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**RTCA Special Committee 186, Working Group 5**

**ADS-B UAT MOPS**

**Meeting 7**

**Draft 3 of Section 2.1 of UAT MOPS**

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<b>SUMMARY</b>
<p>This document represents the 3<sup>rd</sup> draft of Section 2.1 (General Requirements) for the UAT MOPS. New material in this draft is primarily in Tables 2-1 and 2-3 and the related notes. A new Table 2-2 has been created to summarize receiver selectivity characteristics. The committee may prefer to migrate this information to Section 2.2 instead.</p>

**UAT MOPS  
Section 2.1**

**Draft 1**

Date: 26 March 2001

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## **1 Purpose and Scope**

## **2 Equipment Performance Requirements and Test Procedures**

### **2.1 General Requirements**

#### **2.1.1 Airworthiness**

In the design and manufacture of the equipment, the manufacturer shall provide for installation so as not to impair the airworthiness of the aircraft.

#### **2.1.2 Intended Function**

The equipment shall perform its intended function(s), as defined by the manufacturer, and its proper use shall not create a hazard to other users of the National Airspace System.

#### **2.1.3 Federal Communications Commission Rules**

All equipment shall comply with the applicable rules of the Federal Communication Commission.

#### **2.1.4 Fire Protection**

All materials used shall be self-extinguishing except for small parts (such as knobs, fasteners, seals, grommets and small electrical parts) that would not contribute significantly to the propagation of a fire.

**Note:** *One means of showing compliance is contained in Federal Aviation Regulations (FAR), Part 25, Appendix F.*

#### **2.1.5 Operation of Controls**

The equipment shall be designed so that controls intended for use during flight cannot be operated in any position, combination or sequence that would result in a condition detrimental to the reliability of the equipment or operation of the aircraft.

#### **2.1.6 Accessibility of Controls**

Controls that do not require adjustment during flight shall not be readily accessible to flight personnel.

#### **2.1.7 Equipment Interfaces**

The interfaces with other aircraft equipment shall be designed such that normal or abnormal ADS-B equipment operation shall not adversely affect the operation of other equipment, nor shall normal or abnormal operation of other equipment adversely affect the ADS-B equipment, except as specifically allowed.

**2.1.8 Effects of Test**

The equipment shall be designed so that the application of specified test procedures shall not be detrimental to equipment performance following the application of the tests, except as specifically allowed.

**2.1.9 Integration with Other Avionics Equipment**

In the event that ADS-B functions are partially or wholly incorporated within other avionics equipment, the design shall be partitioned such that any abnormal equipment operation does not adversely affect other function unrelated to ADS-B. Loss of ADS-B capability shall not inhibit other functions of the equipment.

**2.1.10 Design Assurance**

The equipment shall be designed to the appropriate design assurance level(s) based on the intended application of the equipment and aircraft class in which it is to be installed. The appropriate design assurance level(s) are determined by an analysis of the failure modes of the equipment and a categorization of the effects of the failure on the operation of the aircraft. For the purpose of this analysis, a failure is defined as either a loss of function or the output of misleading information. Guidance can be found in AC 23.1309 and 25.1309-1b.

Software included as part of the equipment shall be developed in compliance with the appropriate software level as defined in RTCA/DO-178B.

**2.1.11 Equipage Classes**

ADS-B equipment is categorized into aircraft system equipage classes as defined in the ADS-B MASPS (RTCA/DO-242, Table 3-1). For the UAT, these classes are summarized in the following Table 2-1. Certain of the class distinctions are implemented by applications supported by other equipment, rather than being inherent in the UAT itself.

Table 2-1 UAT Installed Equipment Classes

Application	DO-242 Equivalent Class	RF Effective Radiated Power (ERP)		Antenna Diversity Minimum Requirements	
		< 15K ft	> 15K ft	Tx	Rx
Tx-Only Airborne Vehicle	B1	Per rqmts for equivalent service for A0, A1 and A2			n/a
Surface Vehicles and Fixed Obstructions	B2 & B3	0.5 W (min) (note 3) 5.0 W (max)		Single Antenna	n/a
Aid to Visual Acquisition	A0	Low	Medium	Bottom Only	Bottom Only
Conflict Avoidance	A1	Low	Medium	Alternate	Alternate
Separation and Sequencing	A2	Medium		Alternate	Alternate (see note 4) or Dual Receiver
Deconfliction Planning	A3 (extended range)	High		Alternate	Dual Receiver

*Note 1: See Section 2.1.12 for definition of TX power levels.*

*Note 2: Transmitter power requirement depends on the aircraft maximum altitude capability. Low-altitude aircraft (< 15,000 feet max altitude) need not support the High power transmitter requirement due to line-of-site limitations.*

*Note 3: Class B3 (Fixed Obstructions) has minimum ERP of 1.0 watts.*

*Note 4: Alternate receive antenna diversity allows for economical Separation and Sequencing equipage for A2 class aircraft that do not operate at high altitudes. Dual Receiver required above 15K feet.*

*Note 5: Top antenna is not required if installation does not degrade signal propagation. This allows for single antenna installation on radio-transparent airframes.*

*Author's Note: Is there any concern over surveillance performance for A0 aircraft on the ground that have only a Bottom antenna?*

### 2.1.12 Transmitting Subsystem

An ADS-B transmitting subsystem is classified according to the unit's range capability and the set of parameters it is capable of transmitting. Table 2-3 shall define the transmitter power levels. Power levels are measured in terms of power presented to the transmitting antenna.

**Table 2-2 Transmitter Power Requirements**

Power Classification	Minimum Power at Antenna	Maximum Power at Antenna
Low	7.0 watts (+38.5 dBm)	17.6 watts (+42.5 dBm)
Medium	15.8 watts (+42 dBm)	39.8 watts (+46 dBm)
High	63.0 watts (+48 dBm)	158.5 watts (+52 dBm)

*Note 1: These transmitter power requirements are referenced to the power delivered to the antenna, and assume transmit antenna gain of 0 dB. Alternate means that can demonstrate equivalent performance can be approved. Refer to Appendix E for guidance.*

Performance is specified over full environmental range for desired equipment application.

### 2.1.13 Receiving Subsystem

No distinction in receiver sensitivity by category is made; all receivers have the same sensitivity requirements. Sensitivity requirements shall be -93 dBm at the receiver antenna for 90% Message Success Rate for ADS-B messages.

Receiver selectivity shall comply with the following table:

**Table 2-2 Receiver Selectivity**

DO-242 Equivalent Class	Receiver Selectivity (-20dB passband)
A0	1.2 MHz
A1	1.2 MHz
A2	?? MHz
A3	0.8 MHz

Performance is specified over full environmental range for desired equipment application.

Receiver subsystem is capable of reception of both ADS-B reports and ground-to-air services.

#### **2.1.14 Antenna Subsystem**

Use of gain antennas for ADS-B is permitted and discussed in DO-242 (ADS-B MASPS) Section 3.3.1 and Appendix H, and Appendix E of this document. Antenna horizontal gain patterns shall not contain intentional nulls. Nulls created by airframe blockages should be minimized when antenna locations are selected.

Transmit antenna diversity shall be achieved by transmitting alternately on each installed antenna. Receive antenna diversity can be achieved by alternate antenna selection, or by equipping the aircraft with two full-time receivers, as specified by the equipment class.