Recent Updates on TSOs for Automatic Dependent Surveillance–Broadcast (ADS-B)

TSO-C166c, TSO-C154d & TSO-C195c

2023 TSO Workshop

Ray Mei, AIR-626C

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- **TSO-C166c (issued 03/10/2023)**

  Extended Squitter ADS-B and Traffic Information Service - Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 1090 MHz

- **TSO-C154d (issued 03/10/2023)**

  Universal Access Transceiver (UAT) ADS-B Equipment Operating on the Radio Frequency of 978 MHz

- **TSO-C195c (issued 06/15/2023)**

  Avionics Supporting ADS-B Aircraft Surveillance Applications (ASA) (Informally known as the “ADS-B In TSO”)

TSO-C166c invokes DO-260C and Change 1

Minimum Operational Performance Standards (MOPS) for 1090 MHz Extended Squitter ADS-B and TIS-B

- **DO-260C** was published December 2020
- **DO-260C** Change 1 was published January 2022

- Adds new messages for:
  - High altitude and/or high velocity vehicles
  - Weather
  - Interrogation / Reply monitor
  - Unmanned aircraft lost link
- Adds in support for phase modulation
- Mandates reply rate limiting
- Supports Airborne Collision Avoidance System (ACAS) X

TSO-C154d invokes DO-282C
MOPS for 978 MHz UAT ADS-B

- **DO-282C** was published June 2022

- Adds new messages for:
  - High altitude and/or high velocity vehicles
  - Weather
  - Interrogation / Reply monitor
  - Unmanned aircraft lost link

TSO-C195c Main Changes

- **TSO-C195c makes two major changes:**
  - Adds support for Flight Deck Interval Management (FIM) – a new NextGen air traffic management capability
  - Requires equipment installed in fixed-wing aircraft to provide and use a means of traffic conflict alerting
    - Either via the ADS-B Traffic Advisory System (ATAS) application or interface to a system such as TAS, TCAS or ACAS X
    - Based on recent midair collision accident history
    - This requirement is in the TSO itself, not in the MOPS
    - Traffic conflict alerting may be provided for rotorcraft, but ATAS algorithms are not optimized for some rotorcraft-unique flight trajectories

TSO-C195c continued

Avionics Supporting ADS-B ASA

- The new requirement (for TSO-C195c equipment) and recommendations (for equipment produced to previous TSOAs) for traffic conflict alerting and NAR traffic handling are based on recent midair collision history

- In particular, an investigation of a recent major midair collision in which two airplanes collided despite both aircraft being equipped with operational ADS-B Out and In systems

- National Transportation Safety Board (NTSB) found aural alerts to pilots can significantly improve the effectiveness of these systems

- Consequently, we determined to require aural and visual conflict alerting functionality for an ADS-B In system for TSO-C195c, and to recommend it for equipment produced to previous versions of TSO-C195 (also see SAIB 2022-16)

TSO-C195c invokes DO-317C MOPS for ASA System and DO-361A MOPS for Flight-deck Interval Management (FIM)

- **DO-317C** was published June 2020

- Removes ACAS traffic designation support and references DO-385 instead
- Name change from TSAA to ADS-B Traffic Advisory System (ATAS)
- Updates ATAS test vectors
- Adds requirements that allow CDTI Assisted Visual Separation (CAVS) to be used at closer horizontal ranges for Ownship and traffic with better position accuracy and integrity
- Updates the previously optional requirements for Geometric Altitude to be implemented
- Includes requirements on coasting surveillance quality and data validity metrics
- Includes an interface between ASSAP and ADS-B/ADS-R/TIS-B receiver for the traffic prioritization

TSO-C195c, FIM

- **DO-361A** was published March 2020
- **DO-361A** Change 1 was published December 2020

- Includes updates, corrections and additional materials to support implementation of the FIM
- Includes test Vectors Appendix G and related supplemental material
- Updates ownership requirements and traffic requirements for IM to reflect the inclusion of surveillance validity and quality metric coasting requirements
- Includes edits to language in the sections concerning Maintain Stage – time based, without an achieve stage and data-linked winds and temperatures

TSO-C195c continued

Avionics Supporting ADS-B ASA – Additional Changes

- Adds amendments (Appendix 2) to DO-317C supporting CDTI Assisted Separation (CAS) departure operations
  - * Inhibit CAVS alerts when ownship is on the ground
  - * Allow traffic designation on the ground for CAVS
  - * Not display differential ground speed when ownship is on the ground
  - * Test procedure changes for ASSAP and CDTI
- Requires ADS-B ASA equipment incorporating the FIM or FIM with data communications applications to meet TSO-C166c compliant for ADS-B version 3
- System must compute and display traffic relative altitude on Non-Altitude Reporting (NAR) traffic using geometric-to-geometric comparison when geo altitude is available
- ADS-B ASA equipment approved under a previous TSOA may still be manufactured, but we strongly recommend to incorporate the ATAS application or equivalent traffic conflict alerting capability, and provide alerts on NAR traffic using geometric-to-geometric relative computation depicted in DO-317B or C. Also see SAIB 2022-16.

ADS-B Operating Rule Requirements

- ADS-B Out equipage required in certain airspace by § 91.225
  - Currently only Version 2 ADS-B Out (TSO-C166b/C154c; DO-260B / DO-282B) allowed for compliance with rule
  - Rulemaking currently in work to add Version 3 (TSO-C166c/C154d; DO-260C / DO-282C) as a compliance option

- ADS-B Out performance requirements are in § 91.227

- No current rules requiring ADS-B In

ADS-B Rule Change

- Effort underway to update § § 91.225 and 91.227 to allow the usage of DO-260C as modified by Change 1 and TSO-C166c
  - Will also allow DO-282C and TSO-C154d (UAT)
  - Incorporates previously published legal interpretations
  - Editorial changes for clarity and consistency with MOPS language
  - Planning for “Direct Final Rule” that bypasses public comment
  - Most likely to be published in 1Q 2024

ADS-B Version 3 Outside of US

- European Rule (EU No 1207/2011) requires the use of ADS-B Version 2 (DO-260B)
- Canada has confirmed that they will allow equipment built to DO-260B or later
- Many nations have based their ADS-B rules on either the US or Europe

Special Airworthiness Information Bulletin (SAIB)

- **SAIB 2022-16, ADS-B In Conflict Alerting, published August 17, 2022**
  - The FAA recommends that manufacturers of ADS-B In systems ensure their systems meet the performance requirements of TSO-C195b or later revision, and include the ATAS application or equivalent traffic conflict alerting capability
  - The FAA recommends that operators performing an initial installation of an ADS-B In system in their aircraft install a system that meets the performance requirements of TSO-C195b or later revision, that incorporates ATAS or equivalent traffic conflict alerting capability
  - The FAA recommends that operators with existing ADS-B In equipment installations prior to TSO-C195b, or with an existing TSO-C195b installation without ATAS, upgrade to a system meeting the performance requirements of TSO-C195b or later revision, that incorporates ATAS or equivalent traffic conflict alerting capability
- NOTE: Per TSO-C195c requirements, TSO-C195c systems are required to incorporate ATAS or equivalent traffic conflict alerting capability

Ray Mei

206-231-3541

Raymont.mei@faa.gov

TSO-C195c

Matthew Haskin

202-267-2964

matthew.d.Haskin@faa.gov

TSO-C166c and TSO-C154d

Backup Slides

TSO-C166c

Extended Squitter ADS-B and TIS-B Equipment Operating on the Radio Frequency of 1090 MHz

- **Effective March 10, 2023**
  - TSO-C166b is also effective until 18 months after a rule change allowing TSO-C166c in US airspace
- **Requires compliance with Sections 2.1 and 2.2 of DO-260C as modified by Change 1**
- **Function Qualification per DO-260C Section 2.4 as modified by Change 1**
- **Environmental Qualification per DO-260C Section 2.3**
- **Software Qualification per DO-178C and Hardware Qualification per DO-254**
- **Adds a requirement to address information security review and mitigation strategies in the installation manual**
- **Adds Appendix A for 1090 MHz ADS-B and TIS-B Equipment Marking Scheme (from DO-260C) as a courtesy to operators and repair stations**
- **Includes additional MOPS modifications in Appendix B (tests only)**

TSO-C154d

UAT ADS-B Equipment Operating on the Radio Frequency of 978 MHz

- **Effective March 10, 2023**
  - TSO-C154c is also effective until 18 months after the effective date, after which we will no longer accept applications for TSO-C154c
- **Requires compliance with Section 2 of DO-282C**
- **Function Qualification per DO-282C Section 2.4**
- **Environmental Qualification per DO-282C Section 2.3**
- **Software Qualification per DO-178C and Hardware Qualification per DO-254**
- **Adds a requirement to address information security review and mitigation strategies in the installation manual**
- **Adds Appendix A: UAT ADS-B Equipment Marking Scheme (from DO-282C) as a courtesy to operators and repair stations**

TSO-C195c

Avionics Supporting ADS-B ASA

- Effective June 15, 2023
  - TSO-C195c is also effective until 18 months after the effective date of, after which we will no longer accept applications for TSO-C195b
- Requires compliance with Section 2 of DO-317C
- Requires compliance with **Section 2 of DO-361A as modified by Change 1 for ADS-B ASA equipment incorporating the FIM or FIM with data communications applications**
- Function Qualification per DO-317C Section 3
- Environmental Qualification per DO-317C Section 3.1
- Software Qualification per DO-178C and Hardware Qualification per DO-254
- Adds paragraph 3.g for aircraft systems information security protection
- **Adds Class 21 for FIM and Class 22 for FIM with data communications**
- Requires application bundling (VSA, CAVS, FIM with AIRB; ATAS with ASSAP C1 or C5; SURF with ASSAP C5)