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FEDERAL AVIATION ADMINISTRATION
National Policy

ORDER
8200.45

Effective Date:
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SUBJ: Automatic Dependent Surveillance-Broadcast (ADS-B) Flight Inspection

This order describes the procedures and requirements for the flight inspection of Automatic Dependent Surveillance - Broadcast (ADS-B) services. ADS-B is a surveillance service used to support separation assurance and traffic flow management. ADS-B is a service within the portfolio of services known as Surveillance and Broadcast Services (SBS). The Surveillance and Broadcast Services Subsystem (SBSS) is the ground-based portion of the SBS. The SBSS is designed, built, and maintained by the FAA's primary contractor (the service provider) according to the direction of the SBS Program Office. The SBSS supports four different services: ADS-B, ADS-Rebroadcast (ADS-R), Traffic Information Services - Broadcast (TIS-B), and Flight Information Services - Broadcast (FIS-B). The ADS-B surveillance service is referred to as Automatic Dependent Surveillance Services (ADSS). Air Traffic Control (ATC) automation systems process and display ADS-B targets similar to traditional radar targets.

Flight Inspection is part of the Implementation System Test (IST) for ADSS. The flight inspection is designed to be an end-to-end check of ADS-B based ATC Surveillance and Separation Services. Simultaneously, an assessment is made of ADS-B Advisory Services. The objective of the commissioning flight inspection is to provide an objective means for FAA engineering Technical Operations and air traffic services to verify and quantify the extent to which the service meets ATC operational requirements. Post flight analysis of the data collected during the flight inspection is used to assess the coverage, functionality, and accuracy of all the ADS-B services. Flight inspection may also be needed to support other flight testing required for maintenance or modification of ADS-B services.

Edward W. Lucke, Jr.
Director
Flight Inspection Services

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Chapter 1: General Information.

1. Purpose of this Order. This document describes the procedures for the flight inspection of Automatic Dependent Surveillance-Broadcast (ADS-B) services.

2. Audience. Air Traffic Technical Operations Eastern, Central, and Western Service Areas; Flight Inspection Operations Offices and crewmembers in Flight Inspection Services; Flight Standards Flight Technologies and Procedures Division; NAS Engineering Implementation Centers; Air Traffic Organization Surveillance and Broadcast Services (SBS) Program Office; and special military addressees.

3. Where Can I Find This Order? This order can be found at https://employees.faa.gov/tools_resources/orders_notices/ or http://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.information/documentID/1025648.

Chapter 2: ADS-B Description.

1. ADS-B System Description. ADS-B Surveillance is a service within the portfolio of services known as Surveillance and Broadcast Services (SBS). The deployment and service lifecycle of SBS is managed out of the SBS Program Office. The Surveillance and Broadcast Services Subsystem (SBSS) is the ground-based portion of the SBS. It includes radio stations, control stations, and network connections that enable the service to operate. The SBSS is designed, built, and maintained by the FAA's primary contractor (the service provider) according to the direction of the SBS Program Office. The SBSS supports four different services: Automatic Dependent Surveillance - Broadcast (ADS-B), ADS-Rebroadcast (ADS-R), Traffic Information Services - Broadcast (TIS-B), and Flight Information Services - Broadcast (FIS-B).

ADS-B is a surveillance service used to support separation assurance and traffic flow management. The SBSS receives, processes, and validates position reports broadcast from properly equipped aircraft and distributes this information to Air Traffic Control (ATC) automation systems at designated Service Delivery Points (SDPs). The service is referred to as Automatic Dependent Surveillance Services (ADSS) in the Technical Operations maintenance handbooks and facility records. This service is also monitored by the SBS Monitor (SBSM), developed and maintained by FAA Technical Operations. The automation system processes and displays ADS-B targets to ATC similar to traditional radar targets including safety alerting functions such as minimum safe altitude warnings (MSAW) and traffic conflict alerts (CA). The SBSS also provide service and system status information to the automation platforms. The data, status, and traffic information is used by the FAA Automation Specialists in certifying ADSS for use by ATC.

The SBSM receives ADS-B target reports and system status information. It is used to confirm performance, validate contractor compliance, and report service status to the FAA Operational Control Centers (OCC) who track and report service interruptions with NOTAMs. The OCC, either through observations of the SBSM or by contact from the affected ATC facility, communicates maintenance and performance issues to the service provider. FAA Technical Operations uses the SBS Monitor data for analysis and reports data quality and service availability to FAA stakeholders and other authorized local and remote users.

2. ADS-B Out Avionics Description. The aircraft "ADS-B Out" avionics subsystem receives various inputs to generate and transmit ADS-B messages. The avionics function receives time, horizontal and vertical position, and (derived) speed from an onboard GNSS receiver and barometric pressure altitude from an onboard altitude encoder. The avionics function also receives pilot entries for aircraft identification (e.g., beacon code and call sign). The avionics then assembles the information into a digital ADS-B message for broadcast through the installed antenna. Typically, any given aircraft will have only one of the ADS-B Out data links installed: 1090-Extended Squitter (1090ES), at 1090 MHz; or Universal Access Transceiver (UAT), at 978 MHz.

3. ADS-R Description. Because aircraft on one data link cannot receive ADS-B data from aircraft on the other link, a method was established to "translate" ADS-B messages between data links. While the specific implementations on the aircraft may vary within the standards for the avionics, essentially if a message is received by the ground infrastructure via the UAT data link, it is made available for "rebroadcast" via the 1090 data link, and vice-versa. ADS-R transmissions are only triggered when certain conditions are met. When the ground system determines there are aircraft operating on opposite link types within a certain proximity of each other (distance and altitude), it will rebroadcast the data.

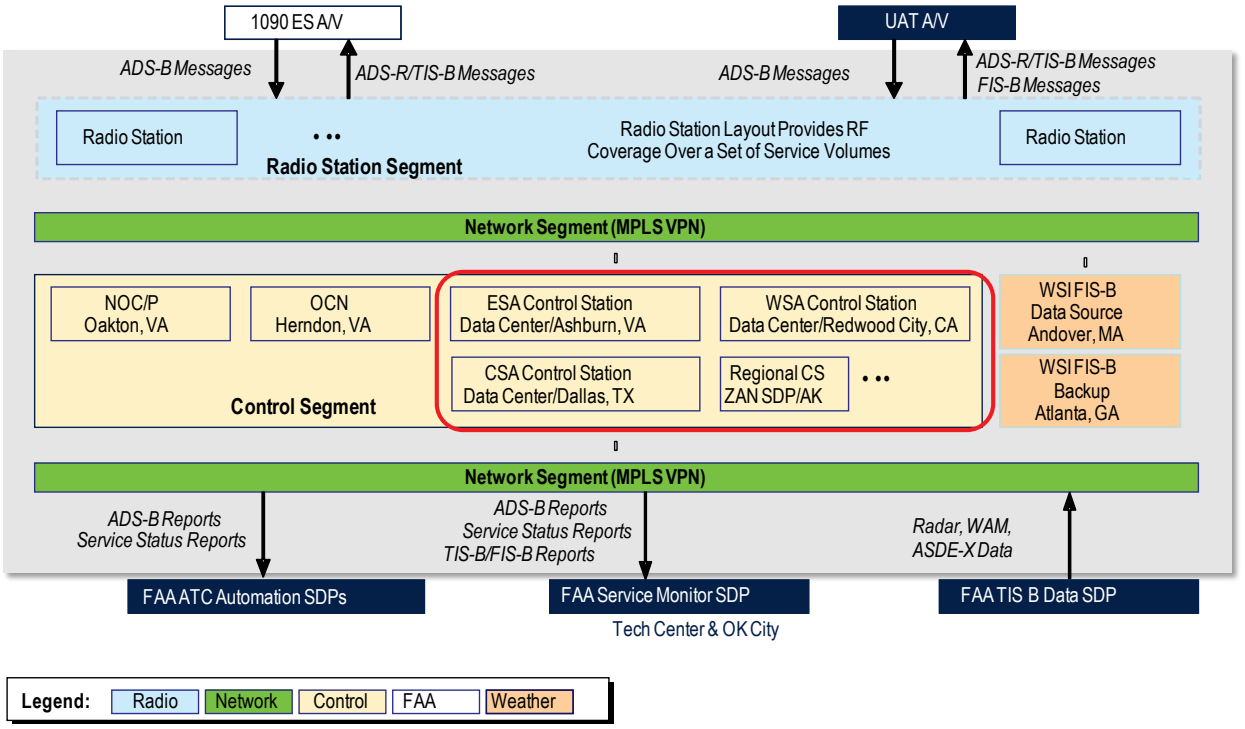
4. TIS-B Description. The SBS ground infrastructure will support airborne and ground-based applications by broadcasting TIS-B messages for targets detected and reported by radar, multilateration, and Airport Surface Detection Equipment – Model X (ASDE-X). The data is transmitted by the SBSS system on both the UAT and 1090ES data links for reception by equipped aircraft. ADS-B targets are suppressed in the TIS-B broadcast in order to minimize the display of duplicate targets in aircraft applications.

TIS-B Service, as specified in the SBS Essential Services Specification, is permitted for the Enhanced Visual Acquisition (EVA) and the Airport Surface Situational Awareness applications only. TIS-B is an advisory service that is not designed for aircraft surveillance or separation, and cannot be used for either purpose.

5. FIS-B Description. Flight Information Service – Broadcast (FIS-B) is a service that provides the broadcast of weather and pilot advisory information which supports safe and efficient operations. FIS-B is a tool targeted to benefit General Aviation situation awareness and is only available on the UAT link. Below is a list of the Basic Meteorological and Aeronautical Information Products contained in the FIS-B message:

- **a.** Airman's Meteorological Information (AIRMET)
- **b.** Aviation Routine Weather Report (METAR) and Unscheduled Specials (SPECI)
- **c.** Next Generation Radar (NEXRAD) precipitation reflectivity (CONUS and Regional)
- **d.** Pilot Reports (PIREPS) (urgent and routine)
- **e.** Significant Meteorological Information (SIGMET) (including Convective SIGMET)
- **f.** Terminal Area Forecast (TAF) and unscheduled Amendments (AMEND)
- **g.** Winds and Temperatures Aloft
- **h.** Distant (D) and Flight Data Center (FDC) Notices to Airmen (NOTAMs) important to flight safety or currently not documented in the FAA NOTAM Bulletin
- **i.** Status of Special Use Airspace (SUA)
- **j.** TIS-B Service Status

Figure 1. Simplified ADS-B Block Diagram.



6. ADS-B Service Volumes and Composite Traffic Volumes. A Service Volume (SV) is a defined volume of airspace in the NAS within which a set of ADS-B Services are provided and the required performance for the set of services is achieved. A Composite Traffic Volume (CTV) is the aggregation of reports from multiple Service Volumes. The reports within a CTV are filtered spatially according to a specified polygon and to eliminate radio station duplicates. SVs in three different airspace domains are defined. En Route SVs are configured as CTVs. They have polygon shapes with vertices that define the boundaries, typically aligned with the division of airspace among Air Route Traffic Control Centers (ARTCC). The En Route CTVs are configured to extend the defined boundary further out to provide overlapping coverage with adjacent En Route SVs. Terminal SVs are typically cylindrical in shape, centered on an airport, and have a typical radius of 60 nautical miles. Large Terminal Radar Approach Control (TRACON) SVs are also CTVs configured to combine multiple underlying SVs and provide the terminal automation platform with a combined single feed for its coverage area. Surface SVs are cylindrical in shape, covering an airport and all approach, and departure corridors out to five miles from the runway thresholds. All Service Volumes have an identification number, e.g., SV-168. Flight inspection records will identify and track ADS-B inspections by the "Site ID" on the SBS ADS-B schedule. The flight inspection plan and report will list the CTV number, if there is one, and the individual SVs involved. Special inspections may use this identification, or they may use the SV number if the inspection is limited to a specific SV.

Chapter 3: Flight Inspection.

1. Preflight Coordination. For commissioning flight inspections, Engineering Services in support of the SBS Program Office, develops a comprehensive and detailed flight inspection plan. Development of the flight inspection plan is a collaborative effort between Engineering Services, Air Traffic, and Flight Inspection Services. With the Implementation Service Acceptance Testing (ISAT) report as a reference, input is gathered from local air traffic and technical operations to determine specific flight inspection requirements, and what may be accomplished with recorded targets-of-opportunity (TOO) data. Collaboration with Flight Inspection Services is also required to refine the plan and schedule the actual flights. The plan must include, and is not limited to the following:

For the commissioning of ADSS (ADS-B ATC Separation Services):

a. A description of the CTV and/or associated SVs to be inspected.

b. A detailed description of lateral and vertical SV/CTV dimensions.

c. The location of all ADS-B Radio Stations (RS) supporting the SV.

d. A list of airports, airways, routes, and fixes to be flown during the inspection, including the minimum altitudes for each.

e. Identification of an ATC coordination liaison.

f. Identification of an ADS-B service provider liaison for coordination and verification of system status.

Note: The final ISAT report provides details on SVs and RS locations. These and other coverage maps are provided by the SBS Program Office.

It is highly recommended that all radio stations are operational prior to flight inspection to reduce the possibility of regression testing. Prior to the inspection, confirm the operational status of all ADS-B radio stations and radars supporting the SVs/CTV. Note any Radio Stations that are not operational in the flight inspection report.

It is assumed that during all inspections, SBS support at the W.J.H. Technical Center will record the necessary data from the ADS-B system and associated automation system for post-flight analysis. Engineering Services will coordinate with local technical operations to record any radar data that may be needed.

2. Flight Inspection Procedures.

a. General. The flight inspection (FI) aircraft shall be "dual-link" equipped and configured for simultaneous operation on both the UAT and 1090ES links. The 1090 equipment will use the aircraft's registered International Civil Aviation Organization (ICAO) address, and the UAT equipment will be configured to use a "test" ICAO address and call sign. This configuration allows the ADS-B system to "see" the flight inspection aircraft as two different aircraft, one transmitting on the 1090ES data link, the other on the UAT data link. This results in a great gain in efficiency by allowing both links to be checked at the same time, as well as a means for confirming ADS-R. A specific set of ICAO addresses has been reserved for this purpose. See Table 1.

Table 1. UAT Test Addresses and Flight IDs

ICAO Address HEX	ICAO Address Octal	Altitude Offset Feet	Flight ID
FAAFC1	**76527701**	**+1000**	**FLTCK1U**
FAAFC2	**76527702**	**-1000**	**FLTCK2U**
FAAFC3	**76527703**	**-500**	**FLTCK3U**
FAAFC4	**76527704**	**+1000**	**FLTCK4U**
FAAFC5	**76527705**	**-1000**	**FLTCK5U**
FAAFC6	**76527706**	**-500**	**FLTCK6U**

When one of these ICAO addresses is used with its corresponding Flight Identification (ID), the ADS-B control stations will create an altitude offset. The altitude change is only seen in the automation (ATC display), and not by other ADS-B equipped aircraft. Using the 1000 foot offset will prevent the FI aircraft from triggering a CA on itself.

b. Commissioning Inspections. The objective of the commissioning inspection is to provide an objective means to verify and quantify the extent to which the service meets ATC operational requirements. It also provides a baseline for the detection of a deterioration of performance. The commissioning is a thorough inspection and requires a correspondingly detailed plan and report.

c. Periodic Inspections. Dedicated periodic flight inspections of ADS-B are not required. During the early deployment of ADS-B, Program Office Systems Engineering will consult with Engineering Services in each Service Area to select locations for followup evaluations. In the period 3-5 years after the commissioning flight inspection, a Special flight inspection will be flown to evaluate ADS-B system performance in at least three Air Traffic Control facilities, e.g., Terminal Radar Approach Control or Air Route Traffic Control Center. The ATC facilities selected should represent a sample of different ATC automation systems. The appropriate Regional Office Operational Engineering group will perform the inspection analysis. Program Office Systems Engineering in collaboration with Flight Inspection Services will use the results of these inspections to determine any future periodic requirements. In addition, the feasibility of equipping flight inspection aircraft with the ability to autonomously record ADS-B data while performing other flight inspection missions will be investigated by Flight Inspection Services in order to support a means to randomly monitor ADS-B performance throughout the NAS on a regular basis.

d. Special Inspections. Special inspections are requested when user complaints, system modifications, or software upgrades dictate that such an inspection is required. Special inspections are typically scheduled for events such as a change of major components (either physical or in software) that directly affect the performance and cannot be validated by ground test or confirmed by utilization of targets-of-opportunity (TOO). TOO may provide sufficient information to confirm that changes have not affected the performance or coverage characteristics of the SV. User complaints about the ADS-B service that have been verified by other user reports may indicate a need for a Special flight inspection. Special inspections for radio frequency interference reports and after accidents may also apply. Normally Regional Office Operational Engineering will make the request for a Special inspection post-commissioing driven by user complaints or other functional problems. Special Inspections include the following:

(1) Engineering Support is a type of Special flight inspection designed to help engineering and Air Traffic personnel determine if the system meets certification and operational requirements.

This data may be used for commissioning purposes, provided no equipment or major software modifications are made prior to the commissioning inspection.

(2) System Modifications. Program Office Systems Engineering subject matter experts must evaluate any changes to the ADS-B system to determine if a flight inspection is warranted. Changes to be considered include, but are not limited to:

(a) Significant changes to ADS-B ground system architecture, software algorithms, or automation platform integration software.

(b) Significant changes to the software configuration or algorithms related to coverage, service filters, boundaries, etc.

The ground-based network is under configuration management. The service provider is required to submit a Service Change Proposal (SCP) to the SBS Program Office prior to any modifications. The SCP documents any changes to the system and must be approved by SBS Systems Engineering. Prior to requesting any Special flight inspection, Technical Operations should consult with SBS Systems Engineering.

It is suitable for a new software version to be flight inspected at a representative SV or key site, and then have no requirement for flight inspection before its use in other SVs. Targets-of-opportunity, simulation testing, or flight tests, singularly or in combination, may provide sufficient information to confirm that changes have not adversely affected the system. When these methods are not sufficient to validate proper performance, SBS Systems Engineering or Technical Operations will determine if flight inspection is required during the approval process of those changes.

(3) Radio Antenna or Radio Equipment Modification. When validated maintenance procedures for replacement of antennas or transceivers with like equipment are used, no flight inspection is required. Replacement of a radio antenna with a different type (radiation pattern and peak gain) or a reduction in radio transmitter power or receiver sensitivity may require a flight inspection. Vendor and FAA tools are in place to evaluate link margin both before and after a change, but do not directly monitor signal-in-space propagation. A thorough analysis of coverage should be made using TOO, and a determination made by engineering if a flight inspection aircraft is required.

(4) Near Midair-Collision Inspections. These inspections are conducted at the request of the Air Traffic manager of the facility involved. The inspection determines the coverage in the area where the incident occurred. The flight inspection must be conducted as soon as possible following the near-midair-collision, duplicating the maneuvers, altitude, and direction of flight of the incident aircraft. The ADS-B system and automation platform must be operated in the same configuration, to the extent practicable, as it was when the incident occurred.

3. Commissioning Flight Inspection Checklist. The items identified by an "X" are mandatory, (column labeled C is for commissioning). The procedures presented here may be used individually when a special inspection may be satisfied with one or more of the individual tests.

Checklist 1. ADSS/ADS-B Separation Services Flight Inspection

	Inspection Type			
	Para Ref	**C**	**RS Ant or Radio Change**	**Transponder Setting (1)**
Modes/ Codes	8a	X		E
Transition with Radar-only	8b	X (3)		E
General Coverage	8c	X	X (2)	L
Airways/ Route Coverage	8d	X	X (2)	L
MSAW	8e	X		E
Fix/ Map Accuracy	8f	X (2)		E

Footnotes:

(1) Settings for 1090 Transponder: E = Either Normal or Low Power; L = Low Power. In Low Power setting, the 1090 ADS-B transponder approximates power and sensitivity of A1 class 1090ES transponder. The UAT transponder is fixed at an A1H class power and sensitivity level.

(2) May be completed using targets-of-opportunity. Flight inspection aircraft at engineering request only.

(3) Only applicable when SV is adjacent to radar-only airspace.

4. Detailed Procedures: Flight Inspection of ADS-B for Separation Services. Air Traffic Separation Services consists of aircraft ADS-B broadcasts that have been received and processed for display on FAA automation systems for use by Air Traffic to separate aircraft. Configure the FI aircraft to use the dual-link configuration. Some automation platforms permit suppression of conflict alerts for specific aircraft. This is the preferred operation for the inspection, i.e., not using the altitude offset feature. Set the UAT Flight ID to "FLCKU##," where ## is the 2-digit N-number of the FI aircraft. If automation is not capable of suppressing conflict alerts for the FI aircraft, use a UAT transceiver ICAO address and corresponding Flight ID that will activate a +1000 foot offset, (e.g., FAAFC1 and FLTCK1U). See Table 1.

The following checks must be accomplished:

a. Modes/Codes. Check ADS-B Out for proper operation when changing Mode 3/A codes. Verify that the controller reads the entered code. Change code to 1200 and another discrete code containing the number 7, (e.g., 0707, or 7070). There is no requirement to check any of the emergency codes. Along with the codes, check that the controller observed altitude readout is within ±125 feet of the indicated aircraft altitude. This requirement can be waived when the test is being conducted on a display without the ability to compensate ADS-B target altitudes with pressure corrections.

b. Transition with Radar-Only Airspace. Demonstrate on either ADS-B link the proper operation during transition from an ADS-B coverage area to radar-only coverage and vice versa. This check is only applicable to SVs/CTV with included or adjacent radar-only airspace. This test requires the FI aircraft to record time-stamped aircraft position (including altitude) and vector data, referred to as "truth" data, and ADS-B data for post-flight analysis. The FI aircraft systems record received ADS-B message data on both links.

c. General Coverage. Verify ADS-B broadcast coverage on both ADS-B links. Engineering Services in close coordination with the appropriate air traffic facilities will determine exactly which areas must be checked with a flight inspection aircraft. When designing the plan, the following must be considered:

- Coverage prediction based on validated modeling tools.
- Areas of predicted marginal coverage (per coverage models and Airspace Assessments).
- Data collected from targets-of-opportunity.
- Ensure enough of the SV interior is sampled (profile should allow contact with every RS).
- Areas with gaps in radar coverage.
- Specific airports and specific arrival and departure procedures.
- SV perimeter (if required per the guidance below).

Unless engineering requests otherwise, all coverage checks are performed with the aircraft ADS-B Out avionics configured for low power, i.e., transmission power is set at or near the minimum specified for the ADS-B link type. Operating in the dual-link configuration will allow the check to be accomplished without repeating the profile. This test requires the flight inspection aircraft to record time-stamped aircraft position (including altitude) and vector data, and ADS-B data for post-flight analysis.

(1) Perimeter Checks. It is not mandatory to fly any of the SV/CTV perimeter. The same guidance about using coverage prediction tools and TOOs apply to deciding if and where the perimeter should be checked. The intent is to ensure coverage along the edges of a SV/CTV that does not border another SV/CTV, or in areas of questionable line-of-sight with ADS-B radio stations.

(2) Follow this guidance when positioning the flight inspection aircraft: Fly offset to the inside of defined SV/CTV boundaries, both horizontally and vertically, to preclude loss of coverage due to crossing outside the SV/CTV. Horizontally, offset inside a half mile; vertically offset 200 to 500 feet below the ceiling. When practical, compensate for non-standard atmospheric conditions, which may place the aircraft several hundred feet higher or lower than indicated; however, consider that SV/CTV filters are based on the transmitted 29.92 referenced barometric altitude. Change the UAT altitude offset if necessary.

Table 2. For En Route Service Volumes
(perimeter boundary track as defined for the specific SV)

	1090ES	UAT
High	Highest Practical above FL180 (1)	Between 17,000 – 18,000'MSL
Low (3)	Floor of current radar coverage (2), but no lower than MOCA	Floor of current radar coverage (2), but no lower than MOCA

Footnotes:

(1) If simultaneously checking 1090ES coverage when conducting a high UAT perimeter check (below 18,000'MSL), it will fulfill the 1090ES requirement, provided there are no areas of concern for 1090ES coverage at higher altitudes.

(2) When there is a specific establishment of surveillance coverage below or beyond current radar coverage, ADS-B coverage must be checked with a flight inspection aircraft to ensure it supports the planned air traffic operations.

(3) A low altitude perimeter check of En Route SV coverage is only required in areas of interest as determined by pre-inspection analysis. If no possible problem areas are identified for investigation, the perimeter will be spot checked in locations that will best characterize coverage performance.

Table 3. For Terminal Service Volumes.

(Default boundary is a 60nm radius, otherwise as defined for the specific service volume)

	1090ES	UAT
High (4)	200 to 500 feet below top of SV	200 to 500 feet below top of SV, but no higher than 17,800'MSL
Low	500 feet below MEA/MVA, but no lower than MOCA.(5)	500 feet below MEA/MVA, but no lower than MOCA.(5)

Footnotes:

(4) High altitude perimeter check is not normally performed for Terminal SVs.

(5) When there is a specific establishment of surveillance coverage below or beyond current radar coverage, ADS-B coverage must be checked with a flight inspection aircraft to ensure it supports the planned air traffic operations.

Note: No specific perimeter check is flown for Surface SVs. Use of ADS-B on the ground is advisory only, and any desire to check surface coverage and performance could be performed by a properly equipped ground vehicle.

d. Airways/Route Coverage. Verify ADS-B Out coverage on the airways and routes identified in the flight inspection plan on both ADS-B links. Engineering Services will use TOO data and validated modeling tools to determine which areas should be checked by flight inspection. Use coverage models and Airspace Assessments provided by SBS Systems Engineering. The intent is not to fly every airway or route, but a smart sample including areas where coverage may be marginal, or in heavily used areas where ATC wants to ensure coverage is adequate. Coverage requirements in an En Route SV, extend down to the floor of radar coverage, but no lower than minimum obstruction clearance altitude (MOCA). And coverage requirements in a Terminal SV, extend down to 500' below the minimum en route altitude (MEA)/ minimum vectoring altitude (MVA), but no lower than MOCA. In general, the objective should be to fly near the bottom of the predicted ADS-B coverage to the maximum extent practical. This provides Air Traffic with valuable information about any improved surveillance coverage provided by ADS-B. However, when there is a specific establishment of surveillance coverage below or beyond current radar coverage, ADS-B coverage must be checked with a flight inspection aircraft to ensure it supports the planned air traffic operations. Any new airway/route must be checked in accordance with FAA Order 8200.1, Unites States Standard Flight Inspection Manual, to ensure it also meets obstacle clearance and communications requirements. Operating in the dual-link configuration will allow the check to be accomplished without repeating the profile. This test requires the flight inspection aircraft to record both position truth data and ADS-B data for post-flight analysis.

e. Minimum Safe Altitude Warning (MSAW) Functionality. Perform an end-to-end check of Minimum Safe Altitude Warning (MSAW) features activated solely by an ADS-B only target, thus verifying a target processed through the ADS-B network will trigger a low altitude alert correctly. There are two different components of MSAW: General Terrain Monitor (GTM) and Approach Path Monitor (APM). An APM check can be accomplished at any airport with an APM adaptation. The GTM must be in an area away from any airports and not in a MSAW inhibited area. One way to accomplish the check is to switch off the Mode S and ADS-B 1090ES transmissions, while transmitting the proper Mode 3/A code on UAT only. This ensures an ADS-B only target. Another is to switch off the altitude encoding function (Mode C) of the 1090 transponder while transmitting the proper Mode 3/A code on UAT. Still another is to keep the 1090ES transponder operating normally, but activate the -1,000 foot offset for the UAT target prior to descending through the alert altitude. These methods all activate the MSAW alert through the UAT link. The only sure way to isolate the 1090ES link would be to perform the check in an area without radar coverage, and is therefore not required. Proper attention to the correct configuration on the ATC automation system is required, including selecting the proper Mode-3/A code and associating the aircraft with an instrument flight rule (IFR) flight plan. Perform the check on either ADS-B link per engineering and automation requirements.

f. Fix/Map Accuracy. This check is designed to reveal an unknown problem between the SDP and the air traffic display that affects the position of the displayed target. It is not a check of the veracity of the MAP overlay, which should have been verified during standard operational procedures prior to the inspection. During the course of the inspection, the controller should compare reported aircraft position relative to the airway, route, or fix with the video map presentation. At least one time during the inspection, the controller observing the ADS-B enabled display will call out over the radio to the flight inspection aircraft when passing over a marked fix or NAVAID. The flight inspection crew will either confirm over the fix or provide the distance from it. In addition, this check may be required due to installation of new radar maps or addition of new fixes. The check may be accomplished using TOO.

Chapter 4. Assessment of ADS-B Advisory Services.

1. Assessment of ADS-B Advisory Services with Flight Inspection Aircraft. ADS-B Pilot Advisory Services consists of ADS-B In, which includes ADS-R, TIS-B and FIS-B. TIS-B is an advisory service that is not designed for aircraft surveillance or separation, and thus not authorized for either purpose. Similarly, ADS-R is currently advisory-only in nature. At such time ADS-R is redefined as an ATC Separation Service for ADS-B applications, additional flight inspection requirements will be established for commissioning ADS-R.

Flight inspection will collect ADS-B In data in conjunction with the commissioning flight inspection of ADSS (ADS-B Out). The data will be provided to the SBS Systems Engineering Test organization. The data will be evaluated by Engineering Services and the Technical Center SBS Testing organization. Analysis of the data will be used to establish a coverage baseline and to make an overall assessment of system performance.

2. Detailed Procedures: Flight Assessment of ADS-B Advisory Services. Follow this guidance when collecting data on ADS-B In Advisory (Essential) Services.

a. General Coverage. Verify ADS-B In coverage on both links as appropriate, e.g., FIS-B only operates on the UAT link, TIS-B operates on both. Check coverage in conjunction with flying the commissioning flight inspection of the Service Volume ADS-B Out Critical Services. Engineers may request additional areas to be flown if deemed necessary. Operating in the dual-link configuration will allow the check to be accomplished without repeating any profiles and is necessary to check ADS-R.

During the commissioning flight inspection of the ADSS (Critical Services), the radio frequency (RF) function of the test targets may be turned on. The test targets, typically at FL600 over every RS within the subject SV, continuously broadcast their position on both links. When seen by the flight inspection aircraft ADS-B avionics, it proves communication with that particular Radio Station demonstrates signal coverage, and helps identify areas of single station coverage.

b. TIS-B is the ADS-B In function that provides for the in-cockpit display of other aircraft (without ADS-B) in the vicinity that are being seen via FAA secondary radar. General observations can be made during the flight to verify that known radar targets are appearing in the correct relative position on the ADS-B display(s) in the flight inspection aircraft. Of course, if there are no such targets-of-opportunity in the area during the flight, the opportunity to check TIS-B in this way will not be possible. The flight inspection aircraft should record ADS-B data on both links for post-flight analysis. Because position "truth" data will not be available for the TOO aircraft, engineers will only be able to compare the TIS-B information recorded on the flight inspection aircraft with the position of the TOO, as recorded in the radar data input to the ADS-B system. Analysis should concentrate on missing and false targets.

c. FIS-B reception may be checked using UAT alone or the dual-linked configuration since it currently only provides products over the UAT link. FIS-B data reception can be spot checked visually in flight, but post-flight analysis should check for reception coverage, content, and availability. Proper operation (products available and display quality), vice coverage, can be considered satisfactory if it has already been validated with the same version of ADS-B system software. No specific profiles are required. In-flight observations should be recorded in the written mission flight log.

d. Service Volume Transition. This check concerns ADS-R operation and does not directly impact the surveillance (ADS-B Out) operation. Verify the ground system's ability to continue ADS-R operation as the aircraft transitions from one SV to the next (vertical or lateral). Any SV that is contained within the SV being inspected should be transitioned also. The volume of a Surface SV rises to 200'AGL and normally extends out to 5 miles from the runway ends. This check would normally be accomplished in the course of checking coverage. This check requires the flight inspection dual-link configuration and the flight inspection aircraft to record both position truth data and ADS-B data for post-flight analysis.

e. ADS-R Coverage and Functionality. This check requires the dual-link flight inspection configuration or two ADS-B equipped flight inspection aircraft flying in formation. This test can be performed simultaneously with other coverage checks so that it is checked in multiple areas of the SV. Special attention should be placed on high traffic areas. Service filters and their proper operation are also of primary interest. This evaluation requires the flight inspection aircraft to record position truth data and ADS-B data for post-flight analysis. Assessment of ADS-R performance is accomplished by comparing the recorded flight inspection aircraft position truth data to the corresponding rebroadcast ADS-R positions (UAT ADS-R ownship position received over the 1090ES data link, and the 1090ES ADS-R ownship position received over the UAT data link). These time-stamped truth and ADS-R positions are then compared to evaluate coverage, accuracy, latency, and availability. It is also important to check ADS-R for hazardous or misleading information.

Chapter 5. Analysis and Reporting.

1. Post Flight Analysis. Post-flight analysis of data collected by the flight inspection aircraft and that recorded from the ADS-B system and associated automation system will be conducted by Engineering Services and the FAA Technical Center. ADS-B data, including TIS-B, FIS-B, ADS-R, and on-board GPS truth data collected by the flight inspection aircraft will be delivered to the FAA Technical Center for analysis. Detailed procedures for post-flight analysis of each applicable requirement are documented by the FAA Technical Center. Data analysis should include, but is not limited to, the following:

Description	Required Data/Test Parameters
Verify ATC Target Display is correct and accurate .	Visual verification using ATC display. During Flight Inspection: • Ensure target is on track on display for designated flight profile • Ensure track is matched with correct icon information • Note any observations or anomalies
Comparison of ADS-B data recordings to predicted coverage charts.	Verify that actual ADS-B coverage is comparable to predicted RS coverage plots. Post-flight Analysis: • Using the processed data recordings, identify actual ADS-B coverage gaps (1090 and UAT) and note the extent(s) and altitude(s) in the report. o Compare with the predicted ADS-B coverage charts provided by the SBS Program Office

Description	Required Data/Test Parameters
Update Rate & Overall Track Probability of Detection (PD) (Coverage) for 1090ES/UAT. NOTE: The validation of this parameter is more of a check against the proper functionality of the on-board avionics rather than the ADS-B system.	The purpose of this test is to assess availability of ADS-B coverage throughout the flight inspection using the ADS-B SDP data. Verify ADS-B coverage is provided over areas of interest, (airways, airports, fixes, etc.). Post-flight Analysis: • Assess the calculated update interval and associated PD over the entirety of the recorded (SDP data) flight inspection. NOTE: The PD for the ADS-B update rate cannot be *exactly* calculated since the ADS-B messages are not broadcasted at exact timing intervals. A calculated PD may show a failed PD even though the update rate can meet the expected performance rate. Expected Performance: • Terminal- o Update Rate no greater than 3 seconds (PD of 95%) • En Route- o Update Rate no greater than 6 seconds (PD of 95%)
Latency.	The test will verify the maximum delay between the reception of an ADS-B Message, containing a State Vector or an emergency condition, and the reception of the corresponding ADS-B Report at the SDP. Post-flight Analysis: • Assess the latency values using the processed data recordings Expected Performance: • Latency shall be less than or equal to 700 ms

Description	Required Data/Test Parameters

Validation.	The ADS-B service performs a reasonableness test, or validation, of reported ADS-B position data. If the service volume or CTV does not offer the validation functionality, validation status will be reported as 'unknown.' If validation functionality is provided in the service volume or CTV, the validation field will be populated with the current validation status determined for this target. The Validation will be reported as a value = 3 if the data is determined to be valid.
	
	Post-flight Analysis:
	
	• Summarize the number and percentage of message reports categorized under each Validation type (ie, 0, 1, 2, or 3)
	  ○ 0 = unknown
	  ○ 1 = invalid
	  ○ 2 = reserved
	  ○ 3 = valid

Description	Required Data/Test Parameters
Position/Velocity Accuracy. NOTE: The validation of this parameter is more of a check against the proper functionality of the on-board avionics rather than the ADS-B system.	The purpose of this test is to validate that the vertical and horizontal position and velocity data broadcast by the aircraft, received by the radio station and presented to automation are within the accuracy bounds set in the listed requirements. Post-flight Analysis: • Summarize the comparison results of the applicable FRN fields between the SDP Cat 33 recorded data and recorded on-board truth data Expected Performance: • Terminal o Horizontal Positional Accuracy Error no greater than 92.6 meters (95%) • EnRoute o Horizontal Positional Accuracy Error no greater than 555.35 meters (95%)
Data Integrity.	The objective of the ADS-B Data Integrity test will be to verify that data fields in the ADS-B SDP CAT33 message or ADS-B CDR message are encoded with accurate values from the ADS-B aircraft source data. Post-flight Analysis: • Summarize the comparison results of the applicable FRN fields between the SDP Cat 33 recorded data and the transponder data recorded on-board the aircraft.

Description	Required Data/Test Parameters
Navigational Integrity Code (NIC). NOTE: The validation of this parameter is more of a check against the proper functionality of the on-board avionics rather than the ADS-B system.	The NIC values contained in the SDP CAT33 messages should meet the requirements outlined in the ADS-B Out Performance Requirements: Final Rule. Post-flight Analysis: • Summarize the distribution of reported NIC values.
Navigational Accuracy Code (NAC_p) Position. NOTE: The validation of this parameter is more of a check against the proper functionality of the on-board avionics rather than the ADS-B system.	The NAC_p values contained in the SDP CAT33 messages should meet the requirements outlined in the ADS-B Out Performance Requirements: Final Rule. Post-flight Analysis: • Summarize the distribution of reported NAC_p values.

Note: Post-flight data analysis can be referenced to detailed procedures developed and stored by FAA Tech Center.

2. Facility Status. The flight inspection report will only reflect a record of what was accomplished during the inspection and will not list the facility status. Engineering Services will document the initial test results of the flight inspection in a quick look report and the finalized results in the Flight Inspection Analysis Report. The analysis reports can be used by local Air Traffic and Technical Operations to determine if the performance of the ADS-B system is satisfactory. Any NOTAM action is the responsibility of Air Traffic and the associated Operations Control Center (OCC).

Chapter 6: Administrative Information.

1. Distribution. This order is distributed to selected offices. Distribution within the Department of Defense is handled by the National Geospatial Intelligence Agency. For the U.S. Air Force, this revision is included in the AF STDPUBs CD-ROM and is available on the Internet (http://afpubs.hq.af.mil/).

2. Authority to Change This Order. Changes to this order will be made by Technical Services Team, Flight Inspection Operations Group (AJW-33). Any suggested changes can be made via FAA Form 1320-19 found here: https://employees.faa.gov/tools_resources/forms/

3. Related Publications.

- 14 CFR Part 91, Automatic Dependent Surveillance Broadcast (ADS-B) Out Performance Requirements to Support Air Traffic Control (ATC) Service; Final Rule. May 28, 2010.
- Advisory Circular 20-165A; Airworthiness Approval of Automatic Dependent Surveillance – Broadcast (ADS-B) Out Systems. November 7, 2012.
- Advisory Circular 90-114, Change 1; Automatic Dependent Surveillance – Broadcast (ADS-B) Operations. September 9, 2012.
- Final Program Requirements SBS-002, Revision 04. June 26, 2012.
- JO 6100.1H CHG 1, Maintenance of NAS En Route Stage A – Air Traffic Control System. June 4, 2010.
- JO 6190.12D, Maintenance of the Automated Radar Terminal System Expansion (ARTS IIIE). March 4, 2011.
- Program Implementation Plan (PIP) for the Surveillance and Broadcast Services Program, PMO-002, Rev 01. August 1, 2010.
- RTCA DO-260B, Minimum Operational Performance Standards for 1090ES ADS-B and TIS-B. December 2, 2009 © 2009, RTCA, Inc.
- RTCA DO-282B, Minimum Operational Performance Standards for UAT ADS-B. December 2, 2009 © 2009, RTCA, Inc.
- Surveillance and Broadcast Services Description Document SRT-047, Revision 01. October 24, 2011.
- J0 6191.3A, Standard Terminal Automation Replacement System (STARS) Maintenance Technical Handbook. July 7, 2009