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FIJI AIRWORTHINESS NOTICE

CIVIL AVIATION AUTHORITY OF FIJI
PRIVATE BAG (NAP 0354), NADI AIRPORT
REPUBLIC OF FIJI

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ADS-B AIRCRAFT EQUIPMENT STANDARDS

1 PURPOSE

This Airworthiness Notice is published pursuant to ANR 146 (Issue of directions and publications) and provides a definition of the airborne components of the 1090 Megahertz Extended Squitter Automatic Dependent Surveillance Broadcast (ADS-B) data link for use in Fiji, and to provide information, guidance and advice for the airworthiness approval of aircraft equipment proposed to support that use.

2 BACKGROUND

2.1 ADS-B is a surveillance application that periodically transmits aircraft parameters, such as identification, pressure altitude, position and position integrity, via a broadcast data link that is available to any receiver, either airborne or ground-based, within range of the transmitter.

2.2 ADS-B information is broadcast without any knowledge of which users may be receiving it and without the expectation of an acknowledgement or reply. As an automatic system, ADS-B requires no flight crew or controller action for the information to be transmitted. The surveillance-type information broadcast is dependent on the aircraft's navigation system and the broadcast capability of the source emitter.

2.3 An ADS-B "out" system consists of the following components:

(a) a transmitting subsystem that includes message generation and transmission functions at the source aircraft; and

(b) the data link broadcast medium.

2.4 The sources of the transmitted information, as well as the user applications, are not considered to be part of the ADS-B system, but their performance needs to be considered when defining overall ADS-B system performance.

3 APPLICABILITY

3.1 This Airworthiness Notice is applicable to all Fiji registered aircraft and aircraft which are operated by an operator domiciled in Fiji to be fitted with ADS-B equipment by ANR 23 unless –

(a) The aircraft's airworthiness flight authorization document (Certificate of Airworthiness, Flight Permit or equivalent) specifically allows the aircraft to operate without an ADS-B capability; or

(b) The equipment is fitted but is unserviceable and the aircraft is being flown to a place where repair or replacement can be carried out.

4 FUNCTIONAL REQUIREMENT

4.1 ADS-B Avionics

4.1.1 For an aircraft to be ADS-B capable, it requires:

- appropriate data sources, and
- an ADS-B transmitter to broadcast the data in a predetermined standard format.

4.2 ADS-B Transmitter

4.2.1 The ADS-B transmitter needs to comply with the minimum performance standards detailed in RTCA Document DO-260, DO-260A or DO-260B Paragraph 2.2 as appropriate for the aircraft type.

4.2.2 For ADS-B data to be universally usable, it needs to be transmitted in the formats and characteristics defined in the following standards -

- ICAO Annex 10 to the convention on International Civil Aviation, Volume III and IV, Amendment 85;
- RTCA/DO-260 Change 2 (systems compliant with earlier versions may continue to use HFOM in abnormal situations as described in Paragraph 4.2.9;
- RTCA/DO-260A Change 2; or
- RTCA/DO-260B.

  Compliance with RTCA/DO-260B is preferred – noting that this is the requirement being implemented in the USA, Australia and Europe.

4.2.3 To be useable for ATC surveillance in a "radar like" manner, ADS-B transmitters must transmit the following minimum data set: -

- **Position** (in extended squitter surface position message and in extended squitter airborne position message);
- **Position Integrity Information** (e.g. NUC or NIC value transmitted in the "TYPE" code in extended squitter surface position message and in extended squitter airborne position message);
- **Pressure Altitude** (in extended squitter airborne position message, GNSS height may also be transmitted in this message when barometric altitude is not available);
- **Aircraft Identification** (in extended squitter identity and category message); and
- **Version Number, SIL and NAC_P** in aircraft operational status message, if the avionics equipment is RTCA/DO-260A or RTCA/DO-260B compliant.

4.2.3.1 To provide a more comprehensive data set to other stations, transmission of the following data is highly desirable, as it is used by the Fiji ATC system:

- **SPI Indication** (in Surveillance Status Subfield of ADS-B airborne position messages);
- **Emergency Flag** (in Surveillance Status Subfield of ADS-B airborne position messages);
- **Emergency Priority Status Information** (may be broadcast in Extended Squitter Aircraft Status Message, RTCA/DO-260A or RTCA/DO-260B);
- **Velocity Information** (Extended Squitter Velocity Message of Surface Position message);
- **GNSS height** (GNSS Altitude Difference from Barometric Altitude in Extended Squitter Velocity message);
- **Vertical rate** (in Extended Squitter Velocity message); and

- **Aircraft category** (ensure the parameter is correctly set in the extended squitter and category message).

4.2.4 Additional ADS-B data, defined in ICAO Annex 10, Volumes III and Volume IV, Amendment 85 or RTCA/DO- 260 or RTCA/DO-260A, may also be transmitted.

4.2.5 Operators installing systems compliant with RTCA/DO260-B are urged to configure their systems to transmit all available parameters. Utilization of the failure annunciation output is recommended – refer RTCA/DO-260B paragraph 2.2.11.5

4.2.6 Equipment marked as compliant with ATSO-C1004(a), ATSO-C1005(a), TSO-C166, TSO-C166a or TSO-C166b, are considered capable of transmitting data described above in the correct formats. Later versions of these TSOs are acceptable.

4.2.7 Transponders marked as compliant with the following standards –

- AEEC – ARINC 718A;
- TSO C112;
- EUROCAE ED73B;
- JTSO-2C112a; or
- ETSO-2C112a

may be capable of transmitting this information in the correct formats. Functional testing of the installation would be required to confirm compliance.

4.2.8 RTCA/DO-260 compliant ADS-B transmitters use the Horizontal Protection Limit/Horizontal Integrity Limit (HPL/HIL) data from the GNSS receiver as the highest priority data source for determination of Navigation Uncertainty Category (NUC).

4.2.9 ADS-B transmitters compliant with pre RTCA/DO-260 Change 2 may use the Horizontal Figure of Merit (HFOM) data from the GNSS receiver during periods of HPL non-availability due to operational reasons (e.g. satellite geometry, etc); however this is considered to be an abnormal situation.

4.2.10 For RTCA/DO-260A and RTCA/DO-260B compliant transmitters, HPL is used for determination of Navigation Integrity Category (NIC) and Horizontal Figure of Merit (HFOM) is used for determination of Navigation Accuracy Category (NAC).

4.2.10 It is desirable but not essential that the flight crew have the ablity to disable the ADS-B function on instruction from ATC without disabling the operation of the ATC transponder function.

4.2.10 It is desirable but that the flight crew are able to initiate emergency messages and “ident” functions.

4.2.11 Transmitter antenna installation, including the need for antenna diversity, needs to comply with manufacturer’s installation instructions for ATC transponders to ensure satisfactory functioning. This is particularly relevant to aircraft above 5700 kg, or with a maximum cruising speed greater than 463 km/h (250 Knots).

4.3 ADS-B data sources (Essential)

4.3.1 The following section describes the minimum data necessary for ADS-B transmitters to function in the ATC environment (for more detailed requirements including references see Appendix A). Each category is essential to ensure the message being transmitted has all the relevant data necessary to enable separation to be calculated. Failure to comply may render the prospective operator unable to obtain the benefits of ADS-B separation.

4.4 Positional data

4.4.1 Accurate positional data is essential for the ADS-B system to operate in a "radar like manner" and be the basis for the allocation of separation between aircraft. Valid GNSS data input provides an acceptable accuracy and integrity for separation purposes with the delivery of position information at a periodic but randomised interval of less than or equal to one second.

4.4.2 GNSS equipment compliant with TSO-C145, TSO-C146, TSO-C196 or an equivalent standard acceptable to the Authority, are suitable for use with ADS-B. Later versions of these TSOs are acceptable.

4.4.3 Particular navigation packages that do not have a TSOA, but can be demonstrated to achieve the accuracy and integrity values required, may be acceptable to the Authority. In assessing the suitability of GNSS avionics that do not have a TSO-C145/146/196 authorisation, the Authority may consider the system differences from the standards documented in RTCA/DO-229C or RTCA/DO-316 (or later version), with particular regard to the following criteria:

- The system's capability of delivering position information with a periodic interval of at least one second; and
- The system can continuously output the HPL value to the ADS-B transmitter; and
- The system has a capability to compute FDE (Fault Detection and Exclusion) in accordance with the definition at paragraph 1.7.3 of RTCA/DO-229D;
- The system addresses Selective Availability (SA) in such a way that, for the purpose of HPL computation, it accounts for the absence of the SA of the GPS in accordance with paragraph 1.8.1.1 of RTCA/DO-229D

4.5 Positional integrity data

4.5.1 HPL integrity data needs to be provided to the ADS-B transmitter from the GNSS receiver on the same interface as the positional data. This data is typically available as ARINC429 label 130.

4.5.2 HFOM data shall be provided to the transponder on the same interface as the HPL data. HFOM typically uses ARINC429 label 247.

4.5.3 A RTCA/DO-260A or RTCA/DO-260B compliant installation will use the HFOM value to calculate NAC.

4.5.4 In some cases, such as during rare periods of inadequate satellites, HPL may not be delivered to the interface. In this case, a RTCA/DO-260 compliant installation may use the HFOM value to generate NUC during the period of HPL non-availability; however this is considered an abnormal situation.

4.5.3 In the case of RTCA/DO-260A or RTCA/DO-260B compliant installations, the SIL is intended to reflect the integrity of the navigation source of the position information broadcast. Where position integrity is based on HPL and the SIL cannot be unambiguously determined and set dynamically, it is recommended that value should be set to 2 (two) or

the value recommended by the equipment manufacturer. During periods where HPL is not available, the NIC should be set to 0 (zero), and the NAC should reflect the accuracy of the broadcast position.

4.6 Pressure altitude

4.6.1 Pressure altitude provided to transponders is to be in accordance with existing requirements for ATC transponders; 7.62 metre (25 foot) altitude encoding shall be used. This data is typically available on ARINC429 label 203.

4.7 Identity

4.7.1 Identity information, that is the aircraft flight identification (Flight ID) or aircraft registration mark, is to be provided to the transponder so that the information is identical to the filed flight plan. This information is normally entered by the flight crew prior to each flight utilizing either;

- a flight management system; or
- a pilot control panel;

For aircraft which always operates with the same Flight ID (e.g. using aircraft registration mark as a callsign), this may be programmed into equipment at installation.

4.8 ADS-B data sources (Desirable)

4.8.1 GNSS altitude. GNSS altitude should be provided from an approved GNSS receiver to the ADS-B transmitter. Typically this data is available as HAE, ARINC 429 label 370 or MSL, ARINC 429 label 076.

4.8.2 Vertical rate (GNSS or Barometric). Vertical rate may be provided from either a GNSS receiver or from a pressure source:

- GNSS vertical rate should be provided from an approved GNSS receiver, and is typically available as ARINC429 label 165; or
- Barometric vertical rate. Barometric (BARO) vertical rate is typically available as ARINC 429 label 212.

Note: The most accurate source should be used.

4.8.3 Velocity Information. Ground speed from an approved GNSS receiver in the form of East/West Velocity and North/South Velocity should be provided. This would be typically available as ARINC429 label 174.

4.8.4 SPI Indication. For ATC transponders, the SPI capability is integrated into the transponder functionality and is controlled from the transponder control panel. For non transponder implementations, a discrete input or a control panel may be provided to trigger the SPI indication.

4.8.5 Emergency indicator. For ATC transponders the emergency declaration capability is integrated into the transponder functionality and is controlled from the transponder control panel. For non transponder implementations a discrete input or a control panel may be provided to trigger the emergency and/or to indicate the type of emergency.

5 DESIGN, DEVELOPMENT AND APPROVAL OF AIRCRAFT MODIFICATIONS

5.1 Compliance

5.1.1 When utilising this guidance material for the approval of an ADS-B installation, the following need to be considered:

- The applicant will need to submit, to the Authority, a compliance statement that shows how the criteria of this guidance material has been satisfied, together with evidence resulting from the activities described in this section.
- Compliance with the airworthiness requirements for intended function and safety may be demonstrated by equipment qualification, safety analysis of the interface between the ADS-B equipment and data sources, equipment cooling verification and ground tests. To support the approval application, design data will need to be submitted showing that the requirements for ADS-B operation have been complied with.
- The safety analysis of the interface between the ADS-B system and its data sources should show no unwanted interaction under normal or fault conditions.

5.1.2 FAA AC 120-86 and AC 20-165 provide additional guidance by providing general information and acceptable methods of compliance for the certification, airworthiness, and operational approval of certain aircraft surveillance systems and selected associated aviation applications.

5.1.3 A self-evaluation checklist to assist in determining compliance is included at Appendix B to this Airworthiness Notice.

5.2 Functional Testing

5.2.1 Testing of the installed system either on ground or in flight, is intended to confirm:

- system operation;
- that the aircraft derived data in the transmitted messages, including integrity data, is correct; and
- correct functioning of installed system fault detectors.

5.2.2 Whilst some of the functionality for ADS-B out applications may be demonstrated by ground testing, thorough validation of the installed equipment combination may need a mix of ground and flight tests.

5.3 Flight Manual

5.3.1 The Aircraft Flight Manual (AFM) or the Pilot's Operating Handbook (POH), whichever is applicable, should provide at least a statement that the transponder system(s) complies with the criteria of ICAO Annex 10 Volumes III and IV, Amendment 85 regarding extended squitter and any necessary procedures for expected operations (e.g. the need to enter Identity/Call sign also known as Flight ID) for use with ATC.

5.3.2 Crew Operating Instructions for the ADS-B system should emphasize the need to use the ICAO format, as defined in ICAO Doc 4444, for entry of the Flight ID or Registration Mark as applicable to the flight. The shortened format commonly used by airlines (a format used by the International Air Transport Association) is not compatible with the ground systems of the air traffic services.

5.4 Minimum Equipment List (MEL)

5.4.1 The MEL should indicate that ADS-B OUT is mandatory for all operations.

5.5 Maintenance

5.5.1 Maintenance tests should include a periodic verification check of aircraft ADS-B data including the ICAO 24 bit aircraft address (also known as the 24-bit Mode S address) using suitable ramp test equipment. A check of the ICAO 24 bit aircraft address should be made in the event of a change of the registration mark of the aircraft (this is always necessary following change in State of registration) or whenever a transponder is replaced.
Note: Fiji registered aircraft are allocated a 24-bit address by the Authority at time of registration.

5.5.2 Where possible, maintenance tests should check the correct functioning of system fault detectors.

5.5.3 The maximum period between ADS-B maintenance tests of the ADS-B transmitter should be the same as for ATC transponders and all transponders fitted to the aircraft should be checked.

APPENDIX A

REFERENCES

Source	Title	Reference	Version	Date
CAAF	Fiji Air Navigation Regulations 1981	ANR 23 Scale Z	Batch 2 & 3	Nov 2009
CASA	Airworthiness Approval of Airborne Automatic Dependant Surveillance – Broadcast Equipment	AC 21-45(1)	1	Feb 2012
CASA	Aircraft Equipment – basic operational requirements	CAO 20.18		23 Aug 2012
FAA	TSO for Mode S Extended Squitter	TSO-C112	d	6 June 2011
FAA	TSO for Airborne Navigation Sensors using GPS Augmented by Satellite Based Augmentation System	TSO-C145	c	2 May 2008
FAA	TSO for Stand-Alone Airborne Navigation Equipment using The Global Positioning System Augmented by The Satellite based Augmentation System	TSO-C146	c	09 May 2008
FAA	TSO for Extended Squitter Automatic Dependant Surveillance – Broadcast (ADS-B) and Traffic Information Service – Broadcast (TIS-B) Equipment Operating on the radio Frequency of 1090 MHz	TSO-C166	a b	21 Dec 2006 02 Dec 2009
FAA	TSO for Avionics supporting Automatic Dependant Surveillance – Broadcast (ADS-B) Aircraft Surveillance Applications (ASA)	TSO-C195	a	29 Feb 2012
FAA	Airworthiness Approval of Automatic Dependant Surveillance – Broadcast (ADS-B) Out Systems in aircraft	AC 20-165A		07 Nov 2012
ICAO	Technical Provisions for Mode S Services and Extended Squitter	Doc 9871	2	2012
EASA	Acceptable Means of Compliance	AMC 20-24		02 May 2008

APPENDIX B

SELF EVALUATION CHECKLIST

ADS-B Transmitter Manufacturer & Model number	
GNSS positional source Manufacturer & Model number	
GNSS receiver TSO	➢ C145a or later version ➢ C146a or later version ➢ C196 or later version ➢ Other
If not TSO C145() TSO C146() or TSO C196 compliant	➢ Fault Detection and Exclusion - YES/NO ➢ Selective Availability aware – YES/NO ➢ Confirm outputs HPL or HIL ➢ Is BARO aiding provided to GNSS receiver?
Transmitter Message formats compliant with: (Circle one)	➢ ICAO Annex 10, Volume III and Volume IV Amendment 85; or ➢ DO-260; or ➢ DO-260A or TSO C166 or TSO C166a ➢ DO-260B or TSO C166b
Transmitter characteristics compliant with : (Circle one)	➢ ATSO-C1004b ➢ ATSO-1C74c ➢ TSO-C112 and compliant with RTCA/DO-181e; or ➢ ETSO-C112b; or ➢ ED73B or DO-181e ➢ ATSO-C1005b
HPL is provided to ADS-B transmitter on same interface as GNSS positional data and tested ?	YES/NO
Suitable barometric encoder (pressure altitude) data provided to transmitter and tested?	YES/NO
Uses aircraft's own ATC transponder antenna?	YES/NO
If not using the aircraft's own ATC antenna, has antenna been mounted in accord with transponder mounting rules?	YES/NO
Flight ID source installed and tested? (Circle one)	Programmed / Pilot entry panel / Flight Management System interface
Optional data supported and tested (Circle those verified)	➢ SPI indication ➢ Emergency flag ➢ Ground track / Ground speed velocity vector ➢ Emergency type indicator ➢ GNSS height ➢ GNSS vertical rate ➢ BARO vertical rate