



Department of Transportation  
**Federal Aviation Administration**  
Aircraft Certification Service  
Washington, D.C.

**TSO-C63d**

Effective  
Date: 02/28/12

# Technical Standard Order

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**Subject: Airborne Weather Radar Equipment**

1. **PURPOSE.** This technical standard order (TSO) is for manufacturers applying for a TSO authorization or letter of design approval (LODA). In it, we (the Federal Aviation Administration, (FAA)) tell you what minimum performance standards (MPS) your Airborne Weather Radar equipment must first meet for approval and identification with the applicable TSO marking. This TSO addresses forward looking windshear capability. It does not include flight guidance system functionality in support of an approved windshear detection and avoidance system.
2. **APPLICABILITY.** This TSO affects new applications submitted after its effective date.
  - a. All prior revisions to this TSO are no longer effective. Generally, we will not accept applications for the previous revision after the effective date of this TSO. We may do so, however, up to six months after it, if we know that you were working against the prior MPS before the new change became effective.
  - b. Airborne weather radar equipment approved under a previous TSO authorization may still be manufactured under the provisions of their original approval.
3. **REQUIREMENTS.** New models of airborne weather radar identified and manufactured on or after the effective date of this TSO must meet the MPS qualification and documentation requirements in Table 1.

**Table 1 – Airborne Weather Radar Equipment Classes and Applicable MPS**

<b>Equipment Class</b>	<b>Equipment Type</b>	<b>Minimum Performance Standards</b>
A	Airborne Doppler Weather Radar with Forward-Looking Windshear and Forward-Looking Turbulence Detection Capability	RTCA Document, DO-220, <i>Minimum Operational Performance Standards for Airborne Weather Radar with Forward-Looking Windshear Capability</i> , September 21, 1993, Section 2.2, including Change 1, June 23, 1995, and appendices 1 and 2 of this TSO.
B	Airborne Doppler Weather Radar with Forward-Looking Turbulence Detection Capability	RTCA Document, DO-220, <i>Minimum Operational Performance Standards for Airborne Weather Radar with Forward-Looking Windshear Capability</i> , September 21, 1993, Section 2.2, including Change 1, June 23, 1995, and appendices 1 and 2 of this TSO, with the following exclusions; RTCA/DO-220 Sections 2.2.1.5.2, 2.2.2.7.2, 2.2.2.13, and 2.2.2.14.
C	Airborne Weather and Ground Mapping Pulsed Radar	RTCA Document, DO-173, <i>Minimum Operational Performance Standards for Airborne Weather and Ground Mapping Pulsed Radars</i> , Section 2, dated November 19, 1980, and appendix 2 of this TSO.

**a. Functionality.** This TSO's standards apply to equipment intended to:

(1) Detect atmospheric hazards, via radar, and display detected hazards on the flight deck (Equipment Class A, B, and C).

(2) Provide advanced and advisory indication of potentially hazardous turbulence conditions detectable by weather radar, together with other flight information, to assist pilots with turbulence avoidance decisions (Equipment Class A and B).

(3) Maintain contact with geographic features such as international shoreline boundaries as a supplement to navigational orientation (Equipment Class A, B, and C).

(4) Provide airborne windshear detection (Equipment Class A). Equipment Class A provides forward-looking windshear detection functionality. However, this TSO does not include flight guidance system functionality in support of an approved windshear detection and avoidance system.

**b. Failure Condition Classifications.**

(1) Failure of the function defined in paragraph **3.a(2)** resulting in malfunction or missed detection of the function is a minor failure condition.

(2) Failure of the function defined in paragraph **3.a(1)**, **3.a(3)**, or **3.a(4)** resulting in unannounced malfunction or missed detection of the function is a major failure condition.

(3) Loss of the functions defined in paragraph **3.a** is a minor failure condition.

(4) Design the system to at least these failure condition classifications.

c. **Functional Qualification.** Demonstrate the required functional performance under the test conditions specified in RTCA Document, DO-220, *Minimum Operational Performance Standards for Airborne Weather Radar with Forward-Looking Windshear Capability*, September 21, 1993, Section 2.4, including Change 1, June 23, 1995, and appendix **1** of this TSO for equipment classes A and B. (Specific windshear detection mode requirements are not required for Equipment Class B.) Demonstrate the required functional performance under the test conditions specified for airborne weather radar in RTCA Document, DO-173, *Minimum Operational Performance Standards for Airborne Weather and Ground Mapping Pulsed Radars*, Section 2.4, dated November 19, 1980, for Equipment Class C.

d. **Environmental Qualification.** For Equipment Classes A and B, demonstrate the required performance under the test conditions specified in RTCA Document, DO-220, *Minimum Operational Performance Standards for Airborne Weather Radar with Forward-Looking Windshear Capability*, September 21, 1993, Section 2.3, including Change 1, June 23, 1995, using standard environmental conditions and test procedures appropriate for airborne equipment. For Equipment Class C, demonstrate the required performance under the test conditions specified in RTCA Document, DO-173, *Minimum Operational Performance Standards for Airborne Weather and Ground Mapping Pulsed Radars*, Section 2.3, dated November 19, 1980, using standard environmental conditions and test procedures appropriate for airborne equipment. You must use different standard environmental conditions and test procedures than specified in RTCA/DO-173 and RTCA/DO-220.

**Note:** The use of RTCA/DO-160D (with Changes 1 and 2 only, incorporated) or earlier versions is generally not considered appropriate and will require substantiation via the deviation process as discussed in paragraph **3.g** of this TSO.

e. **Software Qualification.** If the article includes software, develop the software according to RTCA Document, DO-178B, *Software Considerations in Airborne Systems and Equipment Certification*, dated December 1, 1992 to at least the software level consistent with the failure condition classification defined in paragraph **3.b** of this TSO.

**Note:** The certification liaison process objectives will be considered satisfied after FAA review of the applicable life cycle data.

**f. Electronic Hardware Qualification.** If the article includes complex custom airborne electronic hardware, develop the component according to RTCA Document, RTCA/DO-254, *Design Assurance Guidance for Airborne Electronic Hardware*, dated April 19, 2000, to at least the design assurance level consistent with the failure condition classification defined in paragraph **3.b** of this TSO. For custom airborne electronic hardware determined to be simple, RTCA/DO-254, paragraph 1.6 applies.

**Note:** The certification liaison process objectives will be considered satisfied after FAA review of the applicable life cycle data.

**g. Deviations.** We have provisions for using alternate or equivalent means of compliance to the criteria in the MPS of this TSO. If you invoke these provisions, you must show that your equipment maintains an equivalent level of safety. Apply for a deviation under the provision of 14 CFR § 21.618.

#### **4. MARKING.**

**a.** Mark at least one major component permanently and legibly with all the information in 14 CFR § 45.15(b). The marking must include the serial number. Mark each article according to Equipment Class from Table 1 above.

**b.** Also, mark the following permanently and legibly, with at least the manufacturer's name, subassembly part number, and the TSO number:

- (1) Each component that is easily removable (without hand tools), and
- (2) Each subassembly of the article that you determined may be interchangeable.

**c.** If the article includes software and/or airborne electronic hardware, then the article part numbering scheme must identify the software and airborne electronic hardware configuration. The part numbering scheme can use separate, unique part numbers for software, hardware, and airborne electronic hardware.

**d.** You may use electronic part marking to identify software or electronic hardware components by embedding the identification within the hardware component itself (using software) rather than marking it on the equipment nameplate. If electronic marking is used, it must be readily accessible without the use of special tools or equipment.

**5. APPLICATION DATA REQUIREMENTS.** You must give the FAA aircraft certification office (ACO) manager responsible for your facility a statement of conformance, as specified in 14 CFR § 21.603(a)(1) and one copy each of the following technical data to support your design and production approval. LODA applicants must submit the same data (excluding paragraph **5.g**) through their civil aviation authority.

**a.** A Manual(s) containing the following:

- (1)** Operating instructions and equipment limitations sufficient to describe the equipment's operational capability.
- (2)** For Equipment Class A and B, identify the installation instructions for the identified Aircraft Class selected from Appendix 1, Table A1.
- (3)** Expected radome performance for the electromagnetic signals passing through it (reference RTCA/DO-213, *Minimum Operational Performance Standards for Nose-Mounted Radomes*, dated January 14, 1993, for radome performance information).
- (4)** Weather performance index (range) in accordance with the requirements of RTCA/DO-173.
- (5)** Windshear detection range in accordance with the requirements of RTCA/DO-220.
- (6)** Describe in detail any deviations.
- (7)** Installation procedures and limitations sufficient to ensure that the airborne weather radar, when installed according to the installation or operational procedures, still meets this TSO's requirements. Limitations must identify any unique aspects of the installation. The limitations must include a note with the following statement:

“This article meets the minimum performance and quality control standards required by a technical standard order (TSO). Installation of this article requires separate approval.”
- (8)** For each unique configuration of software and airborne electronic hardware, reference the following:
  - (a)** Software part number including revision and design assurance level;
  - (b)** Airborne electronic hardware part number including revision and design assurance level; and
  - (c)** Functional description.
- (9)** A summary of the test conditions used for environmental qualifications for each component of the article. For example, a form as described in RTCA/DO-160G, *Environmental Conditions and Test Procedures for Airborne Equipment*, Appendix A.
- (10)** Schematic drawings, wiring diagrams, and any other documentation necessary for installation of the airborne weather radar.

(11) List of replaceable components, by part number, that makes up the airborne weather radar. Include vendor part number cross-references, when applicable.

**b.** Instructions covering periodic maintenance, calibration, and repair, for the continued airworthiness of airborne weather radar. Include recommended inspection intervals and service life, as appropriate.

**c.** If the article includes software: a plan for software aspects of certification (PSAC) software configuration index, and software accomplishment summary.

**d.** If the article includes complex custom airborne electronic hardware: a plan for hardware aspects of certification (PHAC), hardware verification plan, top-level drawing, and hardware accomplishment summary (or similar document, as applicable).

**e.** Nameplate drawing with the information required by paragraph 4 of this TSO.

**f.** Identify functionality, or performance contained in the article not evaluated under paragraph 3 of this TSO (that is, non-TSO functions). Non-TSO functions are accepted in parallel with the TSO authorization. For those non-TSO functions to be accepted, you must declare these functions and include the following information with your TSO application:

(1) Description of the non-TSO function(s), such as performance specifications and software, hardware, and environmental qualification levels. Include a statement confirming that the non-TSO function(s) don't interfere with the article's compliance with the requirements of paragraph 3.

(2) Installation procedures and limitations sufficient to ensure that the non-TSO function(s) meets the declared functions and performance specification(s) described in paragraph 5.f.(1).

(3) Instructions for continued performance applicable to the non-TSO function(s) described in paragraph 5.f.(1).

(4) Interface requirements and applicable installation test procedures to ensure compliance with the performance data defined in paragraph 5.f.(1).

(5) Test plans, analysis and results, as appropriate, to verify that performance of the hosting TSO article is not affected by the non-TSO function(s).

(6) Test plans, analysis and results, as appropriate, to verify the function and performance of the non-TSO function(s) as described in paragraph 5.f.(1).

**g.** The quality system description required by 14 CFR § 21.608, including functional test specifications. The quality system should ensure that you will detect any change to the approved design that could adversely affect compliance with the TSO MPS, and reject the article accordingly. (Not required for LODA applicants.)

- h.** Material and process specifications list.
- i.** List of all drawings and processes (including revision level) that define the article's design.
- j.** Manufacturer's TSO qualification report showing results of testing accomplished according to paragraph **3.c** of this TSO.

**6. MANUFACTURER DATA REQUIREMENTS.** Besides the data given directly to the responsible ACO, have the following technical data available for review by the responsible ACO:

- a.** Functional qualification specifications for qualifying each production article to ensure compliance with this TSO.
- b.** Equipment calibration procedures.
- c.** Schematic drawings.
- d.** Wiring diagrams.
- e.** Material and process specifications.
- f.** The results of the environmental qualification tests conducted according to paragraph **3.d.** of this TSO.
- g.** If the article includes software, the appropriate documentation defined in RTCA/DO-178B including all data supporting the applicable objectives in RTCA/DO-178B *Annex A, Process Objectives and Outputs by Software Level.*
- h.** If the article includes complex custom airborne electronic hardware, the appropriate hardware life cycle data in combination with the design assurance level, as defined in RTCA/DO-254, Appendix A, Table A-1. For simple custom airborne electronic hardware, the following data: test cases or procedures, test results, test coverage analysis, tool assessment and qualification data, and configuration management records, including problem reports.
- i.** If the article contains non-TSO function(s), you must also make available items **6.a** through **6.h** as they pertain to the non-TSO function(s).

**7. FURNISHED DATA REQUIREMENTS.**

- a.** If furnishing one or more articles manufactured under this TSO to one entity (such as an operator or repair station), provide one copy or on-line access to the data in paragraphs **5.a** and

**5.b** of this TSO. Add any other data needed for the proper installation, certification, use, or for continued compliance with the TSO, of the airborne weather radar equipment.

**b.** If the article contains declared non-TSO function(s), include one copy of the data in paragraphs **5.f.(1)** through **5.f.(4)**.

## **8. HOW TO GET REFERENCED DOCUMENTS.**

**a.** Order RTCA documents from RTCA Inc., 1150 18th Street NW, Suite 910, Washington, D.C. 20036. Telephone (202) 833-9339, fax (202) 833-9434. You can also order copies online at [www.rtca.org](http://www.rtca.org).

**b.** Order SAE documents from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001. Telephone (724) 776-4970, fax (724) 776-0790. You can also order copies online at [www.sae.org](http://www.sae.org).

**c.** Order copies of 14 CFR parts 21 and 25 from the Superintendent of Documents, Government Printing Office, P.O. Box 979050, St. Louis, MO 63197. Telephone (202) 512-1800, fax (202) 512-2250. You can also order copies online at [www.access.gpo.gov](http://www.access.gpo.gov). Select "Access," then "Online Bookstore." Select "Aviation," then "Code of Federal Regulations."

**d.** You can find a current list of technical standard orders and advisory circulars on the FAA Internet website Regulatory and Guidance Library at <http://rgl.faa.gov>. You will also find the TSO Index of Articles at the same site.



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**APPENDIX 1**  
**FEDERAL AVIATION ADMINISTRATION MINIMUM**  
**PERFORMANCE STANDARD FOR AIRBORNE DOPPLER WEATHER RADAR**  
**WITH FORWARD-LOOKING TURBULENCE DETECTION CAPABILITY**

1. **PURPOSE.** This appendix establishes the Minimum Performance Standards (MPS) for the Forward-Looking Turbulence Detection function of Airborne Doppler Weather Radar Systems. The primary operational goal by equipment meeting the performance standard set forth in this document is to provide the flight crew with an advisory display of radar-detected, in-flight turbulence in the vicinity of the aircraft which indicates an elevated risk to occupants and flight safety. This display is to be used by the flight crew to make them aware of turbulence ahead of the aircraft.

2 **SCOPE.** The scope of this appendix is to provide minimum performance standards for Airborne Doppler Weather Radar Systems with Forward-Looking Turbulence Detection and flight deck display. The FAA tasked the Airborne Turbulence Detection Systems (ATDS) Industry Working Group to develop recommendations for minimum performance standards for the Forward-Looking Turbulence Detection function of Airborne Doppler Weather Radar Systems. The minimum performance standards described in this appendix are based on the ATDS Working Group recommendations. All paragraph references cited herein are in reference to this appendix only.

3. **DETAIL REQUIREMENTS.** In addition to the performance requirements set forth in the main text of this TSO, the following general requirements and equipment characteristics are defined below:

a. Performance levels. The radar shall comply with one of the following levels:

(1) Level 1 –

- Must Indicate: The radar shall indicate turbulence that corresponds to a standard deviation of aircraft g-load excursions of 0.3g with reflectivity  $\geq$  20 dBZ at a minimum of 12 nautical miles (nmi) with a probability of 0.85.
- Must Not Indicate: The radar shall not indicate turbulence that corresponds to a standard deviation of aircraft g-load excursions of 0.1g with reflectivity  $\geq$  20 dBZ at a minimum of 12 nmi with a probability of 0.8 or greater.

(2) Level 2 –

- Must Indicate: The radar shall indicate turbulence that corresponds to a standard deviation of aircraft g-load excursions of 0.34g with reflectivity  $\geq$  25 dBZ at a minimum of 12 nmi with a probability of 0.85.
- Must Not Indicate: The radar shall not indicate turbulence that corresponds to a standard deviation of aircraft g-load excursions of 0.1g with reflectivity  $\geq$  25 dBZ at a minimum of 12 nmi with a probability of 0.8 or greater.

**(3) Level 3 –**

- **Must Indicate:** The radar shall indicate turbulence that corresponds to a standard deviation of aircraft g-load excursions of 0.38g with reflectivity  $\geq$  25 dBZ at a minimum of 12 nmi with a probability of 0.85.
- **Must Not Indicate:** The radar shall not indicate turbulence that corresponds to a standard deviation of aircraft g-load excursions of 0.1g with reflectivity  $\geq$  25 dBZ at a minimum of 12 nmi with a probability of 0.8 or greater.

**b.** In Table A1, the performance levels described in paragraphs **3.a(1)**, **3.a(2)**, and **3.a(3)** are applied as minimum performance levels for radar systems installed on different classes of aircraft differentiated by wing loading throughout the entire flight regime under typical operating conditions. These aircraft classes are intended to span the range of aircraft on which turbulence detecting radar would be installed. For example, the 80 – 135 lbs/ft<sup>2</sup> wing loading indicated in the Table A1 below exemplifies Aircraft Class 1. Aircraft Classes 2 and 3 cover a variety of other aircraft types, wing loading, and configurations. Aircraft data necessary for conversion of radar observables to RMS-g for Aircraft Class 1, 2, and 3 systems are documented in Reference 1 of Appendix 1 of this TSO.

**Table A1: Aircraft Class and Detection Performance Criteria**

<b>Aircraft Classes (by Wing Loading)</b>	<b>Minimum Performance</b>
<b>Class 1</b> 80 – 135 lbs/ft <sup>2</sup>	Level 1 0.1 / 0.3 RMS-g detection at 12 nmi / 20 dBZ
<b>Class 2</b> 60 – 100 lbs/ft <sup>2</sup>	Level 2 0.1 / 0.34 RMS-g detection at 12 nmi / 25 dBZ
<b>Class 3</b> 30 – 70 lbs/ft <sup>2</sup>	Level 3 0.1 / 0.38 RMS-g detection at 12 nmi / 25dBZ

**c.** At a minimum, the radar system shall provide for a graphical output of regions ahead of the aircraft,  $\pm$ 25 degrees of the longitudinal axis, that present a hazard to the aircraft under weather conditions that permit radar detection of turbulence.

**d.** The manufacturer shall demonstrate that the methods used to display optional multiple levels of turbulence include depictions ensuring those levels are sufficiently distinct from each other and do not interfere with the minimum detection and display requirement of paragraph **3.a**.

**4. TESTS.** A combination of statistical analysis and simulation is acceptable to demonstrate compliance with the requirements of Appendix 1 of this TSO. The manufacturer shall provide evidence of compliance with the performance requirements given in section 3. This evidence will, at a minimum, consist of:

- An evaluation of the turbulence detection performance; and,
- A demonstration of system capability to properly detect turbulence and indicate the turbulence on a display device.

**a. Evaluation of Performance**

(1) The manufacturer shall provide results of evaluations of the turbulence detection performance of the radar system that show the capability of the system to satisfy the requirements contained in sections **3.a** and **3.b**. There are a wide range of methods by which these evaluations can be performed. The manufacturer shall clearly describe the method by which the evaluations are performed, including descriptions of any simplifying assumptions used in the analysis.

(2) In the performance evaluation for compliance with paragraphs **3.a** and **3.b**, the manufacturer shall indicate how the evaluation of the errors in the turbulence measurement process is properly accounted for. The performance evaluation shall be implemented in a manner that reflects the actual turbulence measurement or estimation processing that is implemented onboard the radar system processor.

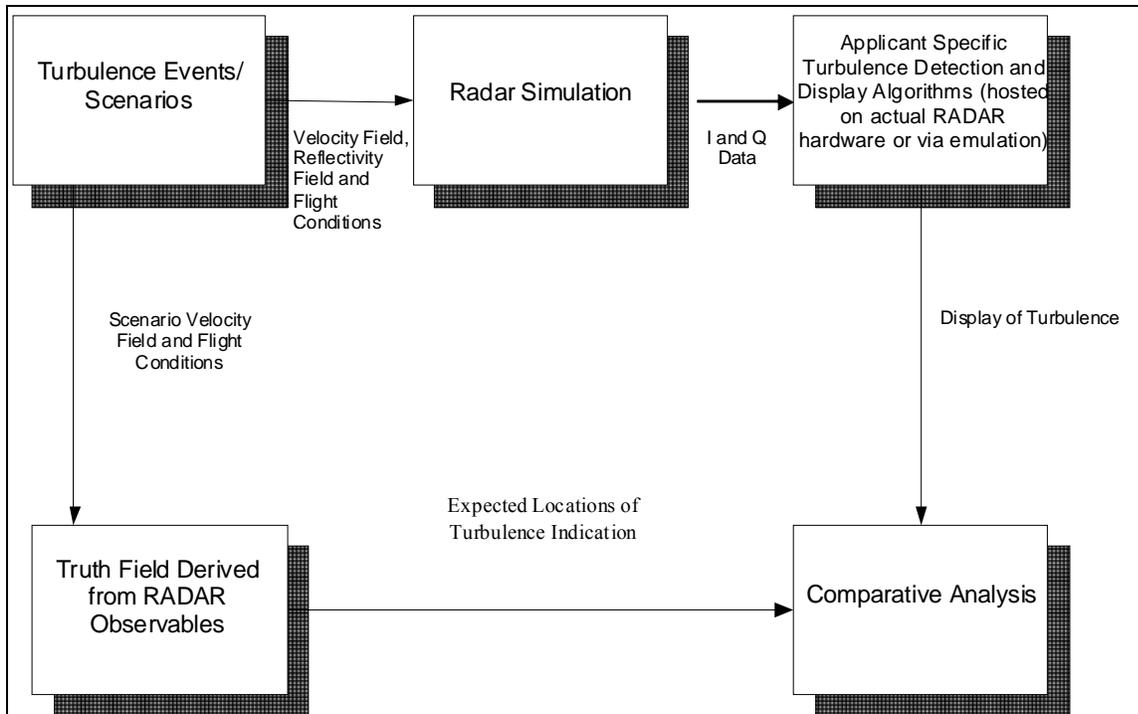
(3) The evaluation of performance shall include the effect of variation in aircraft type and weight for the aircraft on which the radar system will be installed. Aircraft properties affect the relationship between the turbulence threat (RMS-g) and the turbulent wind variance.

(4) A manufacturer shall provide a probabilistic and statistical analysis comparing the design characteristics of the radar system, variability in aircraft wing loading, and atmospheric disturbance to the turbulence measurement performance required by **3.a** and **3.b**. The manufacturer may accomplish this by using accepted analytical or Monte-Carlo simulation techniques. Use Reference 1 for these purposes.

**b. Simulation Analysis**

(1) The manufacturer shall demonstrate system performance, defined in Table A1, by simulating radar signals returned from specific weather models [reference paragraph **4.(b)(3)** of this Appendix]. Processing of these signals by the radar system into displayed turbulence indications are then compared to a truth field to show acceptable performance of the system.

(2) A graphical depiction of the process used to simulate, display, and evaluate radar system performance is shown in Figure A1.



**Figure A1**  
**System Simulation Methodology**

- (3) The radar simulations used for the demonstration in 4.b(1) shall be the Airborne Doppler Weather Radar Simulation (ADWRS). You can find the ADWRS tool and related data sets with TSO-C63d on the FAA Internet website Regulatory and Guidance Library at <http://rgl.faa.gov>.

**Note:** When using ADWRS for turbulence detection performance simulation, array indices for radar range characteristics of the turbulence detection radar should be suitably modified. The manufacturer can make minor change such as radar range array indices to the ADWRS simulation for the demonstration of the forward-looking turbulence detection performance as long as the change does not affect the system performance of the radar simulations. In this case, the manufacturer must provide data, in accordance with 14 CFR § 21.603(a), describing rationales for the change, and validation that was performed to ensure the manufacturer's simulation is adequate to meet the intent of these requirements.

c. ADWRS shall be used to simulate the radar signal return for the following NASA developed datasets with the following flight conditions:

- 191-06 (must detect scenario)
  - Altitude 30,000 ft AGL/MSL
  - Airspeed = 290 knots (indicated)/450 knots (true)
  - Ground Speed = 491 knots

- Scenario is initialized at  $X = -2$  km flying parallel to Y axis toward positive Y
- Miles City or MCY (must not detect scenario)
  - Altitude = 22,000 ft AGL, 25,000 ft MSL
  - Airspeed = 290 knots (indicated)/418 knots (true)
  - Ground Speed = 418 knots
  - Scenario is initialized at  $Y = -15.5$  km flying parallel to X axis toward positive X

**d.** The simulated IQ data collected as part of **4.(b)** shall be utilized by the manufacturer's signal processing and turbulence detection algorithms in order to generate a representative display of detected turbulence.

**e.** The manufacturer shall compute a representative radar observable truth field equivalent to the radial velocity elements of the turbulence scenarios described in **4.c**.

**f.** In the case of display output for the simulation of dataset "191-06" (paragraph **4.c**), the manufacturer must demonstrate display of turbulence at 12 nmi within the resolution of the sweep rate, and within 2 km of the peak of the aircraft radar observable truth field as defined in **4.e**. Since radar detection of turbulence is statistical in nature, multiple sweeps may be used to demonstrate compliance for this requirement.

**g.** In the case of output for the simulation of dataset "MCY", the manufacturer must demonstrate that the radar does not produce persistent turbulence indications at 12 nmi (within the resolution of the sweep rate).

**Note:** Non-persistent indications imply that the turbulence indications are not spatially correlated from sweep to sweep.

**h.** The manufacturer shall multiply the wind magnitudes by a suitable factor less than one for the purpose of creating a simulated wind field that is appropriate to test the Must-Not-Detect condition for Aircraft Class 2 or 3. In this case, the manufacturer must provide data, in accordance with 14 CFR § 21.603(a), justifying for any modification of the MCY wind field model.

**Note:** The manufacturer may use the ratio of wing loading of Aircraft Class 2 or 3 (as shown in the Table A1 of this appendix) and wing loading of Aircraft Class 1 as the factor for modification of the MCY wind field model.

**REFERENCES**

1. "A Methodology for Determining Statistical Performance Compliance for Airborne Doppler Radar with Forward-Looking Turbulence Detection Capability," Roland L. Bowles and Bill K. Buck, NASA Contractor Report Series, NASA/CR-2009-215769, Newport News, Virginia, June 2009.
2. "Airborne Turbulence Detection System Certification Tool Set," AIAA-2006-75
3. "Progress in the Development of an Airborne Detection System," ARAM-06
4. "NASA Turbulence Data Set Deliverable for FAA Certification Utilization," Lisa Rippey, letter, December 2005
5. "Doppler Radar and Weather Observations, 2<sup>nd</sup> Edition", Richard J. Doviak and Dusan S. Zrnica, Dover Publications, Inc., Mineola, New York, 2006.

**APPENDIX 2**  
**EXCEPTIONS TO MINIMUM PERFORMANCE STANDARDS**

The following exceptions apply to the minimum performance standards of RTCA/DO-220 for Radar Equipment Class A and B:

1. **Paragraph 2.2.1.2** – Manufacturers may provide selectable display formats. However, at least one of these formats shall comply with paragraph 2.2.1.2.
2. **Paragraph 2.2.1.4** – Manufacturers providing plan format display capability may use less than two range markers for plan format display mode.
3. **Paragraph 2.2.2.2** – Manufacturers may use automatic adjustment of the beam tilt in lieu of manual adjustment of beam tilt.
4. **Appendix A** – Manufacturers may also use TSO-C113, Airborne Multipurpose Electronic Displays, dated October 27, 1986, in lieu of the color requirements of RTCA/DO-173.

The following exceptions apply to the minimum performance standards of RTCA/DO-173 for Radar Equipment Class C:

1. **Paragraph 2.2.1.2** – Manufacturers may provide selectable display formats. However, at least one of these formats shall comply with paragraph 2.2.1.2.
2. **Paragraph 2.2.1.4** – Manufacturers providing plan format display capability may use less than two range markers for plan format display mode.
3. **Appendix A** – Manufacturers may also use TSO-C113, Airborne Multipurpose Electronic Displays, dated October 27, 1986, in lieu of the color requirements of RTCA/DO-173.