



# Introduction to Airworthiness Standards for 1090ES ADS-B

Aircraft Airworthiness Department, CAAC



# Main contents

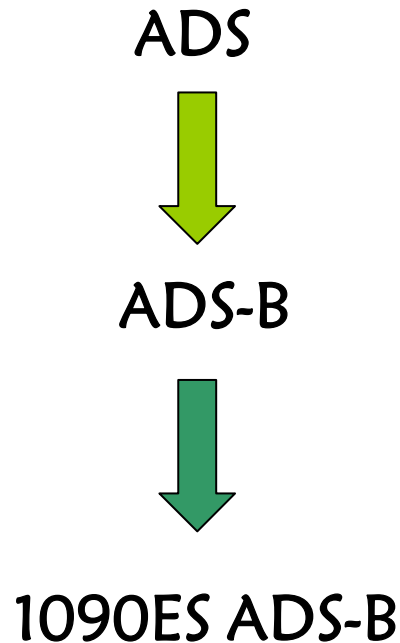
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- ❑ Airborne equipments necessary for 1090ES ADS-B
- ❑ Approval methods and applicable regulations to ADS-B airborne equipments by CAAC
- ❑ Introduction to CTSO-C166b
- ❑ Introduction to AC-91-FS/AA-2010-14
- ❑ What should domestic operators do?



# Airborne equipments necessary for 1090ES ADS-B

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- OUT** function only, based on *S* mode transponder
  - *S* mode transponder
  - GNSS receiver
  
- OUT** and **IN** functions, based on *S* mode transponder
  - *S* mode transponder
  - GNSS receiver
  - 1090 receiver
  - CDTI: Cockpit Display of Traffic Information



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# Approval methods and applicable regulations to ADS-B airborne equipments by CAAC

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- **CCAR21**
  - CCAR-21-R3** Certification Procedures for Civil Aviation Products and Parts
  - AP-21-06R3** Certification Procedures for Civil Aviation Materials, Parts and Appliances
- **Approval of equipments**
  - **Domestic : CTSOA**
    - CCAR-37** Civil Aeronautical Materials, Parts and Appliances Technical Standard Order
    - CTSO-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
  - **Imported : VDA or CTSOA**
    - AP-21-01R2** Validation Procedures for Import Civil Aviation Products and Parts
    - AP-21-AA-2009-19** Validation Procedures for the U.S. Civil Aviation Products and TSO Articles
    - CTSO-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



# Approval methods and applicable regulations to ADS-B airborne equipments by CAAC (continued)

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## □ Approval of installation

- For original aircraft manufactures: **TC, VTC, TDA or Changes to these certificates**
  - AP-21-03R3** Type Certification Procedures
  - AP-21-01R2** Validation Procedures for Import Civil Aviation Products and Parts
  - AP-21-AA-2009-19** Validation Procedures for the U.S. Civil Aviation Products and TSO Articles
- Other methods: **STC, MDA**
  - AP-21-14** Supplemental Type Certification Procedures
  - AP-21-15** Major Modification Design Approval Procedures for Import Civil Aircraft

## □ **AC-91-FS/AA-2010-14** Airworthiness and Operational Approval of Automatic Dependent Surveillance-Broadcast Application in Non-Radar Areas via 1090 MHz Extended Squitter



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# Introduction to CTSO-C166b

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- Title
  - Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Service-Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 Megahertz
- Date of issue
  - April 30, 2010
- Referenced RTCA/DO
  - DO-260B: Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance-Broadcast (ADS-B) and Traffic Information Service-Broadcast (TIS-B)





# Introduction to CTSO-C166b (continued)

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- Purpose
  - For manufactures applying for a CTSOA for 1090ES ADS-B and TIS-B equipment.
  - Regulate the minimum performance standards 1090ES ADS-B and TIS-B equipment first meet for approval and identification with the applicable marking.
- Applicability
  - New applications of 1090ES ADS-B and TIS-B equipment after the effective data of this CTSO.



# Introduction to CTSO-C166b (continued)

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- Requirements
  - Functionality
  - Failure condition classification
  - Functional qualification  
DO-260B
  - Environmental qualification  
DO-260B、 DO-160D
  - Software qualification  
DO-178B
  - Electronic hardware qualification  
DO-254
  - Deviation



# Introduction to CTSO-C166b (continued)

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- Marking
  
- Data requirements
  - Application data requirements
  - Manufacture data requirements
  - Furnished data requirements
  
- Referenced documents



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# Introduction to AC-91-FS/AA-2010-14

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- Title
  - Airworthiness and Operational Approval of Automatic Dependent Surveillance-Broadcast Application in Non-Radar Areas via 1090 MHz Extended Squitter
- Date of issue
  - May 10, 2010
- Applies to
  - The **manufactures or modification units** who want to get **airworthiness approval** for ADS-B airborne equipment; the **operators** under CCAR91、121、135 who want to get **operational approval** for ADS-B airborne system.



# Introduction to AC-91-FS/AA-2010-14 (continued)

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- Applicability
  - Based on 1090 ES ADS-B OUT technology
- Referenced RTCA/DO
  - DO-260/260A/260B
  - DO-303: Safety, performance and interoperability requirements document for ADS-B-NRA application
  - DO-264: Guidelines for approval of the provision and use of air traffic services supported by data communications
- Main contents related to airworthiness
  - 7 airworthiness requirements
  - 8 airworthiness approval



# Introduction to AC-91-FS/AA-2010-14 —

## 7 Airworthiness requirements

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- Airworthiness certification objectives
  - Data delivered should satisfy the airborne domain requirements in DO-303 section 3.4
- ADS-B system
  - The minimum requirements to the overall ADS-B system

Parameter	Requirement
Integrity	$10^{-5}/\text{fh}$
Continuity	$2 \times 10^{-4}/\text{fh}$
Horizontal Position Latency	1.5 sec/95%



# Introduction to AC-91-FS/AA-2010-14 — 7 Airworthiness requirements (continued)

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## □ ADS-B transmit system

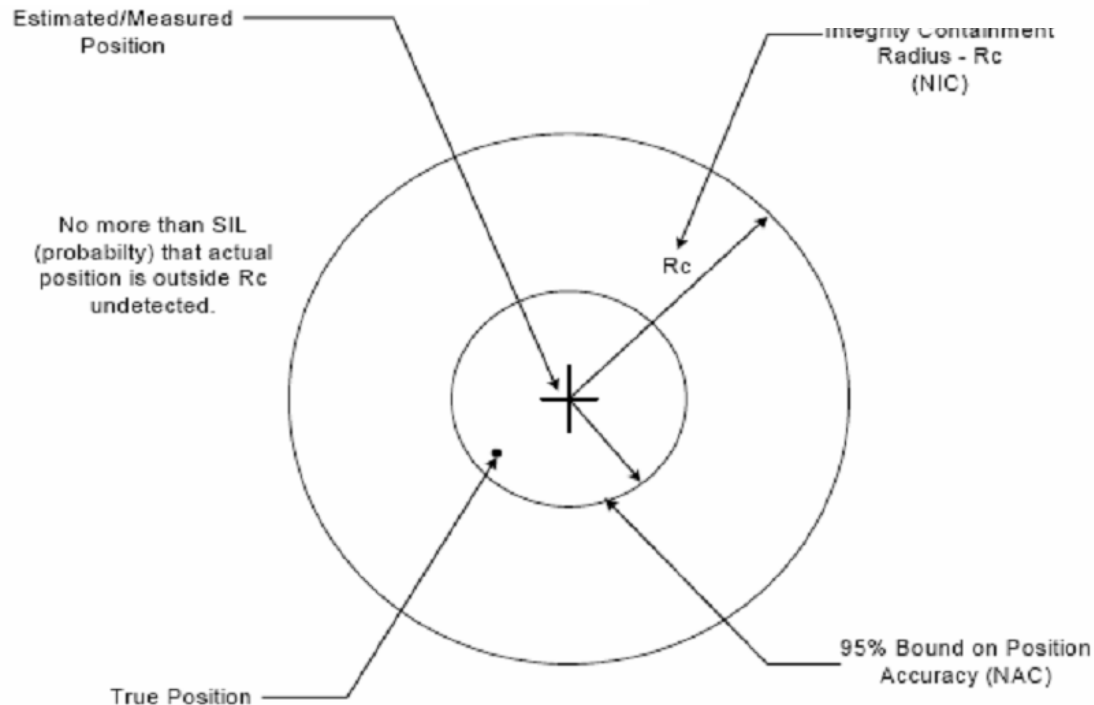
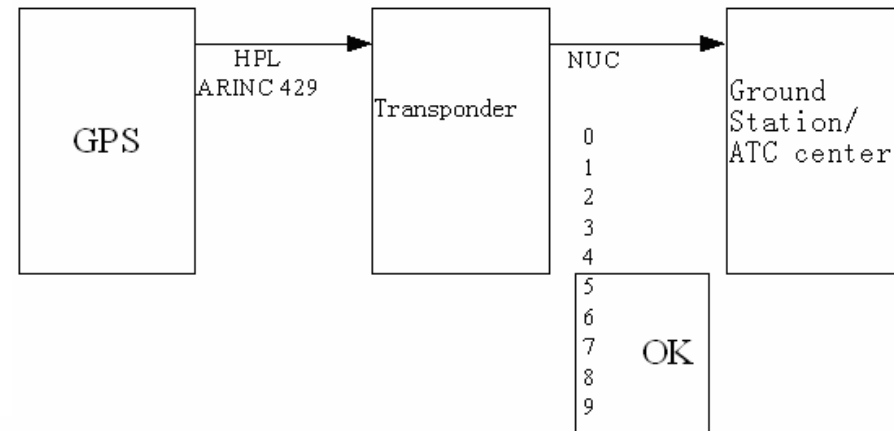
- Transmit data requirements, relevant tests documents, encoding of horizontal position quality indicators, antenna installation, etc.
- Transmit data
  - ICAO 24 bit aircraft address
  - Horizontal position
  - Horizontal position quality indicators (Integrity, Accuracy)
  - Barometric altitude
  - Aircraft identification
  - Special position identification
  - Emergency status and emergency indicator
  - Version number





# Introduction to AC-91-FS/AA-2010-14 — 7 Airworthiness requirements (continued)

- ✓ Integrity: HPL, Rc
- ✓ Accuracy: HFOM
- ✓ DO260: NUC
- ✓ DO260A/DO260B: NIC, NAC, SIL



# Introduction to AC-91-FS/AA-2010-14 — 7 Airworthiness requirements (continued)

- Horizontal position data sources
  - The minimum requirements should be met

Parameter	Requirement
Horizontal position source	
● Accuracy (95%)	5 NM Sep: 926 m
● Integrity	
✓ Containment Radius ( $R_c$ )	5 NM: $R_c = 2$ NM
✓ Source Failure Probability	$10^{-4}/h$
✓ Alert Failure Probability	$10^{-3}$ (per position source failure event)
✓ Time to Alert	5 NM Sep: 10 sec

- Data sources
  - Primary position data source: GPS; Alternative compliant position data sources; Temporary back-up position data sources



# Introduction to AC-91-FS/AA-2010-14 — 7 Airworthiness requirements (continued)

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- Barometric altitude data sources
  - Requirements, specified tolerance, altitude resolution, other more stringent requirements
- Aircraft identification
- Special position identification
- Emergency status/ Emergency indicator
- Airworthiness considerations regarding optional provisions



# Introduction to AC-91-FS/AA-2010-14 —

## 8 Airworthiness approval

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- Equipments approval
  - Domestic equipments: CTSOA
  - Imported equipments: VDA or CTSOA
- Installation approval
  - For original aircraft manufactures: TC, VTC, TDA or changes to TC, VTC, TDA
  - Other methods: STC, VSTC, MDA
- Existing installation
  - Compliance statement
  - Design review and inspection of the installed system
- Airworthiness compliance



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# What should domestic operators do?

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- The required functions for airborne equipment to realize 1090ES ADS-B OUT
  - Collect the information from aircraft: position, position quality indicator, velocity, barometric altitude
  - Encode the information
  - Broadcast the message
- Aircrafts with ADS-B OUT ability
  - Compliance statements should be provided
- Aircrafts without ADS-B OUT ability
  - Modifications needed
  - Probable manners used



# What should domestic operators do? (continued)

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## Modifications needed

- Modification to existed S mode transponder
- Installation of 1090ES transponder

## Probable manners used

- Change according to Service Bulletin (SB) provided by manufactures
- VSTC
- STC/MDA
  - Modification to domestic aircrafts—STC
  - Modification to imported aircrafts—MDA



# Thank you!

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