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~~ UAT 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~~ UAT 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~~ UAT 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~~ UAT. Loss of ~~ADS-B~~ UAT 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 23.1309-1C and AC 25.1309-1A.

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~~ UAT equipment is categorized into aircraft system equipage classes as defined in Table 3-1 of RTCA/DO-242A (ADS-B MASPS). For UAT ~~ADS-B~~ equipment, the installed performance of these equipment classes **shall** be defined by Table 2-1.

The ADS-B MASPS "A1" equipment has been divided into two classes, based on the maximum altitude that the aircraft is operated under. For A1 aircraft that always operate below 18,000 feet MSL, the "A1 Low" class is created, and abbreviated throughout this document as "A1L." For A1 aircraft that have no altitude operating restrictions, the "A1 High" class is created, and abbreviated throughout this document as "A1H." The only equipment performance difference between classes A1L and A1H is the Transmitter RF output power, as shown in Table 2-1.

The remainder of the interactive aircraft/vehicle classes (A0, A2, and A3) are as defined in RTCA/DO-242A.

For "B" class aircraft that always operate below 18,000 feet MSL, the "B0" class is created. For "B" class aircraft that have no altitude operating restrictions, the "B1" class is available. The ADS-B MASPS "B0" class (broadcast-only aircraft) is defined as having transmitter characteristics and payload capability identical to the UAT A0 interactive aircraft class. The ADS-B MASPS "B1" class (broadcast-only aircraft) is defined as having transmitter characteristics and payload capability identical to the UAT A1H interactive aircraft class.

The characteristics of the ADS-B MASPS "B2" class (broadcast-only ground vehicle) are defined in Table 2-1.

The characteristics of the ADS-B MASPS "B3" class (broadcast-only fixed or moveable obstacle) are defined in Table 2-1. The payload capability supports the surface position, height of highest point, and identification (including Emitter Category) of the obstacle, so that both State Vector and Mode Status reports must be supported. Moveable obstacles require a position source. A moveable obstacle is one that can change its position, but only slowly, such that its horizontal velocity may be ignored. See §2.2.6.1.2 of this document for the payload characteristics.

Requirements for Class 'C' ground-based receive-only equipment are not addressed in this document. See Appendix D for guidance in ground-based receiver performance.

Table 2-1: UAT Installed Equipment Classes

Typical Application	Equipage Class	Tx RF Power Delivered to Antenna System	Intended Antenna Diversity ~~Minimum Requirements~~ (when Airborne for Classes A & B0-B1)	
			~~Tx~~Transmit	~~Rx~~Receive
Aid to Visual Acquisition	A0	Low Power *(Altitude always below 18,000 feet)*	Single Antenna (see Note 4)	Single Antenna (see Note 4)
Conflict Avoidance	A1L	Low Power *(Altitude always below 18,000 feet)*	Alternate~~e~~ing every 2 sec.	Alternate~~e~~ing every second
	A1H	Medium Power	Alternate~~e~~ing every 2 sec.	Alternate~~e~~ing every second
Separation and Sequencing	A2	Medium Power	Alternate~~e~~ing every 2 sec.	Dual Receiver
Deconfliction Planning	A3 (extended range)	High Power	Alternate~~e~~ing every 2 sec.	Dual Receiver
Tx-Only Airborne Vehicle	B0	Low Power *(Altitude always below 18,000 feet)*	Single Antenna (see Note 4)	n/a
Tx-Only Airborne Vehicle	B1	Medium Power	Alternate~~e~~ing every 2 sec.	n/a
Surface Vehicle	B2	+28 to +32 dBm	Single Antenna	n/a
Obstacle	B3	+30 dBm (minimum)	Single Antenna	n/a

Notes:

1. *See* §2.1.12 *for definition of Transmitter RF power levels.*

2. *Transmitter RF power requirement depends on the aircraft maximum altitude capability. Low-altitude aircraft (< 18,000 feet max altitude) need not support the higher-power transmitter requirements due to line-of-site limitations.*

3. *Top antenna is not required if use of a single antenna does not degrade signal propagation. This allows for single antenna installation on radio-transparent airframes.*

4. *For a single-antenna installation, antenna gain pattern performance should be shown at least equivalent to that of a quarter-wave resonant antenna mounted on the fuselage bottom surface.*

5. *See* §2.2.6.1.2 *for definition of payload transmission requirements for each equipment class.*

2.1.12 Transmitting Subsystem

~~An~~ A ~~ADS-B~~ UAT Transmitting Subsystem is classified according to the unit's range capability and the set of parameters it is capable of transmitting. Table 2-2 **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)	18 watts (+42.5 dBm)
Medium	16 watts (+42 dBm)	40 watts (+46 dBm)
High	100 watts (+50 dBm)	250 watts (+54 dBm)

Note: *These transmitter power requirements are referenced to the power delivered to the antenna, and assume transmit antenna gain of 0 dB. Alternate means that demonstrates 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. The receiver sensitivity is –93 dBm at the receiver antenna for 90% Message Success Rate for Long ADS-B Messages, and –91 dBm at the receiver antenna for 90% Message Success Rate of Ground Uplink (ground-to-air) messages.

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

2.1.14 Antenna Subsystem

Throughout this document, requirements have been derived presuming the use of antennas having omni-directional pattern and 0 dB of gain. The use of gain antennas for ADS-B is permitted and discussed in §3.3.1 and Appendix H of RTCA/DO-242A (ADS-B MASPS), and in Appendix E of this document. Antenna azimuthal gain patterns **shall** not contain intentional nulls. Nulls created by airframe blockages should be minimized when antenna locations are selected.