

§91.215 ATC transponder and altitude reporting equipment and use.

(a) *All airspace: U.S.-registered civil aircraft.* For operations not conducted under part 121 or 135 of this chapter, ATC transponder equipment installed must meet the performance and environmental requirements of any class of TSO-C74b (Mode A) or any class of TSO-C74c (Mode A with altitude reporting capability) as appropriate, or the appropriate class of TSO-C112 (Mode S).

(b) *All airspace.* Unless otherwise authorized or directed by ATC, no person may operate an aircraft in the airspace described in paragraphs (b)(1) through (b)(5) of this section, unless that aircraft is equipped with an operable coded radar beacon transponder having either Mode 3/A 4096 code capability, replying to Mode 3/A interrogations with the code specified by ATC, or a Mode S capability, replying to Mode 3/A interrogations with the code specified by ATC and intermode and Mode S interrogations in accordance with the applicable provisions specified in TSO C-112, and that aircraft is equipped with automatic pressure altitude reporting equipment having a Mode C capability that automatically replies to Mode C interrogations by transmitting pressure altitude information in 100-foot increments. This requirement applies—

(1) *All aircraft.* In Class A, Class B, and Class C airspace areas;

(2) *All aircraft.* In all airspace within 30 nautical miles of an airport listed in appendix D, section 1 of this part from the surface upward to 10,000 feet MSL;

(3) Notwithstanding paragraph (b)(2) of this section, any aircraft which was not originally certificated with an engine-driven electrical system or which has not subsequently been certified with such a system installed, balloon or glider may conduct operations in the airspace within 30 nautical miles of an airport listed in appendix D, section 1 of this part provided such operations are conducted—

(i) Outside any Class A, Class B, or Class C airspace area; and

(ii) Below the altitude of the ceiling of a Class B or Class C airspace area designated for an airport or 10,000 feet MSL, whichever is lower; and

(4) All aircraft in all airspace above the ceiling and within the lateral boundaries of a Class B or Class C airspace area designated for an airport upward to 10,000 feet MSL; and

(5) All aircraft except any aircraft which was not originally certificated with an engine-driven electrical system or which has not subsequently been certified with such a system installed, balloon, or glider—

(i) In all airspace of the 48 contiguous states and the District of Columbia at and above 10,000 feet MSL, excluding the airspace at and below 2,500 feet above the surface; and

(ii) In the airspace from the surface to 10,000 feet MSL within a 10-nautical-mile radius of any airport listed in appendix D, section 2 of this part, excluding the airspace below 1,200 feet outside of the lateral boundaries of the surface area of the airspace designated for that airport.

(c) *Transponder-on operation.* While in the airspace as specified in paragraph (b) of this section or in all controlled airspace, each person operating an aircraft equipped with an operable ATC transponder maintained in accordance with §91.413 of this part shall operate the transponder,

including Mode C equipment if installed, and shall reply on the appropriate code or as assigned by ATC, unless otherwise directed by ATC when transmitting would jeopardize the safe execution of air traffic control functions.

(d) *ATC authorized deviations.* Requests for ATC authorized deviations must be made to the ATC facility having jurisdiction over the concerned airspace within the time periods specified as follows:

(1) For operation of an aircraft with an operating transponder but without operating automatic pressure altitude reporting equipment having a Mode C capability, the request may be made at any time.

(2) For operation of an aircraft with an inoperative transponder to the airport of ultimate destination, including any intermediate stops, or to proceed to a place where suitable repairs can be made or both, the request may be made at any time.

(3) For operation of an aircraft that is not equipped with a transponder, the request must be made at least one hour before the proposed operation.

§91.225 Automatic Dependent Surveillance-Broadcast (ADS-B) Out equipment and use.

(a) After January 1, 2020, and unless otherwise authorized by ATC, no person may operate an aircraft in Class A airspace unless the aircraft has equipment installed that—

(1) Meets the performance requirements in TSO-C166b, Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Service-Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz); and

(2) Meets the requirements of §91.227.

(b) After January 1, 2020, and unless otherwise authorized by ATC, no person may operate an aircraft below 18,000 feet MSL and in airspace described in paragraph (d) of this section unless the aircraft has equipment installed that—

(1) Meets the performance requirements in—

(i) TSO-C166b; or

(ii) TSO-C154c, Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast (ADS-B) Equipment Operating on the Frequency of 978 MHz;

(2) Meets the requirements of §91.227.

(c) Operators with equipment installed with an approved deviation under §21.618 of this chapter also are in compliance with this section.

(d) After January 1, 2020, and unless otherwise authorized by ATC, no person may operate an aircraft in the following airspace unless the aircraft has equipment installed that meets the requirements in paragraph (b) of this section:

(1) Class B and Class C airspace areas;

(2) Except as provided for in paragraph (e) of this section, within 30 nautical miles of an airport listed in appendix D, section 1 to this part from the surface upward to 10,000 feet MSL;

(3) Above the ceiling and within the lateral boundaries of a Class B or Class C airspace area designated for an airport upward to 10,000 feet MSL;

(4) Except as provided in paragraph (e) of this section, Class E airspace within the 48 contiguous states and the District of Columbia at and above 10,000 feet MSL, excluding the airspace at and below 2,500 feet above the surface; and

(5) Class E airspace at and above 3,000 feet MSL over the Gulf of Mexico from the coastline of the United States out to 12 nautical miles.

(e) The requirements of paragraph (b) of this section do not apply to any aircraft that was not originally certificated with an electrical system, or that has not subsequently been certified with such a system installed, including balloons and gliders. These aircraft may conduct operations without ADS-B Out in the airspace specified in paragraphs (d)(2) and (d)(4) of this section. Operations authorized by this section must be conducted—

(1) Outside any Class B or Class C airspace area; and

(2) Below the altitude of the ceiling of a Class B or Class C airspace area designated for an airport, or 10,000 feet MSL, whichever is lower.

(f) Each person operating an aircraft equipped with ADS-B Out must operate this equipment in the transmit mode at all times unless—

(1) Otherwise authorized by the FAA when the aircraft is performing a sensitive government mission for national defense, homeland security, intelligence or law enforcement purposes and transmitting would compromise the operations security of the mission or pose a safety risk to the aircraft, crew, or people and property in the air or on the ground; or

(2) Otherwise directed by ATC when transmitting would jeopardize the safe execution of air traffic control functions.

(g) Requests for ATC authorized deviations from the requirements of this section must be made to the ATC facility having jurisdiction over the concerned airspace within the time periods specified as follows:

(1) For operation of an aircraft with an inoperative ADS-B Out, to the airport of ultimate destination, including any intermediate stops, or to proceed to a place where suitable repairs can be made or both, the request may be made at any time.

(2) For operation of an aircraft that is not equipped with ADS-B Out, the request must be made at least 1 hour before the proposed operation.

(h) The standards required in this section are incorporated by reference with the approval of the Director of the Office of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51. All approved materials are available for inspection at the FAA's Office of Rulemaking (ARM-1), 800 Independence

Avenue, SW., Washington, DC 20590 (telephone 202-267-9677), or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html. This material is also available from the sources indicated in paragraphs (h)(1) and (h)(2) of this section.

(1) Copies of Technical Standard Order (TSO)-C166b, Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Service-Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz) (December 2, 2009) and TSO-C154c, Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast (ADS-B) Equipment Operating on the Frequency of 978 MHz (December 2, 2009) may be obtained from the U.S. Department of Transportation, Subsequent Distribution Office, DOT Warehouse M30, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785; telephone (301) 322-5377. Copies of TSO -C166B and TSO-C154c are also available on the FAA's Web site, at http://www.faa.gov/aircraft/air_cert/design_approvals/tso/. Select the link "Search Technical Standard Orders."

(2) Copies of Section 2, Equipment Performance Requirements and Test Procedures, of RTCA DO-260B, Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Services-Broadcast (TIS-B), December 2, 2009 (referenced in TSO-C166b) and Section 2, Equipment Performance Requirements and Test Procedures, of RTCA DO-282B, Minimum Operational Performance Standards for Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast (ADS-B), December 2, 2009 (referenced in TSO C-154c) may be obtained from RTCA, Inc., 1828 L Street, NW., Suite 805, Washington, DC 20036-5133, telephone 202-833-9339. Copies of RTCA DO-260B and RTCA DO-282B are also available on RTCA Inc.'s Web site, at <http://www.rtca.org/onlinecart/allproducts.cfm>.

§91.227 Automatic Dependent Surveillance-Broadcast (ADS-B) Out equipment performance requirements.

(a) *Definitions.* For the purposes of this section:

ADS-B Out is a function of an aircraft's onboard avionics that periodically broadcasts the aircraft's state vector (3-dimensional position and 3-dimensional velocity) and other required information as described in this section.

Navigation Accuracy Category for Position (NAC_P) specifies the accuracy of a reported aircraft's position, as defined in TSO-C166b and TSO-C154c.

Navigation Accuracy Category for Velocity (NAC_V) specifies the accuracy of a reported aircraft's velocity, as defined in TSO-C166b and TSO-C154c.

Navigation Integrity Category (NIC) specifies an integrity containment radius around an aircraft's reported position, as defined in TSO-C166b and TSO-C154c.

Position Source refers to the equipment installed onboard an aircraft used to process and provide aircraft position (for example, latitude, longitude, and velocity) information.

Source Integrity Level (SIL) indicates the probability of the reported horizontal position exceeding the containment radius defined by the NIC on a per sample or per hour basis, as defined in TSO-C166b and TSO-C154c.

System Design Assurance (SDA) indicates the probability of an aircraft malfunction causing false or misleading information to be transmitted, as defined in TSO-C166b and TSO-C154c.

Total latency is the total time between when the position is measured and when the position is transmitted by the aircraft.

Uncompensated latency is the time for which the aircraft does not compensate for latency.

(b) *1090 MHz ES and UAT Broadcast Links and Power Requirements—*

(1) Aircraft operating in Class A airspace must have equipment installed that meets the antenna and power output requirements of Class A1, A1S, A2, A3, B1S, or B1 equipment as defined in TSO-C166b, Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Service-Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz).

(2) Aircraft operating in airspace designated for ADS-B Out, but outside of Class A airspace, must have equipment installed that meets the antenna and output power requirements of either:

(i) Class A1, A1S, A2, A3, B1S, or B1 as defined in TSO-C166b; or

(ii) Class A1H, A1S, A2, A3, B1S, or B1 equipment as defined in TSO-C154c, Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast (ADS-B) Equipment Operating on the Frequency of 978 MHz.

(c) *ADS-B Out Performance Requirements for NAC_P , NAC_V , NIC, SDA, and SIL—*

(1) For aircraft broadcasting ADS-B Out as required under §91.225 (a) and (b)—

(i) The aircraft's NAC_P must be less than 0.05 nautical miles;

(ii) The aircraft's NAC_V must be less than 10 meters per second;

(iii) The aircraft's NIC must be less than 0.2 nautical miles;

(iv) The aircraft's SDA must be 2; and

(v) The aircraft's SIL must be 3.

(2) Changes in NAC_P , NAC_V , SDA, and SIL must be broadcast within 10 seconds.

(3) Changes in NIC must be broadcast within 12 seconds.

(d) *Minimum Broadcast Message Element Set for ADS-B Out.* Each aircraft must broadcast the following information, as defined in TSO-C166b or TSO-C154c. The pilot must enter information for

message elements listed in paragraphs (d)(7) through (d)(10) of this section during the appropriate phase of flight.

(1) The length and width of the aircraft;

(2) An indication of the aircraft's latitude and longitude;

(3) An indication of the aircraft's barometric pressure altitude;

(4) An indication of the aircraft's velocity;

(5) An indication if TCAS II or ACAS is installed and operating in a mode that can generate resolution advisory alerts;

(6) If an operable TCAS II or ACAS is installed, an indication if a resolution advisory is in effect;

(7) An indication of the Mode 3/A transponder code specified by ATC;

(8) An indication of the aircraft's call sign that is submitted on the flight plan, or the aircraft's registration number, except when the pilot has not filed a flight plan, has not requested ATC services, and is using a TSO-C154c self-assigned temporary 24-bit address;

(9) An indication if the flightcrew has identified an emergency, radio communication failure, or unlawful interference;

(10) An indication of the aircraft's "IDENT" to ATC;

(11) An indication of the aircraft assigned ICAO 24-bit address, except when the pilot has not filed a flight plan, has not requested ATC services, and is using a TSO-C154c self-assigned temporary 24-bit address;

(12) An indication of the aircraft's emitter category;

(13) An indication of whether an ADS-B In capability is installed;

(14) An indication of the aircraft's geometric altitude;

(15) An indication of the Navigation Accuracy Category for Position (NAC_P);

(16) An indication of the Navigation Accuracy Category for Velocity (NAC_V);

(17) An indication of the Navigation Integrity Category (NIC);

(18) An indication of the System Design Assurance (SDA); and

(19) An indication of the Source Integrity Level (SIL).

(e) *ADS-B Latency Requirements*—

(1) The aircraft must transmit its geometric position no later than 2.0 seconds from the time of measurement of the position to the time of transmission.

(2) Within the 2.0 total latency allocation, a maximum of 0.6 seconds can be uncompensated latency. The aircraft must compensate for any latency above 0.6 seconds up to the maximum 2.0 seconds total by extrapolating the geometric position to the time of message transmission.

(3) The aircraft must transmit its position and velocity at least once per second while airborne or while moving on the airport surface.

(4) The aircraft must transmit its position at least once every 5 seconds while stationary on the airport surface.

(f) *Equipment with an approved deviation.* Operators with equipment installed with an approved deviation under §21.618 of this chapter also are in compliance with this section.

(g) *Incorporation by Reference.* The standards required in this section are incorporated by reference with the approval of the Director of the Office of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51. All approved materials are available for inspection at the FAA's Office of Rulemaking (ARM-1), 800 Independence Avenue, SW., Washington, DC 20590 (telephone 202-267-9677), or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html. This material is also available from the sources indicated in paragraphs (g)(1) and (g)(2) of this section.

(1) Copies of Technical Standard Order (TSO)-C166b, Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Service-Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz (MHz) (December 2, 2009) and TSO-C154c, Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast (ADS-B) Equipment Operating on the Frequency of 978 MHz (December 2, 2009) may be obtained from the U.S. Department of Transportation, Subsequent Distribution Office, DOT Warehouse M30, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785; telephone (301) 322-5377. Copies of TSO -C166B and TSO-C154c are also available on the FAA's Web site, at http://www.faa.gov/aircraft/air_cert/design_approvals/tso/. Select the link "Search Technical Standard Orders."

(2) Copies of Section 2, Equipment Performance Requirements and Test Procedures, of RTCA DO-260B, Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Services-Broadcast (TIS-B), December 2, 2009 (referenced in TSO-C166b) and Section 2, Equipment Performance Requirements and Test Procedures, of RTCA DO-282B, Minimum Operational Performance Standards for Universal Access Transceiver (UAT) Automatic Dependent Surveillance-Broadcast (ADS-B), December 2, 2009 (referenced in TSO C-154c) may be obtained from RTCA, Inc., 1828 L Street, NW., Suite 805, Washington, DC 20036-5133, telephone 202-833-9339. Copies of RTCA DO-260B and RTCA DO-282B are also available on RTCA Inc.'s Web site, at <http://www.rtca.org/onlinecart/allproducts.cfm>.

Appendix

Appendix D to Part 91—Airports/Locations: Special Operating Restrictions

Section 1. Locations at which the requirements of §91.215(b)(2) and §91.225(d)(2) apply. The requirements of §§91.215(b)(2) and 91.225(d)(2) apply below 10,000 feet MSL within a 30-nautical-mile radius of each location in the following list.

Atlanta, GA (Hartsfield-Jackson Atlanta International Airport)

Baltimore, MD (Baltimore/Washington International Thurgood Marshall Airport)

Boston, MA (General Edward Lawrence Logan International Airport)

Camp Springs, MD (Joint Base Andrews)

Chantilly, VA (Washington Dulles International Airport)

Charlotte, NC (Charlotte/Douglas International Airport)

Chicago, IL (Chicago-O'Hare International Airport)

Cleveland, OH (Cleveland-Hopkins International Airport)

Covington, KY (Cincinnati/Northern Kentucky International Airport)

Dallas, TX (Dallas/Fort Worth International Airport)

Denver, CO (Denver International Airport)

Detroit, MI (Detroit Metropolitan Wayne County Airport)

Honolulu, HI (Honolulu International Airport)

Houston, TX (George Bush Intercontinental/Houston Airport)

Houston, TX (William P. Hobby Airport)

Kansas City, MO (Kansas City International Airport)

Las Vegas, NV (McCarran International Airport)

Los Angeles, CA (Los Angeles International Airport)

Memphis, TN (Memphis International Airport)

Miami, FL (Miami International Airport)

Minneapolis, MN (Minneapolis-St. Paul International/Wold-Chamberlain Airport)

Newark, NJ (Newark Liberty International Airport)

New Orleans, LA (Louis Armstrong New Orleans International Airport)

New York, NY (John F. Kennedy International Airport)

New York, NY (LaGuardia Airport)

Orlando, FL (Orlando International Airport)
Philadelphia, PA (Philadelphia International Airport)
Phoenix, AZ (Phoenix Sky Harbor International Airport)
Pittsburgh, PA (Pittsburgh International Airport)
St. Louis, MO (Lambert-St. Louis International Airport)
Salt Lake City, UT (Salt Lake City International Airport)
San Diego, CA (Miramar Marine Corps Air Station)
San Diego, CA (San Diego International Airport)
San Francisco, CA (San Francisco International Airport)
Seattle, WA (Seattle-Tacoma International Airport)
Tampa, FL (Tampa International Airport)
Washington, DC (Ronald Reagan Washington National Airport)

Section 2. Airports at which the requirements of §91.215(b)(5)(ii) apply. [Reserved]

Section 3. Locations at which fixed-wing Special VFR operations are prohibited.

The **Special VFR weather minimums of §91.157 do not apply** to the following airports:

Atlanta, GA (Hartsfield-Jackson Atlanta International Airport)
Baltimore, MD (Baltimore/Washington International Thurgood Marshall Airport)
Boston, MA (General Edward Lawrence Logan International Airport)
Buffalo, NY (Greater Buffalo International Airport)
Camp Springs, MD (Joint Base Andrews)
Chicago, IL (Chicago-O'Hare International Airport)
Cleveland, OH (Cleveland-Hopkins International Airport)
Columbus, OH (Port Columbus International Airport)
Covington, KY (Cincinnati/Northern Kentucky International Airport)
Dallas, TX (Dallas/Fort Worth International Airport)
Dallas, TX (Dallas Love Field Airport)
Denver, CO (Denver International Airport)
Detroit, MI (Detroit Metropolitan Wayne County Airport)
Honolulu, HI (Honolulu International Airport)

Houston, TX (George Bush Intercontinental/Houston Airport)
Indianapolis, IN (Indianapolis International Airport)
Los Angeles, CA (Los Angeles International Airport)
Louisville, KY (Louisville International Airport-Standiford Field)
Memphis, TN (Memphis International Airport)
Miami, FL (Miami International Airport)
Minneapolis, MN (Minneapolis-St. Paul International/Wold-Chamberlain Airport)
Newark, NJ (Newark Liberty International Airport)
New York, NY (John F. Kennedy International Airport)
New York, NY (LaGuardia Airport)
New Orleans, LA (Louis Armstrong New Orleans International Airport)
Philadelphia, PA (Philadelphia International Airport)
Pittsburgh, PA (Pittsburgh International Airport)
Portland, OR (Portland International Airport)
San Francisco, CA (San Francisco International Airport)
Seattle, WA (Seattle-Tacoma International Airport)
St. Louis, MO (Lambert-St. Louis International Airport)
Tampa, FL (Tampa International Airport)
Washington, DC (Ronald Reagan Washington National Airport)

Section 4. Locations at which solo student, sport, and recreational pilot activity is not permitted.

Pursuant to §91.131(b)(2), solo student, sport, and recreational pilot operations are not permitted at any of the following airports.

Atlanta, GA (Hartsfield-Jackson Atlanta International Airport)
Boston, MA (General Edward Lawrence Logan International Airport)
Camp Springs, MD (Joint Base Andrews)
Chicago, IL (Chicago-O'Hare International Airport)
Dallas, TX (Dallas/Fort Worth International Airport)
Los Angeles, CA (Los Angeles International Airport)
Miami, FL (Miami International Airport)

Newark, NJ (Newark Liberty International Airport)

New York, NY (John F. Kennedy International Airport)

New York, NY (LaGuardia Airport)

San Francisco, CA (San Francisco International Airport)

Washington, DC (Ronald Reagan Washington National Airport)

[Amdt. 91-227, 56 FR 65661, Dec. 17, 1991]

How will the ADS-B Out rule affect aircraft operators?

As of January 1, 2020, when operating in the airspace designated in [14 CFR 91.225](#) (outlined below) you must be equipped with ADS-B Out avionics that meet the performance requirements of [14 CFR 91.227](#).

Under the rule, ADS-B Out performance is required to operate in:

1. Class A, B, and C airspace.
2. Class E airspace within the 48 contiguous states and the District of Columbia at and above 10,000 feet MSL, excluding the airspace at and below 2,500 feet above the surface.
3. Class E airspace at and above 3,000 feet MSL over the Gulf of Mexico from the coastline of the United States out to 12 nautical miles.
4. Within 30 nautical miles of those airports identified in 14 CFR part 91, Appendix D. Otherwise known as the Mode C veil.

The ADS-B Out rule does not apply in the airspace defined in items 2 and 4 above for any aircraft not originally certificated with an electrical system or that has not subsequently been certified with such a system installed, including balloons and gliders. For additional requirements for using the exception for item 4, please refer to [CFR 91.225](#) section (d) for the requirements.

Please refer to "[What are the ADS-B rules?](#)" for more information.

What are the ADS-B rules?

The FAA published Federal Regulation [14 CFR 91.225](#) and [14 CFR 91.227](#) in May 2010. The final rule dictates that effective January 1, 2020, aircraft operating in airspace defined in 91.225 are required to have an Automatic Dependent Surveillance – Broadcast (ADS-B) system that includes a certified position source capable of meeting requirements defined in 91.227. These regulations set a minimum performance standard for both the ADS-B transmitter and the position sources integrated with the ADS-B equipment.

Installation

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An ADS-B Out transmitter alone is not sufficient to meet the requirements of [14 CFR 91.225](#) and [91.227](#). Aircraft must be equipped with a [Version 2 ADS-B Out transmitter](#) and a compatible GPS position source. There are two types of ADS-B systems available:

- **Mode S transponder with Extended Squitter**, referred to as **1090ES** that meets the performance requirements of [Technical Standard Order TSO-C166b](#)

- **Universal Access Transceiver (UAT)** that meets the performance requirements of [TSO-C154c](#). UAT has the additional capability to receive weather data provided by the FAA ADS-B network and operates on 978 MHz.

The most important factor when considering which system to choose is the airspace in which you operate. For aircraft operating at and above Flight Level 180, you must be equipped with 1090ES. For aircraft operating below 18,000 feet mean sea level (MSL) and within U.S. ADS-B-required airspace, you must be equipped with either 1090ES or UAT equipment. Please note that outside U.S. airspace, almost all ADS-B systems operate on 1090 MHz.

The FAA recommends a WAAS GPS that is compliant with the latest version of TSO-C145 or TSO-C146:

- These units are readily available for general aviation and provide sufficient performance to meet the 14 CFR 91.227 requirements.
- Avionics vendors offer stand-alone GPS receivers and package them with ADS-B transmitters or with GPS Navigators.
- GPS and ADS-B transmitter pairings installed on Type Certificated aircraft require FAA approval.
- ADS-B Out systems marketed for installation on Experimental and Light Sport aircraft must have a 14 CFR 91.227 compliance statement from the applicable airframe and/or equipment manufacturer. Be sure to contact your manufacturer before installation if you are unsure of ADS-B Out system component compatibility.

The [Installation Approval for ADS-B OUT Systems](#) memo explains the FAA's policy regarding installation of ADS-B Out systems into civil aircraft.

Getting the Installation Right

It is important to know that incorrectly installed ADS-B equipment on your aircraft does not comply with the ADS-B equipage rule.



ADS-B ground testing equipment, as shown above, can verify all parameters are correct after an ADS-B installation. Once your equipment is installed, be sure to [find out if your equipment is working properly](#).

The FAA is working with operators, manufacturers, and installers on eliminating common ADS-B installation errors. The most common issues associated with an ADS-B installation are:

- Missing Barometric Pressure Altitude
- Air/Ground Determination Issues
- Flight ID issues including Missing Flight ID 3-letter identifier
- Wrong ICAO aircraft address
- Invalid Mode 3/A Code
- Incorrect Emitter Category
- Aircraft with Position Errors

For additional information, please read the [technical paper](#) (PDF) explaining the FAA's policy regarding alterations to aircraft for the installation of ADS-B equipment.

FAA Field Approval Guidance

[Current policy](#) allows for field approvals under specific conditions.

To check if your installation complies with the rule, you can request:

- [Compliance report](#) for field approvals and post installation performance certification
- [Certification report](#) for certification of ADS-B systems per AC 20-165B section 4-3 a (1)

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