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Minimum Operational Performance Standards for 1090 MHz Automatic Dependent Surveillance - Broadcast (ADS-B)

Change 1

Change 1 to RTCA DO-260
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Foreword

This report was prepared by Special Committee 186 (SC-186) and approved by the RTCA Program Management Committee (PMC) on June 27, 2006.

RTCA, Incorporated is a not-for-profit corporation formed to advance the art and science of aviation and aviation electronic systems for the benefit of the public. The organization functions as a Federal Advisory Committee and develops consensus based recommendations on contemporary aviation issues. RTCA's objectives include but are not limited to:

- coalescing aviation system user and provider technical requirements in a manner that helps government and industry meet their mutual objectives and responsibilities;
- analyzing and recommending solutions to the system technical issues that aviation faces as it continues to pursue increased safety, system capacity and efficiency;
- developing consensus on the application of pertinent technology to fulfill user and provider requirements, including development of minimum operational performance standards for electronic systems and equipment that support aviation; and
- assisting in developing the appropriate technical material upon which positions for the International Civil Aviation Organization and the International Telecommunications Union and other appropriate international organizations can be based.

The organization's recommendations are often used as the basis for government and private sector decisions as well as the foundation for many Federal Aviation Administration technical Standard Orders.

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Executive Summary

The update to the *Minimum Operational Performance Standards (MOPS) for the 1090 MHz Automatic Dependent Surveillance – Broadcast (ADS-B)* systems, published by RTCA on September 13, 2000 as RTCA/DO-260, contained herein as RTCA/DO-260 Change 1, has been produced to reflect changes that have resulted in requirements for ADS-B transmitting systems. RTCA/DO-260 was developed in accordance with the *Minimum Aviation System Performance Standards (MASPS) for Automatic Dependent Surveillance – Broadcast (ADS-B)*, which was published by RTCA on February 19, 1998 as RTCA/DO-242. Even during the development of DO-260, it was always the intention of RTCA and the International community to update the initial 1090ES MOPS with the addition of enhanced reception techniques, as well as improved definitions of navigational accuracy and integrity measurements, and system integrity levels, among other things. However, prior to the updating of such information, it was necessary to update the ADS-B MASPS on which those standards were to be based. On June 25, 2002, RTCA published the updated ADS-B MASPS as RTCA/DO-242A, and the revision of the 1090ES MOPS was also begun. On April 10, 2003, RTCA published RTCA/DO-260A as the update to the 1090ES MOPS which was intended to replace RTCA/DO-260 and all of its requirements.

When RTCA/DO-260 was published in September 2000, the International community began to refine and adapt the requirements contained therein into ICAO Standards and Recommended Practices (SARPs) for all International States to use. The initial 1090ES SARPs were adapted and published by ICAO into Annex 10 with Amendment 77, which became effective on November 28, 2002.

With the publication of the 1090ES SARPs, a trial program was started by Australia for transmit-only 1090ES equipment for the purpose of evaluating ADS-B for supplying surveillance in areas of their country where no radar exists. As this program progressed, operational experience was gained and data was collected on the implementations of 1090ES equipment, which in turn shed light on some issues within the ADS-B MOPS and SARPs documents that outlined the requirements. This initial Australian program relied solely on aircraft avionics that were based on the initial 1090ES MOPS, RTCA/DO-260.

One of the initial issues uncovered by the Australian trials were errors reported in the airborne/on-the-ground status of ADS-B equipped aircraft. It was found that there were errors in the determination of the "on-the-ground" condition of the aircraft. After an extensive analysis of the collected data and of the algorithms defined in RTCA/DO-260 (and by that time also in DO-260A), it was determined that there had been errors introduced in both documents which could lead an ADS-B system to indicate that an aircraft was on-the-ground, when in fact, it was still airborne. **This problem had to be corrected**.

Another issue that was a concern for ground stations and other users of position data from RTCA/DO-260 transmitters, was that the Navigational Uncertainty Category (NUC) in DO-260-based systems could be based either on accuracy or integrity measurements. It was deemed necessary for the benefit of receivers of RTCA/DO-260 transmitted position information that the NUC be based on integrity, and not on accuracy. To correct this problem, a statement in DO-260,

§2.2.3.2.3.1.2 and §2.2.3.2.4.1.2, which indicated that "*if the Horizontal Protection Limit (HPL) was not available from a navigation source, then the TYPE Code of the respective 1090ES ADS-B Airborne or Surface Position Message could be based on the 95% bound on the horizontal and vertical position error identified in Table 2-11*," **had to be changed to not allow NUC to be based on HFOM**. Additionally, the column in Table 2-11 that gave the "95% containment radius for horizontal and vertical position error" needed to be removed to eliminate possible confusion.

In order to correct these problems prior to the MOPS being updated for manufacturers that are building equipment, specifically for those systems that were being built for transmit-only compliance to RTCA/DO-260 in the Australian trials, corrections were written for the basic requirements, and for the test procedures which verify those requirements, for both RTCA/DO-260 and for RTCA/DO-260A, and attached as an Appendix to the first Technical Standard Order (TSO) that was written for 1090ES ADS-B systems, and published as TSO C166 by the Federal Aviation Administration (FAA) on September 20, 2004.

Additionally, with the development and publication of RTCA/DO-260A, it was recognized that in the United States, ground systems required the information transmitted in the Mode 3/A, or "4096" code. In DO-260A, the 1090ES ADS-B TEST Message (TYPE Code=23, SUBTYPE=7) was identified to contain this Mode 3/A Code. With the publication of TSO C166, and its attached Appendix, a change was also identified for DO-260-compliant transmit-only systems to optionally transmit this 1090ES ADS-B TEST Message. This transmission would assist with the identification of these aircraft if they enter the United States airspace.

Since no 1090ES equipment was submitted in the United States for certification for DO-260-compliant transmit-only systems under TSO C166, the FAA has determined that it is in the best interest of the aviation community to update TSO C166, and eliminate any reference to systems that only comply with DO-260. This update resulted in the removal of the section of the Appendix that was included with TSO C166 which specifically identified those changes to DO-260 that were necessary for any State that wishes to implement a DO-260-compliant transmit-only ADS-B system. To insure that this set of changes would be included when implementing DO-260 compliant transmit-only ADS-B systems, these changes were extracted and are published in this document as "Change 1 to RTCA/DO-260."

Since the publication of RTCA/DO-260A in March 2003, ICAO has also been in the process of updating the ICAO 1090ES SARPs to include those requirements identified in DO-260A. These updated SARPs are expected to become effective in November 2007. It has also been recognized by the International community that systems based solely on the requirements of DO-260 and the initial 1090ES SARPs published in Annex 10, Amendment 77, are not sufficient to provide robust receiver/decoder systems for reception of 1090ES ADS-B information. Therefore, the updated 1090ES SARPs recommend (and it is required by FAA TSO C166A) that 1090ES ADS-B receiver systems must be based on the requirements of the updated 1090ES SARPs, which are consistent with RTCA/DO-260A, Change 1. Therefore, the receiver/decoder requirements of DO-260 have not been updated since all receiver/decoder implementations will need to adhere to DO-260A, Change 1, and the latest available version of TSO C166.