td> <td colspan="6">Reserved</td> </tr> <tr> <td>15</td> <td></td> <td colspan="6">Reserved</td> </tr> </tbody> </table>	NIC Value	Radius of Containment (R _c)	Airborne			Surface			Airborne Position TYPE Code	NIC Supplement Codes		Surface Position TYPE Code	NIC Supplement Codes		A	B	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	7	R _c < 0.3 NM (555.6 m)	13	0	1	8	1	0	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 Value	Radius of Containment (R _c)	Airborne			Surface																																																																																																																																																													
		Airborne Position TYPE Code			NIC Supplement Codes		Surface Position TYPE Code	NIC Supplement Codes																																																																																																																																																										
			A	B	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																																																																																																																																																											
7	R _c < 0.3 NM (555.6 m)	13	0	1	8	1	0																																																																																																																																																											
	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		<p>NIC baro is a one-bit field that is used to report if the altitude is being checked against another source of pressure altitude.</p> <table border="1"> <thead> <tr> <th>Coding</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>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</td> </tr> <tr> <td>1</td> <td>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</td> </tr> </tbody> </table>	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																																																																																																																																																										
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 24-bit ICAO 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 24-bit 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 if you fail any of the categories mandated. If this box is labeled no, the test was a success.																																																																																																																																																																
		Measures the likelihood of bad data being sent. Pass for values 2 and 3																																																																																																																																																																

SDA	System Design Assurance	<table border="1"> <thead> <tr> <th colspan="2">SDA Value</th> <th rowspan="2">Supported Failure Condition <small>Note 2</small></th> <th rowspan="2">Probability of Undetected Fault causing transmission of False or Misleading Information <small>Note 3,4</small></th> <th rowspan="2">Software & Hardware Design Assurance Level <small>Note 1,3</small></th> </tr> <tr> <th>(decimal)</th> <th>(binary)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>00</td> <td>Unknown/ No safety effect</td> <td>$> 1 \times 10^{-3}$ per flight hour or Unknown</td> <td>N/A</td> </tr> <tr> <td>1</td> <td>01</td> <td>Minor</td> <td>$\leq 1 \times 10^{-3}$ per flight hour</td> <td>D</td> </tr> <tr> <td>2</td> <td>10</td> <td>Major</td> <td>$\leq 1 \times 10^{-5}$ per flight hour</td> <td>C</td> </tr> <tr> <td>3</td> <td>11</td> <td>Hazardous</td> <td>$\leq 1 \times 10^{-7}$ per flight hour</td> <td>B</td> </tr> </tbody> </table>	SDA Value		Supported Failure Condition <small>Note 2</small>	Probability of Undetected Fault causing transmission of False or Misleading Information <small>Note 3,4</small>	Software & Hardware Design Assurance Level <small>Note 1,3</small>	(decimal)	(binary)	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
		SDA Value		Supported Failure Condition <small>Note 2</small>				Probability of Undetected Fault causing transmission of False or Misleading Information <small>Note 3,4</small>	Software & Hardware Design Assurance Level <small>Note 1,3</small>																				
		(decimal)	(binary)																										
		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																											
		<table border="1"> <thead> <tr> <th colspan="2">SIL Coding</th> <th rowspan="2">Probability of Exceeding the NIC Containment Radius (R_c)</th> </tr> <tr> <th>(Binary)</th> <th>(Decimal)</th> </tr> </thead> <tbody> <tr> <td>00</td> <td>0</td> <td>Unknown or $> 1 \times 10^{-3}$ per flight hour or per sample</td> </tr> <tr> <td>01</td> <td>1</td> <td>$\leq 1 \times 10^{-3}$ per flight hour or per sample</td> </tr> <tr> <td>10</td> <td>2</td> <td>$\leq 1 \times 10^{-5}$ per flight hour or per sample</td> </tr> <tr> <td>11</td> <td>3</td> <td>$\leq 1 \times 10^{-7}$ per flight hour or per sample</td> </tr> </tbody> </table>	SIL Coding		Probability of Exceeding the NIC Containment Radius (R_c)	(Binary)	(Decimal)	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										
		SIL Coding		Probability of Exceeding the NIC Containment Radius (R_c)																									
		(Binary)	(Decimal)																										
		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																											
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 a PAPR if the <u>velocity</u> 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