International Civil Aviation Organization

REGULATOR'S WORKSHOP ON ADS-B AVIONICS EQUIPAGE REQUIREMENTS

Jakarta, Indonesia, 16 – 17 August 2010

Agenda Item 6: **Review existing ADS-B equipage mandates world-wide, and preview any future mandates**

- **Australian Civil Aviation Order**

EXPLANATION OF THE AUSTRALIAN ADS-B RULE

(Presented by Australia)

SUMMARY

This IP provides a clause-by-clause explanation of the Australian ADS-B rule. The IP may be useful as guidance material for those APAC State regulators intending to establish their own ADS-B rule and equipage mandate.

1. INTRODUCTION

1.1 The Civil Aviation Safety Authority (CASA) rule for aircraft ADS-B avionics equipment is not an equipment certification scheme. It is a statement of the equipment standards for aircraft GNSS + ADS-B OUT equipment configurations that CASA considers the minimum necessary to provide the integrity and availability of ADS-B OUT message transmissions used for en-route upper airspace surveillance by ATC with a 5NM separation standard. The referenced standards are wide enough that most existing ADS-B equipped aircraft meet the requirements with few exceptions.

1.2 As well as setting the aircraft equipage standards, the rule also includes the 'upper airspace mandate' applicable to all aircraft flying at or above FL290 in Australian territorial airspace that takes effect on 12 December 2013.

1.3 The rule places a legal obligation on aircraft operators to ensure that their ADS-B equipage complies with the standards when operating in upper Australian airspace by December 2013. Until that date, the airspace is being controlled in a mixed mode environment – currently about 60% of the aircraft being fitted with ADS-B.

The rule has been established in keeping with ICAO APANPIRG Conclusions:
Conclusion 19/37 – Revised Mandate Regional ADS-B OUT Implementation
Conclusion 20/55 – Forward Fitment Requirements for SA Aware and FDE

2. EXPLANATION OF AUSTRALIAN ADS-B RULE

2.1 The Australian rule is shown in the Attachment to this IP. The actual text of the rule is in regular font. Underneath each clause of the text, a brief explanation or comment is entered in italic font to explain the reason for each clause.

3. FUTURE MANDATES

3.1 In the long term Australia will move to a nation-wide ground and satellite-based network of CNS for ATM. Although the extent and timing has not yet been decided on, a number of options are under policy consideration for the mandating of aircraft GNSS and ADS-B equipage in the lower airspace.

4. ACTION BY THE WORKSHOP

4.1 The Workshop is invited to consider the Attachment to this IP for guidance material use by those State regulators intending to establish an aircraft ADS-B equipage rule.

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ATTACHMENT

FORM AND EXPLANATION OF THE AUSTRALIAN RULE

Australian ADS-B rule as applicable to foreign airline aircraft operating in Australia; extract from Civil Aviation Order 82.5

Conditions on Air Operators' Certificates authorising regular public transport operations in high capacity aircraft

10.8 The operator of a foreign registered aircraft must ensure that it complies with the requirements (***Directions***) in Appendix 4. The definitions in Appendix 4 also apply for Appendix 5.

Appendix 4

Directions relating to carriage and use of automatic dependent surveillance – broadcast equipment

1 In this Appendix:

ADS-B means automatic dependent surveillance – broadcast.

ADS-B test flight means a flight to prove ADS-B transmitting equipment that is newly installed on the aircraft undertaking the flight.

aircraft means a foreign aircraft.

aircraft address means a unique combination of 24 bits assigned to an aircraft by, or under the authority of, an NAA for the purpose of air to ground communications, navigation and surveillance.

approved equipment configuration means an equipment configuration that:

(a) meets the conditions for approval set out in Appendix 5; or

(b) is approved in writing by CASA.

Note Equipment configurations approved by CASA are published in Appendix D of Advisory Circular 21-45.

ATSO means Australian Technical Standard Order of CASA.

EASA means the European Aviation Safety Agency.

EASA AMC 20-24 means EASA document AMC 20-24 titled *Certification Considerations for Enhanced ATS in Non-Radar Areas using ADS-B Surveillance (ADS-B-NRA) via 1090 MHZ Extended Squitter*, dated 2 May 2008.

ETSO means European Technical Standard Order of the EASA.

FAA means the Federal Aviation Administration of the United States.

FDE means Fault Detection and Exclusion, a feature of a GNSS receiver that excludes faulty satellites from position computation.

FL 290 means flight level 290.

Note Flight level 290 is defined in subregulation 2 (1) of CAR 1988.

GNSS means the Global Navigation Satellite System installed in an aircraft to continually compute the position of the aircraft by use of the GPS.

GPS means the Global Positioning System.

HPL means the Horizontal Protection Level of the GNSS position of an aircraft as an output of the GNSS receiver or system.

NAA has the same meaning as in regulation 1.4 of the *Civil Aviation Safety Regulations 1998*.

Note "***NAA***, for a country other than Australia, means:

(a) the national airworthiness authority of the country; or

(b) EASA, in relation to any function or task that EASA carries out on behalf of the country."

NIC means Navigation Integrity Category as specified in paragraph 2.2.3.2.7.2.6 of RTCA/DO-260A.

NUCp means Navigation Uncertainty Category — Position as specified in paragraph 2.2.8.1.5 of RTCA/DO-260.

RTCA/DO-229D means document RTCA/DO-229D titled *Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment*, dated 13 December 2006, of the RTCA Inc. of Washington D.C. USA (***RTCA Inc.***).

RTCA/DO-260 means RTCA Inc. document RTCA/DO-260 titled *Minimum Operational Performance Standards for 1090 MHz Automatic Dependent Surveillance – Broadcast*, dated 13 September 2000.

RTCA/DO-260A means RTCA Inc. document RTCA/DO-260A titled *Minimum Operational Performance Standards for 1090 MHz Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B)*, dated 10 April 2003.

SA means Selective Availability, and is a function of the GPS that has the effect of degrading the accuracy of the computed GPS position of a GNSS-equipped aircraft.

TSO means Technical Standard Order of the FAA.

Note NAA is defined in regulation 1.4 of the *Civil Aviation Safety Regulations 1998*.

The above definitions establish a plain-English meaning and legal basis for the technical terminology, documentation, and abbreviations referenced or used in the Order. This is necessary in Australian legislation.

2 If an aircraft carries ADS-B transmitting equipment for operational use in Australian territory, the equipment must comply with an approved equipment configuration.

*The term '**approved equipment configuration**' is used to establish that acceptable ADS-B transmissions rely on the combination of GNSS receiver equipment and ADS-B transponder equipment that must meet standards specified in the Order. Approved equipment configurations have been published by CASA in AC 21-45.*

3 If an aircraft carries serviceable ADS-B transmitting equipment for operational use in Australian territory, the equipment must transmit:

(a) a flight identification that corresponds exactly to the aircraft identification mentioned on the flight notification filed with, or relayed to air traffic control (***ATC***) for the flight; or

(b) another flight identification directed or approved by ATC.

The FLT ID as entered in the cockpit is the transmitted parameter that is used by the ANSP's system to identify aircraft on an ATC display and to correlate the aircraft ADS-B track with that FLTID entered on the submitted Flight Notification. It is therefore most important that both exactly match in the Australian system.

4 If an aircraft carries serviceable ADS-B transmitting equipment that complies with an approved equipment configuration, the equipment must be operated continuously during the flight in all airspace at all altitudes unless the pilot is directed or approved otherwise by ATC.

In Australia ADS-B is now being used by ATC for separation in the upper airspace. It is also used in the lower airspace if an aircraft is ADS-B equipped. ATC use in the lower airspace is for situational awareness and for the provision of traffic advisories to aircraft by ATC in airspace outside radar where ADS-B ground station coverage exists.

5 If an aircraft carries ADS-B transmitting equipment which does not comply with an approved equipment configuration, the aircraft must not fly in Australian territory unless the equipment is:

(a) deactivated; or

(b) set to transmit only a value of zero for the NUCp or NIC.

Note It is considered equivalent to deactivation if NUCp or NIC is set to continually transmit only a value of zero.

Most ADS-B equipped aircraft comply with the Australian standards. The few that do not have approved equipment must deactivate the transmissions by some means. Transmission of NUC or NIC = 0 is recognised by the ANSP's ADS-B system as a transmission having no integrity which results in an aircraft's ADS-B transmissions not being displayed on ATC screens.

6 However, the equipment need not be deactivated as mentioned in clause 5 if the aircraft is undertaking an ADS-B test flight in VMC in airspace below FL 290.

This clause permits test flights of ADS-B installations that have not been shown to be 'approved equipment configurations'.

7 On and after 12 December 2013, if an aircraft operates at or above FL 290, it must carry serviceable ADS-B transmitting equipment that complies with an approved equipment configuration.

Note On and after 12 December 2013, an aircraft must carry and continuously operate compliant ADS-B transmitting equipment in accordance with clause 7.

Apart from this, there is no obligation to carry compliant ADS-B transmitting equipment.

However, including the effect of clause 4 above, if compliant ADS-B transmitting equipment is in fact carried, whether voluntarily or in accordance with the obligation under clause 7, it must be operated continuously in all airspace, at all altitudes.

This is the 'upper airspace mandate' that takes effect on 12 December 2013 for all aircraft flying at or above FL290. After that date, ATC separation service in Australia will be by ADS-B outside radar coverage

8 Clause 7 does not apply to an aircraft if the aircraft owner, operator or pilot has written authorisation from CASA for the operation of the aircraft without the equipment.

From time to time, there may be valid reason to grant an aircraft operator an exemption to the requirements to have ADS-B fitted and this clause provides a means to grant individual exemptions.

Appendix 5

Paragraph 10.8 and definition of ***approved equipment configuration*** in clause 1 of Appendix 4

Part A

Approved equipment configuration

1 An equipment configuration is approved if it complies with the standards specified in Part B or Part C of this Appendix.

It is the responsibility of aircraft operators to ensure that their ADS-B equipment configurations meet the standards itemised below in either Part B or Part C. Part B represents the standards for the present system of equipment configuration approval by individual aircraft that has been in use in Australia since the commencement of the ADS-B program. More than 1100 aircraft, many foreign registered, have been approved under this equipment qualification process. The alternative approval process is at Part C which is for acceptance of aircraft that have gained certification under EASA AMC 20-24.

Part B

ADS-B transmitting equipment — standard for approval

2 ADS-B transmitting equipment must be of a type that:

(a) is authorised by:

(i) the FAA in accordance with TSO-C166 as in force on 20 September 2004, or a later version as in force from time to time; or

This provides that transponders meeting TSO-C166 or the later versions C166a or C166b are all acceptable for Australian use.

(ii) CASA, in writing, in accordance with:

(A) ATSO-C1004a as in force on 16 December 2009, or a later version as in force from time to time; or

(B) ATSO-C1005a as in force on 16 December 2009, or a later version as in force from time to time; or

These Australian TSOs are available on the CASA website. They have been written to specify standards for equipment suitable for General Aviation aircraft. They are not applicable to airline category aircraft.

(b) meets the following requirements:

(i) the type must be accepted by CASA as meeting the specifications in RTCA/DO-260 dated 13 September 2000, or a later version as in force from time to time;

Reference to DO-260 was eliminated from TSO-C166 version dated 20 September 2004. The Report of the ADS-B SITF/8 Meeting, at paragraph 7.26, noted that Australia (CASA) will clarify that ADS-B transponders manufactured to RTCA DO-260 standard are acceptable to Australia. That undertaking has been addressed by clause (b)(i) above.

(ii) the type must utilise HPL at all times HPL is available; or

One type of earlier model Mode S transponder with Extended Squitter capability that still remains in service in considerable numbers uses

HFOM not HPL, to generate NUCp. This means that there is no transmission of the integrity level of the aircraft position. That is a safety issue and the reason that this requirement has been inserted in the Order. The manufacturer has a software modification that corrects the problem. However, not all aircraft operators have had the modification incorporated. Regulators should make sure that aircraft of their State have the modification incorporated - requires visual inspection of the modification plate on the transponder to determine if the software modification has been incorporated.

(c) is otherwise authorised, in writing, by CASA for the purposes of subsection 9B of Civil Aviation Order 20.18 as being equivalent to one of the foregoing types.

Permits the regulator to approve equipment having equivalent characteristics or other means of certification.

GNSS position source equipment — standard for aircraft manufactured on or after 28 June 2012

The date of 28 June 2012 for newly manufactured aircraft to be fitted with SA Aware GNSS equipment is considered to provide sufficient time for manufacturers to design and certify installations that comply. Note that this requirement is applicable only to aircraft manufactured after 28 June 2102, not to existing aircraft.

3 For an aircraft manufactured on or after 28 June 2012, the geographical position transmitted by the ADS-B transmitting equipment must be determined by:

(a) a GNSS receiver of a type that is authorised by the FAA in accordance with TSO-C145a or TSO-C146a as in force on 19 September 2002, or a later version as in force from time to time; or

(b) a GNSS receiver of a type that is authorised by the FAA in accordance with TSO-C196 as in force on 9 September 2009, or a later version as in force from time to time; or

GNSS receivers manufactured to these standards are modern equipment having all the necessary features for primary means navigation and the levels of integrity and reliability as a position source for ADS-B based surveillance for current and future ADS-B operational applications.

(c) a GNSS receiver or system which meets the following requirements:

(i) is certified by an NAA for use in flight under the I.F.R.;

(ii) has included in its specification and operation the following:

(A) FDE, computed in accordance with the definition at paragraph 1.7.3 of RTCA/DO-229D;

FDE (Fault Detection and Exclusion) provides internal integrity by identifying a faulty satellite and eliminating it from the computation of aircraft position. This is considered a necessary requirement for safety and position integrity. The RAIM in some GNSS receivers may have Fault Detection but not the Exclusion function and these are not acceptable to CASA. FDE in oceanic mode is acceptable.

(B) the output function HPL, computed in accordance with the definition at paragraph 1.7.2 of RTCA/DO-229D;

HPL (or HIL) is the necessary input parameter to the transponder for the generation of the NUC or NACp horizontal integrity limit (95% probability) of the computed aircraft position.

(C) functionality that, for the purpose of HPL computation, accounts for the absence of the SA of the GPS in accordance with paragraph 1.8.1.1 of RTCA/DO-229D; or

(d) another equivalent system authorised in writing by CASA.

Note The following GNSS receivers meet the requirements of clause 3, namely, those certified to TSO-C145a or TSO-C146a, or later versions, or those manufactured to comply with TSO-C196.

Clause (c) has been included to cover the case of equipment configurations of airline aircraft which have received certification or approval under the aircraft's type certification, and not under a specific equipment TSO certification process.

GNSS position source equipment — standard for aircraft manufactured before 28 June 2012

4 For an aircraft manufactured before 28 June 2012, the geographical position transmitted by the ADS-B transmitting equipment must be determined by:

(a) a GNSS receiver or system that complies with the requirements of clause 3, other than sub-subparagraph 3 (c) (ii) (C) which is optional; or

(b) an equivalent GNSS receiver or system that has been approved in writing by CASA.

SA Aware capability in the GNSS receiver is not mandated for existing aircraft manufactured before 28 June 2012. However the integrity parameters FDE and HPL output are required. (This represents a difference with EASA AMC 20-24.)

Note The following GNSS receivers meet the requirements of clause 4, namely, those certified to TSO-C145a or TSO-C146a, or later versions, or those manufactured to comply with TSO-C196. Some later versions of GNSS receivers certified to TSO-C129 may also meet the requirements, i.e. those having FDE and HPL features incorporated.

Altitude source equipment — standard

5 The pressure altitude transmitted by the ADS-B transmitting equipment must be determined by:

(a) a barometric encoder of a type that is authorised by:

(i) the FAA in accordance with TSO-C88a as in force on 18 August 1983, or a later version as in force from time to time; or

(ii) EASA in accordance with ETSO-C88a as in force on 24 October 2003, or a later version as in force from time to time; or

(b) another equivalent system authorised in writing by CASA.

Aircraft barometric encoder altitude data provided to the ADS-B transmitter must correspond within plus or minus 125 ft at 95% probability of the aircraft pressure-altitude data displayed to pilots for adherence to the assigned flight level. Resolution standard of the encoder is plus or minus 25 ft.

Aircraft address — standard

6 Unless otherwise approved in writing by CASA, the ADS-B transmitting equipment must:

(a) transmit the current aircraft address; and

'Current aircraft address' is the ICAO 24 bit address issued for the aircraft by the State of Registration.

(b) allow the pilot to activate and deactivate transmission during flight.

Note The requirement in paragraph 6 (b) is met if the ADS-B transmitting equipment has a cockpit control that enables the pilot to turn the ADS-B transmissions on and off.

Part C

This Part C process is an alternative path of meeting Australian requirements for total system equipage standards by way of EASA AMC 20-24 certification.

Alternative approved equipment configuration — standard for aircraft manufactured on or after 28 June 2012

7 For an aircraft manufactured on or after 28 June 2012, an equipment configuration is approved if:

(a) it has been certified by EASA as meeting the standards of EASA AMC 20-24; and

(b) the aircraft flight manual attests to the certification; and

(c) the GNSS receiver or system complies with the requirements of clause 3 in Part B.

For aircraft manufactured after 28 June 2012, EASA AMC 20-24 certification is accepted if the GNSS receiver also meets clause 3 above, i.e. must incorporate FDE, HPL output, and SA Aware or SA Off is also mandatory for aircraft manufactured after 28 June 2012. (In EASA AMC 20-24, FDE stated to be highly desirable, not mandatory.)

Alternative approved equipment configuration — standard for aircraft manufactured before 28 June 2012

8 For an aircraft manufactured before 28 June 2012, an equipment configuration is approved if:

(a) it has been certified by EASA as meeting the standards of EASA AMC 20-24; and

(b) the aircraft flight manual attests to the certification; and

(c) the GNSS receiver or system complies with the requirements of clause 4 in Part B.

EASA AMC 20-24 certification is accepted for aircraft manufactured before 28 June 2012 if the GNSS receiver meets clause 4 above, i.e. must incorporate FDE, HPL output. SA Aware or SA Off is not mandatory.

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