ADS-B Regulators Workshop

Session 7: Review existing ADS-B Equipage Mandates

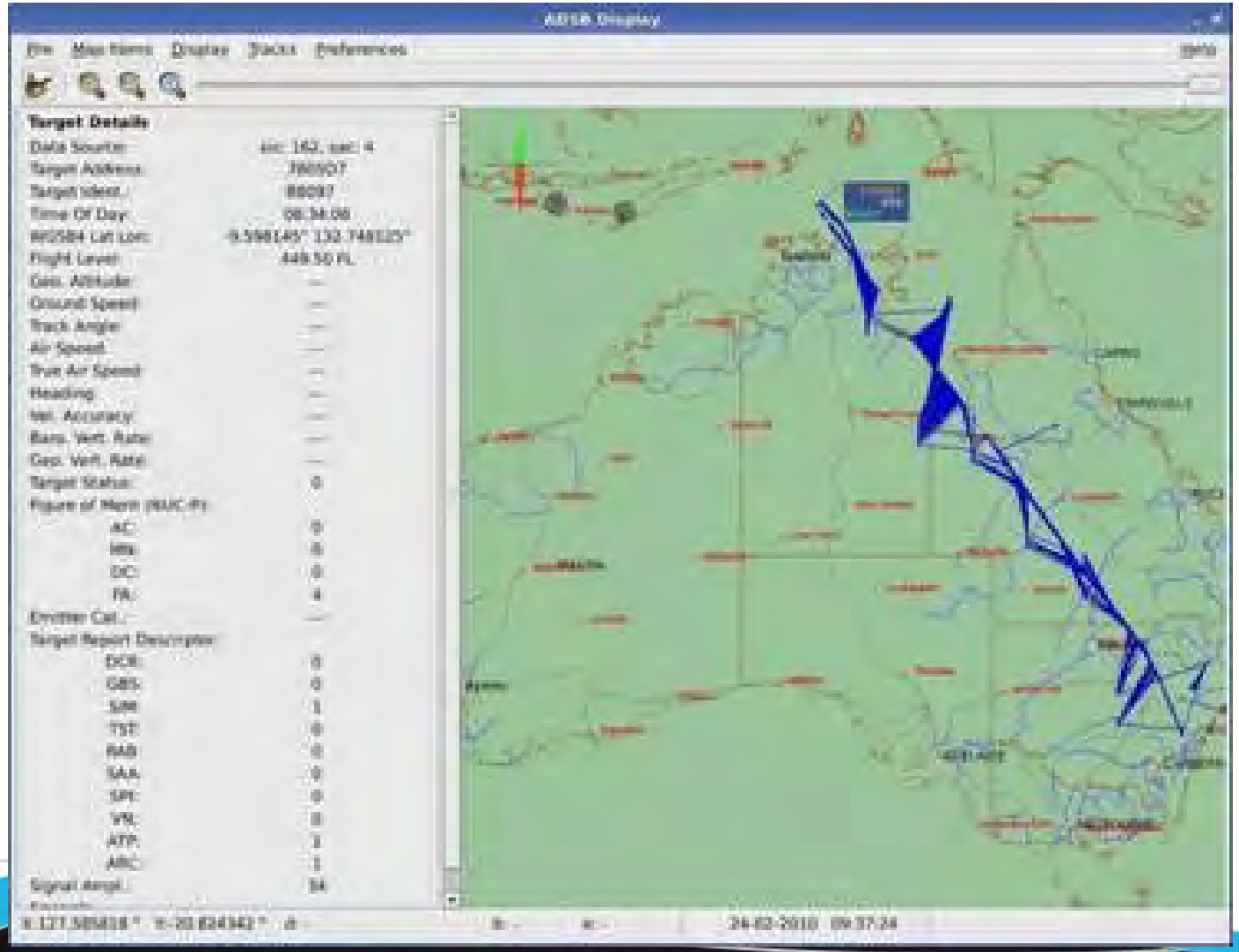
Australian Government
Civil Aviation Safety Authority
www.casa.gov.au

ADS-B Workshop SP/5

Australian rule - ADS-B OUT mandate for enroute surveillance

safe skies for all

Why do we need to regulate equipment standards?
Example of unacceptable ADS-B transponder



Overview

- Justification for a mandate
- Impact of a mandate on an APAC state
- Australian aircraft equipage mandate
- Explanation of the Rule (Workshop IP-2)
  - Not an avionics certification scheme
  - Is an equipage acceptance scheme for GNSS + ADS-B configurations
  - Advisory material for equipage and pilot knowledge
  - Aircraft approvals

Justification for an ADS-B mandate - Airline Operator benefits

- Improved safety – introduction in areas previously without any surveillance coverage and change from procedural to radar-like airspace
  - precise knowledge of a/c and its position for Controllers
- Increased airspace capacity/efficiency by reduced separation standard (50NM to 5NM)
- Less holding at non-preferred levels
- Weather diversions – more flexibility for ATC
- Reduction in fuel use –economic and environmental benefits
- Cost/benefit studies show significant positive outcome (e.g. CANSO study of South China Sea routes)
- Reduced greenhouse gas emissions due to increased fuel efficiency

Justification for ADS-B mandate ANSP benefits in enroute ATM

- Increased airspace total system safety and reduction in overall system risk through more accurate navigation and surveillance;
- Improved in-flight emergency response
- Improved pilot and ATC situational awareness
- Improved accident investigation capabilities due to expanded surveillance
- Additional ATC safety net functions enabled by ADS-B, including cleared level and route adherence monitoring, short term conflict alerts, and danger area infringement and minimum safe altitude warnings
- Improved pilot / ATC communication
- Safer ATC tactical and vectoring operations
- Potential to share ADS-B information across FIR boundaries to reduce current FIR boundary risks
- Cross FIR-boundary surveillance will reduce the impact of coordination errors

Impact of Australian ADS-B mandate

- Mandate applies to both domestic and foreign registered aircraft
- Many international aircraft in this upper airspace already have ADS-B equipment –
  - 1100+ aircraft have been approved to receive ADS-B services
  - ~ 75% of international airline flights by ADS-B approved aircraft
  - ~ 25% of domestic airline flights by ADS-B approved aircraft
  - ~ 23% of all flight plans are for ADS-B approved aircraft
- Airlines will introduce many new generation a/c over next 4 years which will come fitted with ADS-B DO-260A/B - if mandated to the standard necessary for the ANSP operational application.

Australian rule for avionics standards and compliance date

- Voluntary ADS-B avionics fitment until December 2013, then mandatory for aircraft flight at/above FL290 (for enroute surveillance outside radar coverage)
- Non-complying ADS-B equipment to be deactivated prior to flight in Australia
- Standards are fully in keeping with ICAO APANPIRG and ADS-B SITF inter-operability and harmonisation Conclusions.
- Caters for the existing GNSS and ADS-B installations in most airline aircraft on international service (with a few exceptions)
- The exceptions (non-compliant GNSS receivers and ADS-B transponders) are a potential problem area that needs to be controlled

CASA website link to the ADS-B rules

- These Civil Aviation Orders have similar text and operate in combination to impose standards for equipment configurations used for ADS-B transmission. They are applicable to all Australian aircraft (CAO 20.18), to foreign aircraft when operating in Australian territory under an Air Operator's Certificate (CAOs 82.1, 82.3 and 82.5), and to foreign aircraft engaged in private operations in Australian territory (CASA legislative instrument 521/09):

  CAO 20.18 ***Amendment Order (No 3) 2009 (Aircraft Equipment - basic operational requirements): See section 9B and Appendix XI***

- http://casa.gov.au/wcmswr/_assets/main/download/orders/cao20/2018.pdf

  CAO 82.1 ***Amendment Order (No 2) 2009 (Conditions on Air Operator's Certificates authorising charter operations and aerial work operations): See paragraph 5.8 and Appendices 3 and 4***

- http://casa.gov.au/wcmswr/_assets/main/download/orders/cao82/8201.pdf

  CAO 82.3 ***Amendment Order (No 3) 2009 (Conditions on Air Operator's Certificates authorising regular public transport operations in other than high capacity aircraft). See paragraph 10.8 and Appendices 6 and 7.***

- http://casa.gov.au/wcmswr/_assets/main/download/orders/cao82/8203.pdf

  CAO 82.5 ***Amendment Order (No 3) 2009 (Conditions on Air Operator's Certificates authorising regular public transport operations in high capacity aircraft). See paragraph 10.8 and Appendices 4 and 5.***

- http://casa.gov.au/wcmswr/_assets/main/download/orders/cao82/8205.pdf

- ***CASA Miscellaneous Instrument 521/09 - Direction - Use of ADS-B in foreign aircraft engaged in private operations in Australian territory.***
- http://casa.gov.au/wcmswr/_assets/main/rules/miscinst/2009/casa521.pdf

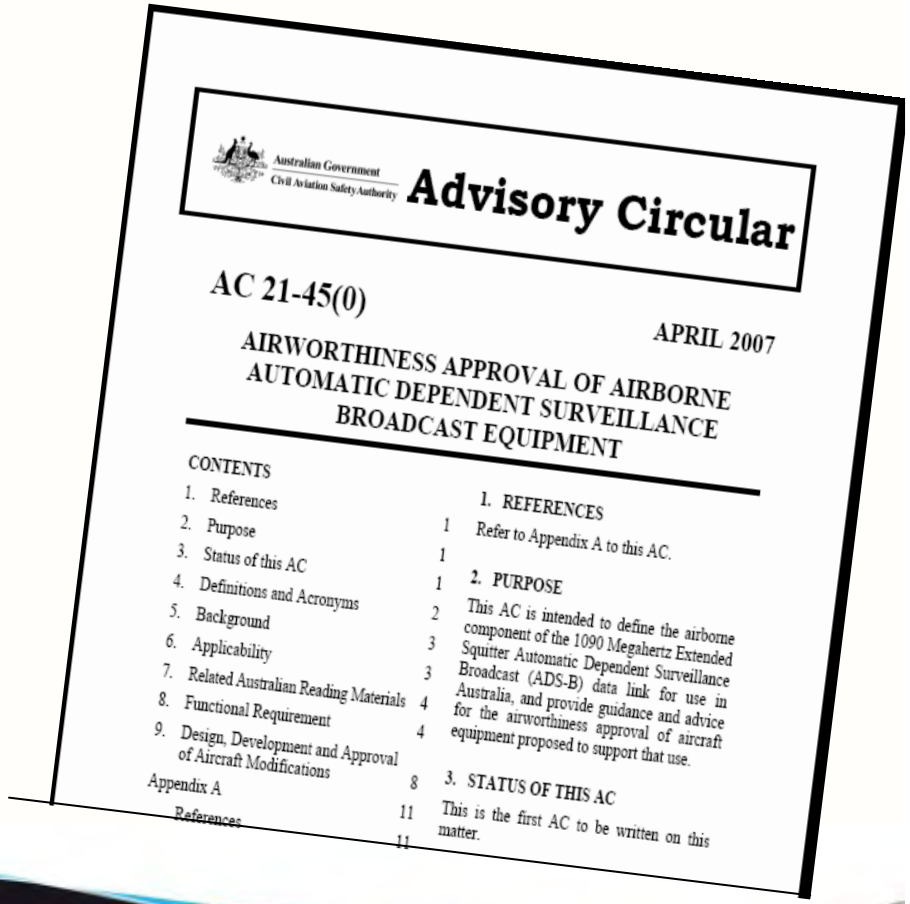
Guidance Material
Advisory Circular AC 21 – 45

- Advisory Circular to provide aircraft operators with guidance on avionics standards/fitment:

http://www.casa.gov.au/wcmswr/_assets/main/rules/1998casr/021/021c45.pdf

- and a listing of approved equipment configurations:

http://www.casa.gov.au/wcmswr/_assets/main/rules/1998casr/021/021c45eqptlist.pdf



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Advisory Circular

AC 21-45(0)

APRIL 2007

AIRWORTHINESS APPROVAL OF AIRBORNE AUTOMATIC DEPENDENT SURVEILLANCE BROADCAST EQUIPMENT

CONTENTS

1. REFERENCES

Refer to Appendix A to this AC.

2. PURPOSE

This AC is intended to define the airborne component of the 1090 Megahertz Extended Squitter Automatic Dependent Surveillance Broadcast (ADS-B) data link for use in Australia, and provide guidance and advice for the airworthiness approval of aircraft equipment proposed to support that use.

3. STATUS OF THIS AC

This is the first AC to be written on this matter.

Refer IP/2
for detailed explanation of Australian Rule

- Australian rule first promulgated in 2006.
- Australia is using ADS-B for ATM now
  - so rule is tailored for application now!
- Rule based on acceptance of most of the GNSS + ADS-B fitments in existing airline aircraft –
  - DO260 or A or B version 1090 + existing GNSS (FDE required)
- Rule was amended Dec 2009 to take account of SITF/8 Conclusions, also OEM manufacturer, airlines IATA and ANSP consultation
  - relaxed GNSS SA Aware (TSO-145/6 or equiv) to forward fit requirement).
  - Added AMC 20-24 as approved means of compliance (with FDE)

Airline aircraft approvals to the Australian Rule

AIRCRAFT TYPE	NUMBER APPROVED
AIRBUS A320	61
AIRBUS A321	4
AIRBUS A330	163
AIRBUS A340	63
AIRBUS A380	26
De Havilland DHC-8	2
BOEING B737	62
BOEING B747	273
BOEING B777	337
McDonnell Douglas MD-11	96

Minimum Performance Criteria for aircraft ADS-B equipment to support enroute and terminal ATC surveillance in NRA (ref. ICAO SASP Circular 311)

Transmitted ADS-B parameter	Minimum requirement 3NM separation. (Proposed amendment to CIRC 311 by SASP)	Current Minimum requirement 5NM NRA separation- CIRC 311	Comment
Position Integrity (NUCp; NICp) derived from HPL	NUC=>5; NIC=>5 corresponds to Rc <1NM	NUC=>5* NIC=>5 corresponds to Rc < 0.5NM	DO-260 equipment - NUCp DO-260A equipment - NICp (*Australia current minimum standard NUC=5/NIC=6 for 5NM surveillance)
SIL (probability of exceeding Rc without detection)	SIL =>2	SIL=>2	SIL = 2; probability >10^{-5} per flight hour
Position accuracy NACp (from HFOM)	NACp=>7 corresponds to HFOM<0.3NM	Assumed to be <0.25NM (DO-260). NACp=>7 corresponds to HFOM <0.1NM (DO-260A)	DO-260 equipment - accuracy not transmitted - assumed to be <0.5Rc
Position latency	4 seconds	4 seconds	Total system, end-to-end/aircraft to ATC display
Position update rate	12 seconds	12 seconds	ADS-B position update ~0.5 sec
Baro Altitude	accuracy <100ft/95%prob. Resolution 25ft	accuracy <100ft/95% prob. Resolution 25ft	Standard: TSO C88a

Pilot Interface

- Procedure for Flight ID entry by pilots
- Transponder cockpit control
- Emergency status transmission initiation
- Communication phraseology
- Check of pilot training

Pilot knowledge requirement

- Flight Plan – enter RMK/ADSB in field 18
- Setting FLTID - must match flight plan
- Transponder controls
- R/T Phraseology – similar to radar airspace phraseology but some specific phraseology introduced for ADS-B OUT
- No position reports required when ADS-B service is provided by ATC
- Emergency status operation
- Special position (SPI) operation

ADS-B guide for pilots

ADS-B Phraseology Quick Reference

The following table gives an overview of the new Radar and ADS-B phraseology.

Circumstance	Radar phraseology	ADS-B phraseology
Termination of radar and/or ADS-B service	IDENTIFICATION TERMINATED [DUE (reason)] (instructions)	
Radar or ADS-B ground equipment unserviceability	SECONDARY RADAR OUT OF SERVICE (appropriate information as necessary) or PRIMARY RADAR OUT OF SERVICE (appropriate information as necessary)	ADS-B OUT OF SERVICE (appropriate information as necessary).
To request the aircraft's SSR or ADS-B capability	ADVISE TRANSPONDER CAPABILITY	ADVISE ADS-B CAPABILITY
To advise the aircraft's SSR or ADS-B capability	TRANSPONDER (ALPHA, CHARLIE or SIERRA as shown in the Flight Plan) or NEGATIVE TRANSPONDER	ADS-B TRANSMITTER (TEN NINETY DATALINK) or ADS-B RECEIVER (TEN NINETY DATALINK) or NEGATIVE ADS-B
To request reselection of FLT ID*	RE-ENTER MODE S AIRCRAFT IDENTIFICATION	RE-ENTER ADS-B AIRCRAFT IDENTIFICATION
To request the operation of the IDENT feature*	SQUAWK [(code)] [AND] IDENT	TRANSMIT ADS-B IDENT
To request termination of SSR transponder or ADS-B transmitter operation*	STOP SQUAWK [TRANSMIT ADS-B ONLY]	STOP ADS-B TRANSMISSION [SQUAWK (code) ONLY]
To request transmission of pressure altitude*	SQUAWK CHARLIE	TRANSMIT ADS-B ALTITUDE
To request termination of pressure altitude transmission due to faulty operation*	STOP SQUAWK CHARLIE WRONG INDICATION	STOP ADS-B ALTITUDE TRANSMISSION [(WRONG INDICATION or reason)]

! Consult the AIP for details of radio communication procedures and phraseology.

* Note that some ADS-B installations may not provide for entry of FLTID, transmission of IDENT or isolation of pressure altitude by the pilot. Some ADS-B installations may share controls with the SSR transponder, meaning that independent operation of the two systems is not possible. If it is not possible to comply with a particular instruction advise ATC and request alternative instructions.

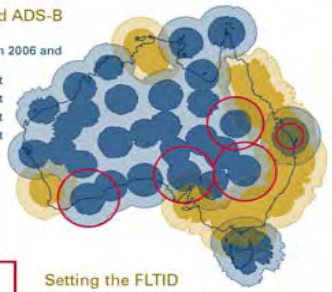
ADS-B Quick Reference Card

Combined Radar and ADS-B Coverage

Initial ADS-B deployment in 2006 and 2007*

- Radar coverage, 10,000ft
- ADS-B coverage, 10,000ft
- Radar coverage, 30,000ft
- ADS-B coverage, 30,000ft
- First sites operational in June 2006

*Bundaberg site will be initially limited to 95NM range.



! IMPORTANT INFORMATION

Pilots must be aware that regardless of the surveillance coverage (radar and/or ADS-B), aircraft may be operating in Class E and G airspace that are not visible or known to ATS.

An ADS-B cockpit display does not replace see and avoid. Separating yourself from other traffic requires you to look out the window.

Emergency notification to ATC will differ according to the type of equipment carried and surveillance coverage available, so make sure you know which equipment is on board. In an emergency you should use all available means to signal your status, irrespective of expected surveillance and communications coverage.

Setting the FLTID

Your callsign normally dictates the applicable option;

(a) the flight number using the ICAO three-letter designator for the aircraft operator if a flight number callsign is being used (e.g. QFA1 for QANTAS 1, VOZ702 for VIRGIN 702)

(b) the nationality and registration mark (without a hyphen) of the aircraft if the callsign is the full or abbreviated version of the registration or if the aircraft is not equipped with radio (e.g. VHABC for ALPHA BRAVO CHARLIE)

(c) the registration mark alone in the case of a VH-registered aircraft operating wholly within Australian territory if the callsign is the full or abbreviated version of the registration, or if the aircraft is not equipped with radio (e.g. DEF for DELTA ECHO FOXTROT)

(d) the designator corresponding to a particular callsign approved by Airservices Australia or the Australian Defence Force (e.g. SPTR3 for FIRESPOTTER 3, ROLR45 for ROLLER 45)

(e) the designator corresponding to a particular callsign in accordance with the operations manual of the relevant recreational aircraft administrative organisation (e.g. G123 for GYROPLANE 123).

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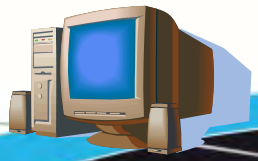
! Don't add any leading zeros, hyphens, dashes or spaces to the FLTID.



- End
- Questions
- CASA contact: brian.harris@casa.gov.au