CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

Advisory Circular
AC91-24

Revision 0

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Automatic Dependent Surveillance—Broadcast (ADS-B) Systems

General

Civil Aviation Authority advisory circulars contain guidance and information about standards, practices, and procedures that the Director has found to be an **acceptable means of compliance** with the associated rules and legislation.

However the information in the advisory circular does not replace the requirement for participants to comply with their own obligations under the Civil Aviation rules, the Civil Aviation Act 1990 and other legislation.

An advisory circular reflects the Director's view on the rules and legislation. It expresses CAA policy on the relevant matter. It is not intended to be definitive. Consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices, or procedures are found to be acceptable they will be added to the appropriate advisory circular.

An advisory circular may also include **guidance material** generally, including guidance on best practice as well as guidance to facilitate compliance with the rule requirements. However, guidance material should not be regarded as an acceptable means of compliance.

An advisory circular may also include **technical information** that is relevant to the standards or requirements.

Purpose

This advisory circular provides information and guidance on ADS-B systems equipment requirements, accuracy parameters requirements; operational requirements, testing and installation requirements and procedures and information on the approvals process.

Related Rules

This advisory circular relates specifically to Civil Aviation Rule Parts 21, 43, and 91, and specifically to rules 43.46 and 91.257, 91.258.

Change Notice

This is the initial issue of this advisory circular.

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1. Introduction

New Zealand will use Automatic Dependent Surveillance - Broadcast (ADS-B) as the main source of air traffic surveillance data when the current primary and secondary surveillance system is decommissioned at the end of 2021. This is in line with ICAO guidance and standard and recommended practices (SARPs), and will improve the safety and efficiency of the air traffic management system.

The intention of this advisory circular is to provide:

(a) an explanation of the mandate for ADS-B OUT above flight level 245;

(b) information on the certification process for installing ADS-B OUT on aircraft;

(c) guidance on equipment requirements for aircraft operating ADS-B systems in New Zealand; and

(d) guidance on performance requirements for ADS-B OUT systems.

Application to aircraft operating below flight level 245

Note: that the July 2018 rule amendments mandate the use of ADS-B OUT in all aircraft operating in controlled airspace above flight level 245 from 31 December 2018.

These rule amendments also set the equipment and performance standards for existing and new ADS-B OUT systems in all aircraft in the New Zealand flight information region.

This includes aircraft operating below flight level 245 that are equipped with ADS-B OUT ahead of the mandate for lower airspace, or will be fitted with new ADS-B OUT systems.

If you only fly below flight level 245, the July 2018 rules do not require you to fit ADS-B OUT. However, if you choose to fit ADS-B OUT, or your aircraft already has ADS-B OUT, then you need to comply with the standards set out in the rules.

The CAA is proposing that the lower airspace mandate will come into force on 31 December 2021. The CAA will update this AC to reflect subsequent rule amendments regarding ADS-B OUT below flight level 245.

2. Related Reading Material

FAA advisory circular:

- AC 20-165B Airworthiness Approval of Automatic Dependent Surveillance - Broadcast Out Systems
- AC 20-172B ADS-B IN

3. List of Acronyms

See also Part 1 of Civil Aviation Rules for other terms

AC Advisory circular

AWU Aircraft Airworthiness Unit**ADS-B** Automatic dependent surveillance – broadcast

ATM Air traffic management

CAA Civil Aviation Authority of New Zealand

DAPs Downlink aircraft parameters

FAA Federal Aviation Administration (U.S. Department of Transportation)

FIR Flight information region

FDE Fault detection and exclusion

GNSS Global navigation satellite system

NACp Navigation accuracy category for position

NACv Navigation accuracy category for velocity

NIC Navigation integrity category

NUC Navigation uncertainty category

POA Position offset applied

SA Selective availability

SBAS Satellite based augmentation system

SDA System design assurance

SIL Source integrity level

UAT Universal access transceiver

4. List of Definitions

See also Part 1 of Civil Aviation Rules for other terms

NACp specifies the accuracy of a reported aircraft's position, as defined in TSO-C166b.

NACv specifies the accuracy of a reported aircraft's velocity, as defined in TSO-C166b.

NIC specifies an integrity containment radius around an aircraft's reported position, as defined in TSO-C166b.

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.

SDA indicates the probability of an aircraft malfunction causing false or misleading information to be transmitted, as defined in TSO-C166b.

NUC is a codified parameter used to report the maximum position error, which might not be detected with a predefined probability. NUC originates in a position-determining system and is transmitted by aircraft ADS-B systems complying with TSO-C166 initial.

Note: NUC is only relevant to TSO-C166 initial issue devices. The NUC is a mathematical combination of the NACp, NACv, NIC, SIL, and SDA.

Position source refers to the equipment installed on board an aircraft used to process and provide aircraft position (for example: latitude, longitude, and velocity) information.

5. Background

5.1 New Zealand's ADS-B OUT mandate

As the surveillance radar network comes out of service, ADS-B OUT will be the main source of information used for air traffic management, a safety-critical service. For that reason, it is essential that ADS-B OUT systems on aircraft meet performance requirements to ensure the surveillance data received by the ANSP are accurate and complete.

5.2 About ADS-B

ADS-B is a surveillance technology incorporating both air and ground aspects. Compared to the current secondary surveillance radar system, ADS-B provides air traffic control (ATC) with a more accurate and frequent picture of the aircraft's position.

Using ADS-B OUT equipment on board, the aircraft broadcasts its identification, position, altitude, velocity, and other information, described as ADS-B Out functionality. The ground portion comprises a network of ADS-B ground stations, which receive these broadcasts and direct them to the ANSP for presentation on a controller's display.

In addition, aircraft equipped with an ADS-B IN receiver can receive these broadcasts and display the information to improve the pilot's situation awareness of other traffic.

ADS-B is automatic because no external interrogation is required. It is dependent because it relies on the global navigation satellite system (GNSS) as its position source and broadcast transmission systems to provide surveillance information to ATC and other users.

Figure 1: How ADS-B works

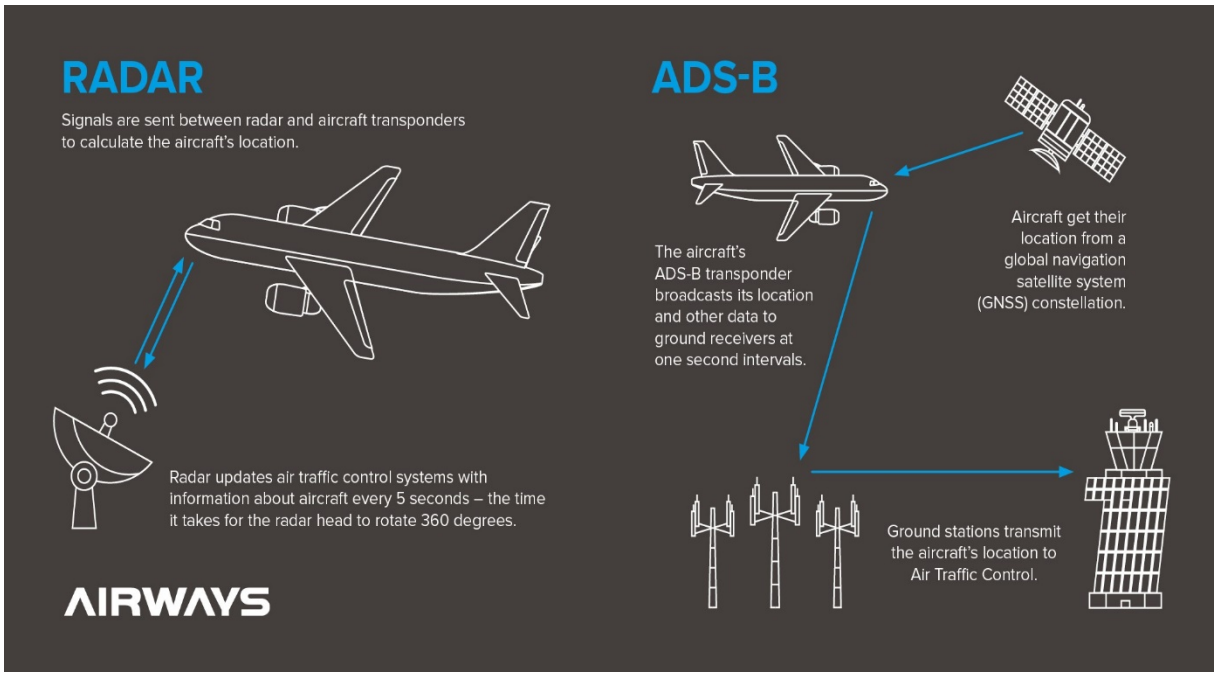
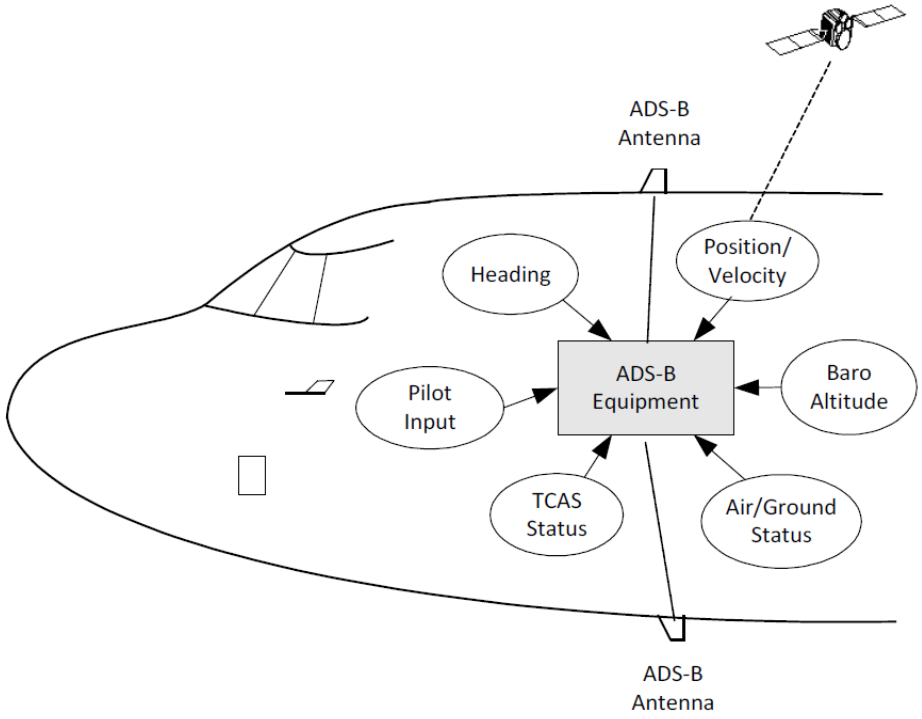


Figure 2 provides a functional overview of an aircraft ADS-B system



Source: FAA AC 20-165B

6. ADS-B OUT Equipment

An ADS-B OUT system includes:

- an ADS-B OUT transponder; and
- a compatible GNSS position source; or
- an all-in-one system comprising a transponder with an in-built GNSS position course

(Note: the position source is used for ADS-B OUT data only. It is not a navigation instrument).

ADS-B OUT systems installed in aircraft operating in the New Zealand FIR must meet the performance criteria as described in Part 43, rule 91.257, and NTC 91.258.

The New Zealand implementation of ADS-B OUT is based on 1090 MHz Mode S Extended Squitter equipment.

For ADS-B systems that do not meet the criteria in NTC 91.258 clause 4(a), operators should seek advice from a design organisation or CAA for issues including but not limited to:

(1) ADS-B systems with TSO-C129 GPS with FDE as the position source

(2) ADS-B systems including a transponder and/or a GNSS position source that is not TSO certified

(3) any unproven ADS-B transponder-position source combination

(4) ADS-B systems with no Acceptable Technical Data

(5) aircraft that will operate in the New Zealand FIR fitted with a UAT transponder.

6.1 Transponder standards

Transponders that are certified against the following technical standard orders (TSO) meet the New Zealand performance requirements for ADS-B Out transponders:

TSO-C166 initial issue or can demonstrate equivalent performance

TSO-C166a or can demonstrate equivalent performance

Note that all transponders installed after the rule comes in to force must be TSO-C166b or demonstrate equivalent performance

TSO-C166b or equivalent – required for fitment after the rule commencement date, or upon aircraft ADS-B transponder replacement for TSO-C166 initial and TSO-C166a transponders.

Under NTC 91.258 clause 3, ADS-B Out transponders that operate in controlled airspace above flight level 245 must have an output power of at least 125W.

Mode S downlink aircraft parameters (DAPs)

Recent developments have enhanced the value of Mode S by introducing Mode S EHS (Enhanced Surveillance). Aircraft with Mode S EHS also provide the following operational benefits: Access by controllers to aircraft intent DAPs, such as selected altitude enables cross-checking of climb/descent instructions and helps the early identification of potential level bust incidents.

Mode S enhanced surveillance downlink aircraft parameters (Mode S EHS DAPS) is not a function of ABS-B OUT, but is valuable as part of the aircraft transponder functions for those aircraft that are capable of Mode S EHS.

6.2 ADS-B OUT Position Source

At this point in time, GPS is the only approved GNSS position source for ADS-B OUT.

For the ADS-B in New Zealand, the GPS position source equipment must be certified according to, or demonstrate performance equivalent to the relevant TSO. The following GNSS certifications meet the requirements for ADS-B OUT position sources. All include fault detection and exclusion (FDE) capability (see note below).

TSO - C145 ()– (or can demonstrate equivalent performance).

TSO - C146 ()– (or can demonstrate equivalent performance).

TSO – C196 ()- (or can demonstrate equivalent performance).

Note:

- ***The GPS positions source must also be capable of fault detection and exclusion (FDE).***
- ***The position source for ADS-B OUT can be the same GNSS unit used for the aircraft navigation, but it does not have to be. If the position source and the transponder are different, the combination must be compatible and must transmit data that is compliant with the rule.***
- ***GPS units fitted in accordance with CAA advisory circular AC43-14 are not permitted as an ADS-B OUT position source. This is because GPS position integrity cannot be guaranteed. GPS units installed in accordance with AC43.14 can only be used for situational awareness.***

6.2.1 TSO - C129

TSO-C129 was the first TSO to apply to GPS equipment providing aviation navigation data. This standard predated current operating environment, and did not anticipate ADS-B as a surveillance technology. As a result, operators of TSO-C129 GPS equipment need to ensure that they understand the functionality and limitations of their equipment.

Fault detection (FD) and fault detection and exclusion (FDE) TSO-C129 GPS receivers include FD functionality. These receivers can detect corrupted or otherwise inaccurate data from any one of the satellites from which it is receiving data. An FD receiver will, at that point, stop providing a navigation solution based on GPS.

FDE is the next generation of technology which enables the receiver to identify and exclude inaccurate satellite data, and, provided it still has access to a sufficient number of satellites, will continue to provide a navigation solution.

FDE is required for GNSS receivers being used for ADS-B OUT. If an FD receiver stops providing data then the aircraft's ADS-B OUT system will stop operating and providing data to air traffic controllers. If the aircraft is also outside radar range, the aircraft will not be visible to controllers. FDE provides an important additional safety benefit for both navigation and surveillance in an ADS-B environment.

TSO - C129 GPS position sources may meet ADS-B OUT position source requirements if the GPS unit is capable of FDE and has an FDE letter of approval from the GPS OEM. Contact airworthiness@caa.govt.nz for more information if this applies to your aircraft.

6.3 Selective availability (SA)

Selective availability was an intentional timing delay in the GPS satellite signal to degrade accuracy for the standard civilian GPS signal. Early TSO-C129 GPS (described as "SA ON") receivers expect SA to be present in the GPS satellite signals. SA on equipment may report a worse accuracy than the device has actually determined, therefore GPS sources that function as SA ON may not meet ADS-B OUT accuracy requirements for ADS-B OUT. SA aware receivers—which can distinguish whether SA is on or not—should be suitable.

6.4 Integration – Transponder and Position Source

Installing a certified ADS-B OUT transponder and a separate, certified GNSS positon source does not necessarily guarantee that the equipment in an ADS-B OUT system will be mutually compatible and produce compliant data. There are known instances of TSO certified transponders and GNSS receivers that do not work with each other to produce an accurate ADS-B OUT signal.

CAA recommends that operators use proven combinations of transponder and position source to ensure compatibility between the ADS-B OUT transponder and the position source.

Proven combinations are described by previously approved combinations as per certified STCs or modifications, OEM recommended combinations and FAA approved combination list.

If you install an unproven combination, you are required under Part 21 to provide a full engineering evaluation to demonstrate that the transponder and position source are compatible and the output meets the performance criteria in NTC 91.258 clauses 2(g) and (3).

As with all ADS-B OUT systems installed after 20 July 2018, systems comprising separate transponder and GNSS position source equipment must be tested to ensure the system produces compliant data.

6.5 Integration – Other Equipment

ADS-B OUT reports two kinds of altitudes: barometric and geometric. Barometric or pressure altitude as displayed on the altimeter in the aircraft. Geometric altitude is calculated by GPS as the height of the aircraft above the earth ellipsoid. These two altitudes are not the same, but having both allows for applications that require one or the other as an altitude source and provides a means of verifying correct pressure altitude reporting from aircraft.

Barometric altitude is also required as ANSP will only use barometric altitude for vertical separation. New Zealand Civil Aviation ADS-B requirements do not alter any existing regulatory guidance regarding the barometric altitude accuracy or resolution.

6.6 ADS-B IN

ADS-B IN receivers use data from in-range ADS-B Out transmissions. ADS-B IN provides pilots with information that aids visual acquisition of other aircraft to support (but not interfere with) see-and –avoid requirements, and generally enhance situational awareness.

CAA is not proposing to mandate ADS-B IN; however, operators should consider the benefits of ADS-B IN.

FAA advisory circular AC20-172B is a suitable source of ADS-B IN guidance.

The Director will not accept ADS-B IN as a substitute or an acceptable means of compliance for ACAS requirements.

Operators should note that online ADS-B position report services (such as Flightradar24) have no guaranteed accuracy performance, may incorporate intentional timing delays, may not provide information about aircraft without ADS-B, and therefore may provide misleading information to the pilot ADS-B Transponder Power.

Furthermore, operators should be aware that pilots with ADS-B IN are receiving and using ADS-B OUT data for situational awareness. This is another reason for strict standards for ADS-B OUT data.

6.7 Antenna diversity requirements

There is no requirement in the CAA rules for transponder antenna diversity (i.e., bottom and top mounted antennae) in order to operate an ADS-B OUT system.

However, antenna diversity may be required for utilising airfield ground movements or in accordance with system installation requirements. Operators may wish to consider antenna diversity to counter aircraft shielding during turns that could affect the reception of ADS-B OUT signals for the ground system and ADS-B IN operators.

6.8 Multiple Transponder Fitments

The CAA rules for ADS-B OUT do not require multiple transponders. Operators may choose to fit more than one transponder for redundancy. In this case, the transponders should be the same make and model and transmit one at a time.

6.9 ADS-B Only Transmitters

While actual ADS-B data is automatically broadcast and does not rely on the signal interrogation and reply operation of a transponder, ADS-B OUT functionality is normally enabled as part of a Mode S transponder's extended squitter capability.

To provide the required message sets, transponders need to broadcast ADS-B OUT and Modes A/C and Mode S functionality. These message set elements are detailed in NTC 91.258.

ADS-B OUT transmitters are available that transmit ADS-B data only (i.e. no Mode A/C or Mode S data).

These ADS-B transmitters are not an acceptable ADS-B OUT solution because they would not be detected by ACAS systems. Transponders that also transmit Modes A, C and S data would continue to function if the aircraft lost its GPS signal. In that situation, air traffic controllers may still be able to see the aircraft if it was within radar range. This would not be case for ADS-B only systems.

6.10 Universal Access Transceiver

Universal Access Transceiver (UAT) is an alternative ADS-B OUT solution used in the USA.

UAT uses a different frequency and an entirely different ground infrastructure system that will not be installed in New Zealand. For these reasons, UAT ADS-B transponders should not be used in New Zealand.

Transmission of 978 MHz UAT is specifically prohibited by rule 91.257A(2).

Dual 1090 MHz ES and 978 MHz transponders are available. They can be used in New Zealand as long as the appropriate requirement for the 1090 MHz ES data link is met and the 978 MHz transmission is disabled, as required by rule 91.258(d).

ADS-B OUT systems that include a UAT transceiver must be approved by the Director. This is to ensure that the operators have disabled the aircraft's UAT transponder in compliance with rule requirements, and that CAA is aware of its presence in the New Zealand FIR.

6.11 Non-Compliant Data

As ADS-B OUT will be the primary source of surveillance data in the New Zealand FIR, all ADS-B data transmitted from aircraft equipment must meet the requirements of rule 91.257 and NTC 91.258.

Non-compliant data includes incomplete, inaccurate and/or misleading ADS-B OUT data, and data not transmitted frequently enough to meet the system requirements. The risks associated with non-compliant or misleading data are that the aircraft's position, identity, heading, velocity etc. may not be displayed on air traffic control screens; or, more seriously, give controllers an incorrect indication of those parameters.

Any aircraft transmissions that do not meet the minimum ADS-B OUT requirements are considered to be non-compliant. Any ADS-B OUT transmissions that interfere with ground or other airborne ADS-B systems are also considered to be non-compliant.

Aircraft that transmit non-compliant or misleading data may be excluded from entering or may be managed by ATC as provided for by rule 91.247(e). Operators of these aircraft will be advised that the aircraft is transmitting non-compliant data and asked to rectify the problem.

Note: *If you are advised by an air traffic controller that your aircraft is transmitting non-compliant data,* ***do not switch the transponder off unless instructed to do so by air traffic control.***

6.12 Testing

Operators must conduct post installation testing in accordance with the manufacturer's instructions. Testing should be conducted, including using appropriate specialist test equipment to prove the ADS-B OUT system meets the required transponder performance requirements (refer to Part 43, Appendix E.12(a) and CAA NTC 91.258 clause 4(a)(5).

Operators should provide CAA with evidence and results of the test for transponder performance requirements on initial installation of the ADS-B OUT system, or as required by CAA, or document it in the aircraft maintenance records (refer to Part 43, Appendix E.12(b)).

Evidence may be in the form of automated test reports or test equipment screen shots if automated test reports are not available.

Airways' surveillance system will be able to identify aircraft that are not transmitting appropriate ADS-B Out data; however, the surveillance system is in place to provide a safe separation service, not as a proxy test system. The onus is on operators to ensure that the ADS-B system is transmitting accurate data before the aircraft enters transponder-mandatory airspace where ADS-B Out is required.

Operators should not rely on air traffic control to advise them of ADS-B equipment problems, because the ATC system cannot identify all equipment failure modes in all situations, and may not be able to distinguish between data that appear to be normal but are in fact misleading. For that reason, robust testing is essential at the time of installation, and on a regular basis (refer to Part 43, Appendix E.12(a)).

Smart device/online ADS-B position reporting applications are not acceptable for ADS-B Out transponder testing. This includes, but is not limited to, online tools such as Flightradar or flight following systems.

6.13 ADS-B Approval

ADS-B OUT systems will require a design change and/or a Form CAA 24091/7 application under Part 21. The key requirement for ADS-B OUT system approval is the post installation testing including using specialist test equipment to prove the installed ADS-B OUT system meets the performance requirements set out in NTC 91.258 clause 4(a)(5). A copy of the test report needs to be attached to Form CAA 337, Form CAA 24091/7 , or certificate of airworthiness (refer to Part 43, Appendix E.12(b)).

Operators of aircraft with ADS-B OUT systems already installed should conduct formal testing to ensure those systems meet the applicable requirements. If the systems do not meet those requirements, operators should contact the CAA for advice.

Note: aircraft with systems that produce non-compliant data cannot be operated above flight level 245 after 31 December 2018.

The Director will not accept prior fitment of equipment before the ADS-B OUT rules come into force as a mitigation if the equipment is transmitting non-compliant data.

The process for certification is set out here: **https://www.nss.govt.nz/dmsdocument/45-your-guide-to-installing-ads-b-and-pbn-equipment.**

You can also contact **airworthiness@caa.govt.nz** for further advice**.**

6.14 Instructions for Continued Airworthiness

Installers and operators should consult OEM and/or designers' requirements for instructions for continued airworthiness.

Under rule 91.605(e)(3), at a minimum, every ADS-B OUT system must be tested at least every 24 months to ensure that it remains compliant including testing of the accuracy parameters.

6.15 Equipment standards

The operator of an aircraft that is already installed with an ADS-B OUT system at the commencement date will need to ensure that the ADS-B OUT system meets the requirements of rule 91.257.

Any ADS-B OUT systems installed after 20 July 2018 must include a TSO-C166b transponder (or demonstrate equivalent performance) and a compatible GNSS positon source certified to TSO-C145, TSO-C146 or TSO-C196, or can demonstrate equivalent performance.

TSO-C166b is the current version of the TSO, so all new ADS-B OUT transponders produced now must meet this standard to be certified. Equipment certified to this standard provides ATC with more precise information.

TSO-C166 or TSO-C166a transponders that have been installed before 20 July 2018 are acceptable if the system meets the applicable performance requirements in NTC 91.258.

6.16 Mode A/C transponders in transponder mandatory airspace outside controlled airspace

Aircraft being operated in transponder mandatory airspace (including within special use airspace) that is outside controlled airspace will not need to be equipped with ADS-B OUT. However, those aircraft must be equipped with and be operating a Mode A/C transponder as a minimum, as per the current rules 91.247 and 91.541.

Note that the Mode S and ADS-B message sets include Mode A/C data.

6.17 Design Change/Modification Classification Guidance

Approved Technical Data is required for all ADS-B installations. Approved Technical Data includes Service Bulletins issued by the aircraft manufacturer, Supplemental Type Certificates issued by the State of Design for the aircraft type, or any other such data approved by the Director.

In the event that no acceptable technical data is available for your aircraft type or the equipment to be installed, you should seek the support of an approved Part 146 Design Organisation.

If you have specific questions about ATD for your aircraft, you can contact airworthiness@caa.govt.nz

6.18 Operational Guidance

Operators should enter EXACTLY the same characters as used in field 7 (call sign) of the flight plan.

Operators who have lodged a flight plan should enter the aircraft's registration (without the ZK-).

AIP table ENR1.10 provides information on the correct use of Flight ID and other important information about transponder use. Operators should note the requirement to include an indication of the surveillance equipment and capability.

7. ADS-B Message Set

The following message set elements may be contained in an ADS-B OUT message. This list is used to explain what may be contained in an ADS-B OUT message. It is not a requirements list.

(a) *ADS-B capability* – only the 1090 ADS-B In message (which indicates if the aircraft has the ability to receive 1090 ES ADS-B messages installed).

(b) *Barometric pressure altitude* indicates the aircraft's barometric pressure altitude referenced to standard sea level pressure of 29.92 inches or 1013.2 hectopascals.

(c) *Call sign/flight ID* is the radiotelephony call sign assigned to an aircraft for voice communication purposes sometimes called "flight identification" or "flight ID". For general aviation aircraft, it is normally the national registration number; for airline aircraft, it is usually the company identification and flight number; and for the military it is usually numbers and code words with special significance for the operation conducted. The call sign is required to be transmitted except when using the TSO-C154c anonymity feature.

(d) *Emergency status* alerts ATC that the aircraft is experiencing emergency conditions and indicates the type of emergency so the aircraft can take appropriate action. Applicable emergency codes are found in ICAO Annex 10 Volume 4, Surveillance Radar and Collision Avoidance Systems, and FAA AC 20-165B, Appendix A.

(e) *Emitter category* provides an indication of the aircraft's size and performance capabilities and are defined in TSO-C166b and TSO-C154c. It is designed to provide information on the wake turbulence that an aircraft produces.

(f) *Geometric altitude* is a measure of altitude provided by a satellite-based position service and is not affected by atmospheric pressure. It is only available with a GNSS position source.

(g) *Geometric vertical accuracy (GVA)* indicates the 95% accuracy of the reported vertical position (geometric altitude) within an associated allowance.

(h) *GNSS antenna offset and position offset applied (POA).* GNSS antenna offset indicates the longitudinal distance between the most forward part of the aircraft and the GNSS antenna and the lateral distance between the longitudinal center line of the aircraft and the GNSS antenna.

(i) *Ground speed* provides ATC with the aircraft's speed over the ground.

(j) *Ground track angle* is the direction of the horizontal velocity vector over the ground and must be transmitted while on the ground in order to complete velocity information.

(k) *Heading* indicates the direction in which the nose of the aircraft is pointing and must be transmitted while on the ground to complete velocity information.

(l) *Horizontal velocity* provides the rate at which an aircraft changes its horizontal position with a clearly stated direction and is expressed with north/south velocity and east/west velocity while airborne and a combination of ground speed, heading, ground track while on the ground)

(m) *ICAO 24-bit address* is a unique address assigned to an aircraft during the registration process and is defined blocks of addresses for countries or states worldwide. Additional information regarding the address can be found in ICAO Annex 10, Part 1, Volume III, appendix to Chapter 9, A World-Wide Scheme for the Allocation, Assignment and Application of Aircraft Addresses.

(n) *IDENT* is a flag manually set by the pilot at the request of ATC in ATCRBS, Mode S and ADS-B Out messages and highlights the aircraft on the controller's screen.

(o) *Latitude and longitude* are derived from the position source and provide a geometric based position.

(p) *Length and width of aircraft* provides ATC and other aircraft with quick reference to the aircraft's dimensions while on the surface.

(q) *Mode 3/A Code* is a four digit number. Secondary surveillance radars and ADS-B will concurrently provide surveillance so the Mode 3/A code is included in the ADS-B Out message.

(r) *Navigation Accuracy Category for Position (NACp).*

(s) *Navigation Accuracy Category for Velocity (NACv).*

(t) *Navigation Integrity Category (NIC).*

(u) *System Design Assurance (SDA).*

(v) *Source Integrity Level (SIL).*

Source: FAA AC 20-165B