TSO-C63d Comment Disposition

Comment Number	Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
1	Honeywell Weather Radar Engineering	Table 1	The use of the word "Class" is already used in TSO C63c for range performance, may want to consider another word such as category. Additionally, Aircraft Class is used elsewhere in the document.	Potential confusion whether Equipment or Performance Class is being referred to.	Use a different term for "Equipment Class"	**Partial concur.** We have chosen to maintain use of "Class", but have made additional clarification to better differentiate "Equipment Class" from "Aircraft Class".
2	Honeywell Weather Radar Engineering	Table 1	Equipment Classes A and B need also to reference Appendix 2 or other similar.	The exceptions listed in Appendix 2 for DO-173 should also apply to Classes A and B for DO-220.	Add DO-220 to Appendix 2 and Reference Appendix 2 in the "Minimum Performance Standards" column for Classes A and B. OR create a new Appendix for DO-220 and reference that.	**Concur.**
3	Honeywell Weather Radar Engineering	Table 1	The wording "*excluding windshear specifications of section 2.2.1.1, sections 2.2.1.5.2 and 2.2.2, including Change 1"* for Class B is confusing.	Change 1 is not relevant if the windshear sections are excluded.	Remove the words "including Change 1" for Class B. Class A wording is OK.	**Concur**. Class B reference was updated to clean up exclusionary references to Section 2.2.

TSO-C63d Comment Disposition

Comment Number	Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
4	Honeywell Weather Radar Engineering	Table 1	As discussed during ATDS meetings, some lower end, magnetron based radars are capable of a basic Turbulence detection mode, but may not be able to meet this MOPS. Clarify if TSO C63c will still be allowed for this type of radar.	May disallow lower end radars from offering a basic turbulence detection mode.	Clarify that TSO C63c or TSO C63d Class C with basic turbulence capability will still be allowed, for example on a non-TSO function basis.	**Non-concur.** TSO authorization for radars with turbulence detection functionality should apply under Equipment Class A or B. For those radars with "basic" turbulence detection, a deviation must be sought. Without industry recommended performance requirements for magnetron based radars, we are unable to describe the performance requirements in the TSO.
5	Honeywell Weather Radar Engineering	3.a.(2)	Should not apply to Class C	Is in conflict with Table 1	Remove reference to Class C in this paragraph.	**Concur.** Paragraph changed as recommended.
6	Honeywell Weather Radar Engineering	3.a.(4)	This appears to be redundant with (2).	Clarity	Clarify.	**Concur.** Deleted 3.a.(4).
7	Honeywell Weather Radar Engineering	3.a.(5)	Formatting issue.	Formatting issue.	Indent the same as previous paragraphs.	**Concur.** Paragraph was indented.

TSO-C63d Comment Disposition

Comment Number	Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
8	Honeywell Weather Radar Engineering	3.b	Loss of function, or Annunciated malfunction of PWS, Weather Detection or Turbulence detection are minor hazards as these conditions would not significantly reduce airplane safety, and involve crew actions that are well within their capabilities.	Incorrect hazard classification of malfunction.	Change to minor failure condition or clarify that this is referring to Unannunciated malfunctions.	**Partial concur.** We have modified this paragraph to address numerous public comments: (1) Loss of the functions defined in paragraph **3.a** of this TSO is a minor failure condition. (2) Malfunction of the functions defined in paragraph **3.a(2)** of this TSO is a minor failure condition. (3) Malfunction of the function defined in paragraph **3.a(1), 3.a(3),** or **3.a(4)** of this TSO is a major failure condition. (4) Design the system to the highest of the failure condition classifications.
9	Honeywell Weather Radar Engineering	3.d	This will require an automatic deviation request since DO-220 calls out DO-160C and DO-173 calls out DO-160A	Conflicting requirements	Add DO-160 call-out as an exception in an Appendix, or clarify which document takes precedence.	**Partial concur.** We recognize that DO-173 and DO-220 are out of date with respect to the environmental conditions specified. We have provided additional clarification in paragraph 3.d.

TSO-C63d Comment Disposition

Comment Number	Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
10	Honeywell Weather Radar Engineering	4.a	The last sentence does not allow for the fact that the Aircraft Class could be installation configurable (e.g. through use of a program pin).	Precludes use of installation configuration and unnecessarily propagates equipment part numbers.	Remove requirement to mark Aircraft Class (Equipment Class OK, notwithstanding earlier recommendation to use different term).	**Concur.** Identification of Aircraft Class in the IM is considered adequate.
11	Honeywell Weather Radar Engineering	4.a	The "Class of Equipment" (which is different than the Equipment Class as defined in TSO C63d) as used in the current TSO C63c (paragraph b.(1)ii of the document) should also be defined in TSO C63d, along with the related label marking requirements.	This is required to declare the Performance Index and Avoidance Range requirement for the equipment. DO-220 defines some classes, but does not define Class 7 and DO-173 does not contain any definitions. Further, the label marking requirement is not provided.	Clarify how to handle the "Class of Equipment" declaration.	**Partial concur.** We have modified paragraph 5.a to include declared weather performance index (in accordance with the requirements of RTCA/ DO-173) and windshear avoidance range (in accordance with the requirements of RTCA/ DO-220) in the installation/operating manual. No marking requirements are necessary.
12	Honeywell Weather Radar Engineering	Appendix 1 1.4.2).a	Paragraph numbering format is inconsistent.	Clarity	Clarify	**Concur.** Clarification accomplished to make Appendix 1 in alignment with the rest of the TSO formatting.

TSO-C63d Comment Disposition

Comment Number	Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
13	Honeywell Weather Radar Engineering	Appendix 1 1.4 2) (a)(4)	"Use Reference 1 for Class A aircraft." We believe Reference 1 should be used for all Aircraft Classes. Also, this method should not be mandated, alternate equivalent methods should be allowed as has been the case with previous Issue Papers.	Clarity	Clarify	**Partial concur.** Sentence was changed to include class B and C aircraft. Use of the NASA method in Reference 1 is required. The ATDS Industry WG agreed by consensus on the NASA method for TSO-C63d MOPS. The NASA method & assumption were extensively validated. The NASA method used in several aircraft turbulence detection radar certification programs
14	Honeywell Weather Radar Engineering	Appendix 1 1.4(b)(3)	The option for a different validated weather radar simulator should be allowed.	Allow for other equivalent means of testing.	Add "or other validated weather radar simulator" after (ADWRS).	**Non-concur.** The ADWRS tool and data sets were developed and agreed with consensus by industry in support of this TSO MPS. ADWRS was extensively validated with B757-200 and B737-800 flight tests for turbulence detection performance. ADWRS has been used in several aircraft turbulence detection radar certification programs. If the applicant elects to use other simulations to demonstrate these turbulence detection performance requirements, use the TSO deviation process and demonstrate equivalent means.
15	Honeywell Weather Radar Engineering	Appendix 1 1.4(c)(3)	Similar to above.	Allow for other equivalent means of testing.	Add "or other validated weather radar simulator" after (ADWRS).	**Non-concur.** See comment 14.

TSO-C63d Comment Disposition

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16	Honeywell Weather Radar Engineering	Appendix 1 1.4(h)	It is not clear what it is that is to be multiplied.	Clarity and completeness.	Clarify.	**Concur.** Clarify paragraph 4(h) in Appendix 1 as: 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. A justification for any modification of the MCY wind field model must be provided. **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.
17	Honeywell Weather Radar Engineering	Appendix 1 1.4(f)	Reference to 1.4.2(e) should just be 1.4(e)	Reference error.	Change to 1.4(e)	**Concur.** Corrected.
18	Honeywell Weather Radar Engineering	Appendix 1 1.4(i)	Appears to be partial repeat of 1.4(f)	Clarity	Clarify	**Concur.** Paragraph 4.i was redundant and thus deleted.
19	Honeywell Weather Radar Engineering	Appendix 1 1.4(j)	Appears to be repeat of 1.4(g)	Clarity	Clarify	**Concur.** Paragraph 4.j was redundant and thus deleted.

TSO-C63d Comment Disposition

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20	Honeywell Weather Radar Engineering	Appendix 2 3.	Incomplete sentence.	Clarity and completeness.	Clarify.	**Concur.** This exception was deleted.
21	Honeywell Weather Radar Engineering	(None Specific)	The requirement in DO-220 Paragraph 2.2.2.2 for manual adjustment of the beam should not be required.	Many modern weather radars automatically control tilt angle which reduces pilot workload and provides a more accurate depiction of weather conditions.	Add manual adjustment of beam tilting as an exception for manufacturers that implement automatic tilt control.	**Concur.** An exception was added to Appendix 2.
22	Honeywell Weather Radar Engineering	(None Specific)	The requirement in DO-220 Paragraph 2.2.2.4 for frequency of antenna scan as worded is not clear.	Difficult to interpret, especially the wording "at any point within the horizontal scan." It is also not clear that this requirement pertains to reflectivity mode (other requirements control windshear mode scan rates). The intent of this requirement is to ensure a minimum azimuth scan rate. As written could cause a deviation request for radars which use a programmed tilt scheme.	Add frequency of antenna scan as an exception and re-write the requirement as "The maximum azimuth revisit time for reflectivity data shall be 20 seconds."	**Non-concur.** The requirement in paragraph 2.2.2.4 is clear. Paragraph 2.2.2.4 states "The antenna scan shall be such that any point within the horizontal scan of the antenna is illuminated by the radar beam at least twice every twenty seconds."
23	Honeywell Weather Radar Engineering	6.h	If the article includes complex custom ~~as~~ airborne electronic hardware,		Remove extra word	**Concur.** Corrected.

TSO-C63d Comment Disposition

Comment Number	Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
24	Honeywell Weather Radar Engineering	Appendix 2	The requirement in DO-173 Paragraph 2.2.2.2 for manual adjustment of the beam should not be required.	Many modern weather radars automatically control tilt angle which reduces pilot workload and provides a more accurate depiction of weather conditions.	Add manual adjustment of beam tilting as an exception for manufacturers that implement automatic tilt control.	**Non-concur.** DO-173 paragraph 2.2.2.2 is agnostic on whether the beam tilt function must be performed manually. No change required.
25	Honeywell Weather Radar Engineering	Appendix 1 1.3(e)	The probability of un-annunciated failures in all previous issue papers has being 1E-3, but is listed here as 1E-5.	Consistency with issue papers	Change requirement from 1E-5 to 1E-3	**Concur.** See comment 8. Note that paragraph numbers in appendix 1 were changed. All prefixed 1's were deleted. For example, paragraph 1.3(e) (in appendix 1) became 3(e).

TSO-C63d Comment Disposition

Comment Number	Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
26	Honeywell Weather Radar Engineering	Reference 1	The analysis method used in this reference document makes the incorrect assumption that the radar measurement errors and the variation in pertinent aircraft characteristics (i.e. the conversion factor between sigma-g and sigma-v) are independent random variables. This is not correct. Use of this assumption could result in a poor analysis of turbulence detection performance. This comment has been made previously in ATDS meetings and has not been addressed to Honeywell's satisfaction.	To do the analysis, we set sigma-g to a fixed value – either 0.3 or 0.1. Then the corresponding sigma-v depends on the aircraft characteristics captured by the conversion factor that relates the two sigmas. Within an aircraft class, there is a variation of the conversion factor that's described by the distribution provided by the reference document. This means there is a range of sigma-v values that have to be accounted for in the analysis. For a radar system used to estimate sigma-v, the measurement error is a function of a lot of things – including the actual sigma-v (i.e. the truth value). So the radar measurement errors are not independent of the truth value of sigma-v, and so are not independent of the conversion factor. Reference 1 illustrates an analysis method that makes the assumption that these two processes are independent. That's not correct.	As a minimum, add a note that Reference 1 illustrates an analysis method that uses simplifying assumptions that may or may not be appropriate for an applicant's radar system.	**Partial concur.** The method in reference 1 (Airborne Turbulence Detection Systems (ATDS) method) was developed and agreed to by consensus within the ATDS Industry Working Group (WG) in support of TSO-C63d MPS for the forward-looking turbulence detection performance. The ATDS method involves conversion of airborne radar measurement products (radar spectrum width) to RMS g-loads. Conversion of radar spectrum width to RMS g's is dependent on aircraft gust load response characteristics. Aircraft gust load response characteristics can be described as a function of aircraft weight and balance, airspeed, and altitude. If the radar is weight strapped to the aircraft, the radar spectrum width is the truth value of the measured turbulence flow field. However, the ATDS WG rejected this method due to the cost of the implementation. The WG agreed on the ATDS statistical method which converts the radar spectrum width to RMS g-loads by multiplying the spectrum width with aircraft scaling factor, which is dependent on aircraft gust load response characteristics (i.e. scaling factor is inversely proportional to wing loading and proportional to airspeed). The radar spectrum width and aircraft scaling factor are assumed as independent variables. Reference 1 shows that the same turbulence detection performance was obtained with the ATDS method vs. the weight strapped implementation for the A320-200 and B777-200 for a variety of flight conditions. The ATDS method and assumptions were extensively validated by simulations for many large transports and 9 business jets, and extensively validated with B757-200 and B737-800 flight tests. ATDS method has been used in several aircraft turbulence detection radar certification programs. Use deviation request if using an alternate analysis method.

TSO-C63d Comment Disposition

Comment Number	Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
27	Collins	Section 3.b	This requirement defines malfunction or loss of function of any of the radar's major functions (atmospheric hazard detection, advanced indication of turbulence, mapping, turbulence detection, windshear detect) as major.		Recommend that requirement be changed to specify "minor" category. Radars are traditionally designed for 1E-3/flight hour loss of function with specific types of detected failures which are designed to be less probable as specified by DO-220 MOPS.	**Partial concur.** See comment 8.
28	Collins	Section 4.d	Recommend removal of term "special tools or equipment".		Recommend removal of term "special tools or equipment".	**Non-concur.** The language is taken from the TSO boilerplate. The intent of the TSO boilerplate language is to ensure that electronic marking is accessible with existing display avionics, and not requiring "special tools or equipment".
29	Collins	Section 1.3b.	The last sentence refers to Class A, B, and C systems. It is unclear what this refers to. The TSO makes mention of Equipment Classes and Aircraft classes, which is confusing.		Recommend that Equipment Classes or Aircraft Classes be re-labled to make this less confusing.	**Concur.** See comment 1.
30	Collins	Section 1.3e.	10^-3 was changed to 10^-5.		Recommend this be changed to 10^-3 to be consistent with Section 3.b.	**Concur.** See comment 8.

TSO-C63d Comment Disposition

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31	Collins	Section 1.4a (4)	The last sentence states to use Reference 1 for Class A aircraft. Why can't this reference be used for Class B and C aircraft?		Recommend sentence be changed to include class B and C aircraft.	**Concur.** Sentence was changed to include class B and C aircraft. See comment 13.

TSO-C63d Comment Disposition

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32	Collins	Section 1.4b (3)	This section specifies the use of ADWRS. Currently ADWRS does not support the turbulence function without modification. Array indices and other functions within the code must be modified. In the past, the turbulence MOPS had language which allowed the use of modified versions of ADWRS or completely different simulations as long as sufficient validation was performed.		Recommend that these words be returned to the TSO, specifically "The applicant can modify and/or supplement the ADWRS simulation or elect to use other simulations to demonstrate these requirements. A simulation validation should be performed to ensure applicant' simulation is adequate to meet the intent of these requirements."	**Partial concur.** The version of the ADWRS code referenced in RTCA/DO-220, *Minimum Operational Performance Standards for Airborne Weather Radar with Forward-Looking Windshear Capability,* for the forward-looking windshear detection performance was used. When using ADWRS code for turbulence detection performance simulation, array indices set for index range characteristics for windshear detection range (1 – 2 nm) should be suitably modified for turbulence detection range (10 – 20 nm). This minor modification does not affect the system performance of the radar simulations. ADWRS was extensively validated, and it has been used in several aircraft turbulence detection radar certification programs. If the applicant elects to use other simulations to demonstrate these turbulence detection performance requirements, use the TSO deviation process. Also see comments 14 and 15. We add the following note statement to paragraph 1.4b (3) (now 4b (3)): **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 applicant 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, rationales for the change must be provided, and a validation must be performed to ensure the applicant's simulation is adequate to meet the intent of these requirements.

TSO-C63d Comment Disposition

Comment Number	Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
33	Collins	Section 1.4f	There is an incorrect reference to 1.4.2(e).		Recommend reference be changed to 1.4(e).	**Concur.** See comment 17.
34	Collins	Section 1.4(h)	Recommend change from shall to may and clarify limit on multiplication factor, i.e. can't multiply by zero.		Recommend change from shall to may and clarify limit on multiplication factor, i.e. can't multiply by zero.	**Partial concur.** We clarify paragraph 4(h) in Appendix 1 (see comment 16). We did not change from "shall" to "may" since it's a requirement. We did not clarify limit on multiplication factor since it varies depending on the aircraft class application. Not allowing multiplication by zero is obvious. A justification for any modification of the MCY wind field model must be provided.
35	Collins	Section 1.4(j)	This is a duplicate of Section 1.4(g) and should be removed.		Recommend 1.4(g) be removed.	**Concur.** See comment 19.
36	Collins	Section 1.4(i)	This is a duplicate of Section 1.4(f) and should be removed.		Recommend 1.4(i) be removed.	**Concur.** See comment 18.

TSO-C63d Comment Disposition

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37	Garmin	Pg 2 Table 1	The verbage states "…Section 2.2, excluding windshear specifications of section 2.2.1.1, sections 2.2.1.5.2 and 2.2.2, including Change 1, June 23, 1995, and appendix 1 of this TSO." The intent of this is to only exclude Sections 2.2.1.1, 2.2.1.5.2, and 2.2.2. Currently written it actually states to exclude DO-220 Change 1 and Appendix 1 of the TSO also.	Grammar	Suggest the following wording, "RTCA Document, DO-220, *Minimum Operational Performance Standards for Airborne Weather Radar with Forward-Looking Windshear Capability*, September 21, 1993, Section 2.2, including Change 1, June 23, 1995, and appendix 1 of this TSO, with the following exclusions; RTCA/DO-220 Sections 2.2.1.1, 2.2.1.5.2, and 2.2.2."	**Concur.** Table 1, Class B, has modified as recommended.

TSO-C63d Comment Disposition

Comment Number	Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
38	Garmin	Pg 2 Para 3.b	"Malfunction of the function defined in paragraph 3.a of this TSO is a major failure condition. Loss of the function defined in paragraph 3.a of this TSO is a major failure condition. Design the system to at least this failure condition classification. Wording needs to change to allow failure condition to be determined at the aircraft level.	AC 23.1309-1D Appendix 1 classifies loss of primary weather radar as "Minor to Major depended on the intended operations." This TSO would unduly restrict the classification of this FHA item with no regard to implementation. This statement implies the failure condition classification of an appliance is determined by the TSO regardless of mitigations employed to meet aircraft level safety requirements such as redundant appliances/systems. Unless the DAL cannot be affected by the installation, the aircraft System Safety Assessment should determine the failure classification and by extension, the design assurance level (DAL) requirement. The aircraft FHA/SSA ultimately determines the DAL requirement for a particular installation. Specifying the DAL at the appliance level without the benefit of the specific aircraft level FHA/SSA means that in some cases the DAL will undoubtedly be higher and more costly than necessary. This will have a chilling effect on the installation of new, safety enhancing technologies since the cost will be greater than necessary. It is possible to build and certify a TSOA appliance that cannot be approved for installation in	Suggest changing to the following wording: "Develop each system to at least the design assurance level required by the anticipated installation for the function defined in paragraph 3a"	**Non-concur.** A TSO authorization is a design and production approval. A TSO authorization is not an installation approval. As such, the FAA has deemed software development assurance levels are a necessary part of the minimum performance standard. It is incumbent upon the installer to ensure the weather radar equipment is appropriate for its intended operating environment.

TSO-C63d Comment Disposition

Comment Number	Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
39	Garmin	Pg 3 Para 3.e	"If the article includes software, develop the software according to RTCA, Inc. document RTCA/DO-178B, Software Considerations in Airborne Systems and Equipment Certification, dated December 1, 1992 to the design assurance level consistent with the failure condition classification defined in paragraph 3.b of this TSO." If agreed to remove the DAL from paragraph 3.b then this statement need to change.	Consistency	Suggest the following wording: "The software design assurance level should be commensurate with the requirements of the proposed aircraft installations."	**Non-concur.** See comment 38.

TSO-C63d Comment Disposition

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40	Garmin	Pg 4 Para 4.a.	There is not a lot of room on the S/N tags for all of the required verbage. Currently this TSO proposes Equipment Classes A,B,&C (Table 1), as well as aircraft classes A,B,&C (TableA1 in Appendix A). In order to mark the tag with this info, we'd have to specify something like: "Equipment Class A, Aircraft Class B". Stating "Class AB" would not be adequate as you would not know whether the equipment or the aircraft was Class A or B.	Marking	Propose changing one of these classes (equipment or aircraft) to numerals (1,2,3). This would allow concise marking of both classes ("Class A1") on the tag without confusion.	**Partial concur.** We have deleted the marking requirements for Aircraft Class in paragraph 4.a. We have included a requirement to note the Aircraft Class in the installation manual per paragraph 5.a., and we have modified Aircraft Class descriptors to use numerals.
41	Garmin	Pg 4 Para 4.b.(2)	**"(2)** Each subassembly of the article that you determined may be interchangeable." Reword to remove confusion.	The language for this requirement is confusing. This could mean that a stuffed printed circuit board needs the TSO number.	Suggest removing the statement or if removing causes problems work with industry to establish wording that is better understood.	**Non-concur.** The wording will remain the same based on TSO template.
42	Garmin	Pg 9	Performance Levels. Should be Performance levels.	Grammar	Change L to l. or make it a stand alone heading.	**Concur.** Appendix 1, Paragraph 3.a title has been changed to "Performance levels".

TSO-C63d Comment Disposition

Comment Number	Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
43	Garmin	Pg 9 Para 1.3(a)(1) Para 1.3(a)(2) Para 1.3(a)(3)	1) should be (1)	Consistency	Change 1) 2) and 3) to (1) (2) and (3) respectively.	**Concur.** See comment 12.
44	Garmin	Pg 9 Para 1.3(a)(1)	Here and a couple other places NM or nm is used as an abbreviation for nautical mile. Either NM or nmi should be used consistently throughout the document	Consistency	Change all NM or nm to nmi	**Concur.** All references have been changed to nmi.
45	Garmin	Pg 9 Para 1.3(a)(1) Para 1.3(a)(2) Para 1.3(a)(3)	It is more intuitive to express a probability of false alarm as a detection case. Therefore the wording would be: The radar shall only 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 NM with a probability of 0.2 or greater.	This remains consistent with the probability of detection defined in the beginning of the paragraph. As opposed to defining a not false alarm probability you define a false alarm probability	Change wording in: 1.3(a)(1) 1.3(a)(2) 1.3(a)(3)	**Non-concur.** We do not believe the proposed wording is more intuitive. The current wording recommended by the ATDS WG for this TSO MPS is intuitive since it addresses the radar probability of "Must Indicate" and probability of "Must Not Indicate" requirements.

TSO-C63d Comment Disposition

Comment Number	Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
46	Garmin	Pg 10 Para 1.3(c)	"The ability of a radar to measure turbulence off the longitudinal axis is dependent on the antenna size and speed of the aircraft. " More elaboration on this seems necessary, (see recommendation)	Physics and measured data	Recommend putting a speed with this measurement. As any radar going fast enough would not be able to meet this spec. Measurements indicate that the turbulence should not be indicated at more than +/- 25 degrees for > 350 knots with a 12 inch antenna, for a class C aircraft.	**Partial concur.** We understand the comment rationale, but without further data on the relationship between off-axis turbulence detection vs. antenna size/ aircraft speed, we are unable address this comment.
47	Garmin	Pg 11 Para 1.4(a)(4)	1.4(a)(4) says to use reference 1 for a class A aircraft (what about B and C?)	Seems like classes B and C are ignored	We are not aware of any other published results for class B and C aircraft so it might as well just say to use reference 1 for all aircraft classes.	**Concur.** See TSO Appendix 1, paragraph 3.b., last sentence. Additionally, see comments 13 and 31.
48	Garmin	Pg 13 Para 1.4(c) bullet 2 subbullet 4	You cannot fly parallel to the X axis toward positive Y.	It is impossible	Based off the context it is assumed that it is meant parallel to the X axis toward positive **X**	**Concur.** Change was made to indicate "parallel to the X axis toward positive X".

TSO-C63d Comment Disposition

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49	Garmin	Pg 14 References section	The format of the references are wildly inconsistent	Inconsistency	Check references for consistent italicizing (titles, dates), representation of dates (Dec-05 or June 2009), quotations around paper/book titles (quotes or no quotes), Where the peoples names are (before the title or after), as well as punctuation (periods or commas)	**Concur.** Format was made consistent.

TSO-C63d Comment Disposition

Comment Number	Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
50	Boeing Commercial Airplanes	Page 2 Para. 3.a(2)	Proposed paragraph 3.a.(2) states: *"(2) Provide advanced indication of potentially hazardous turbulence conditions to assist pilots with turbulence avoidance decisions (Class A, B, and C)."*	An aircraft can encounter hazardous turbulence that is not detectable by weather radar. A note should be added to acknowledge that this requirement only applies to turbulence that is detectable by weather radar, and does not include clear air turbulence. Equipment Class C, as defined in Table 1 of the TSO, does not have turbulence detection capability.	It should be clarified that clear air turbulence is not detectable by the airborne weather radar (WXR). We suggest revising paragraph 3.a(2) as follows *"(2) Provide advanced indication of potentially hazardous turbulence conditions* ***detectable by WXR*** *to assist pilots with turbulence avoidance decisions (Class A, B,* ***and C****)."*	**Partial concur.** We have modified paragraph 3.a(2) by clarifying "Provide advanced indication of potentially hazardous turbulence conditions detectable by weather radar….." We did not include Equipment Class C as this class does not include specific ATDS MPS.

TSO-C63d Comment Disposition

Comment Number	Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
51	Boeing Commercial Airplanes	Page 2 Para. 3.b.	The proposed text states: *"**b. <u>Failure Condition Classifications</u>.** Malfunction of the function defined in paragraph 3.a of this TSO is a major failure condition.*	Typically, the installation methodology of a given system or other redundant systems is used to assess the hazard classification level and the overall effect of any single hazard.	We recommend that the Failure Condition Classifications section be removed and addressed at the aircraft installation level, not in the TSO. If retained, this proposed section should specifically state those failure conditions that result in a major classification as follows: The presentation of hazardously misleading weather information, unannunciated failure of the Predictive Windshear (PWS) function, and missed detectable windshear threat are considered a major failure classification.	**Partial concur.** See comment 8.

TSO-C63d Comment Disposition

Comment Number	Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
52	Boeing Commercial Airplanes	Page 2 Para. 3.b.	The proposed text states: *"**b. Failure Condition Classifications.** … Loss of the function defined in paragraph 3.a. of this TSO is a major failure condition."*	Typically, the installation methodology of a given system or other redundant systems is used to assess the hazard classification level and the overall effect of any single hazard. For weather, the crew can still obtain weather information from ground stations, pilot reports (PIREPS), and/or other approved weather sources on the airplane. For windshear, 14 CFR §121.358 compliance can be fulfilled by a reactive windshear system [e.g., Enhanced Ground Proximity Warning System (EGPWS) reactive windshear) and therefore the PWS feature of weather radar is not a required system, but rather an additional enhancement.	We recommend that the Failure Condition Classifications section be removed and addressed at the aircraft installation level, not in the TSO. If retained, the proposed statement should be revised as follows: *" … Loss of the function defined in paragraph 3.a of this TSO is a major **minor** failure condition."*	**Partial concur.** See comment 8.

TSO-C63d Comment Disposition

Comment Number	Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
53	Boeing Commercial Airplanes	Page 4 Para. 5.a(1)	The proposed text states: *"(1) … Weather radar manufacturers shall include expected Radome performance for the electromagnetic signals passing through it."*	Our suggested revision will help provide guidance to where the radome requirements can be found and help provide commonality to applicants expected radome performance inclusions. [Our recollection is that the FAA, at one point, required suppliers to test their PWS systems with a DO-213 Radome Class one class below the intended certification installation to ensure adequate performance after radome degradation due to repairs and/or normal wear. If that is the case, it should be clearly stated. We were not able to find this specific requirement in regulatory documentation to date.]	We recommend revising the text as follows: *"(1) … Weather radar manufacturers shall include expected Radome performance for the electromagnetic signals passing through it* ***(reference DO-213 for radome performance information)****."* The TSO revision should include any DO-213 Radome Class requirements for supplier validation of PWS.	**Concur.** We have revised paragraph 5.a as recommended.

TSO-C63d Comment Disposition

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54	Boeing Commercial Airplanes	Page 7 Paras. 6.c. and 6.d.	Paragraph 6. lists manufacturer data requirements for review by the responsible AC. The list includes: *"c. Schematic drawings.* *d. Wiring diagrams."*	This is apparently a duplicate request for information.	Paragraphs 6.c. and 6.d. are already included in the requirements found in paragraph 5.a., which lists application data requirements, specifically: *"(6) Schematic drawings, wiring diagrams, and any other documentation necessary for installation of the airborne weather radar."* We therefore recommend removing paragraphs 6.c and 6.d.	**Non-concur.** The wording will remain the same. The language is taken from the TSO boilerplate.
55	Boeing Commercial Airplanes	Page 7 Para. 6.h.	The text states: *"h. If the article includes complex custom as airborne electronic hardware, …"*	Editorial comment: apparent typo.	The text should be revised as follows: *"h. If the article includes complex custom **as** airborne electronic hardware, …"*	**Concur.** See comment 23.

TSO-C63d Comment Disposition

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56	Boeing Commercial Airplanes	Page 9 Appendix 1 Paras. 1.3(a)1), 2), and 3)	Example: Paragraph 1.3(a)1) states, *"1) Level 1 - The radar shall indicate turbulence that corresponds to a standard deviation of aircraft g-load excursions of 0.3g with reflectivity ≥ 20 dBZ at a minimum of 12 nautical miles (NM) with a probability of 0.85. The radar shall not indicate turbulence that corresponds to a standard deviation of aircraft g-load excursions of 0.1g with reflectivity ≥ 20 dBZ at a minimum of 12 NM with a probability of 0.8 or greater."*	Prior white papers on this subject had statements similar to those we have suggested. We question whether this is an oversight or an intended change. If it is intended, then we suggest there be an explanation for the change.	We question if the text should be revised as follows: *"1) Level 1 - The radar shall indicate turbulence that corresponds to a standard deviation of aircraft g-load excursions of ≥ 0.3g with reflectivity ≥ 20 dBZ at a minimum of 12 nautical miles (NM) with a probability of 0.85. The radar shall not indicate turbulence that corresponds to a standard deviation of aircraft g-load excursions of ≥ 0.1g with reflectivity ≥ 20 dBZ at a minimum of 12 NM with a probability of 0.8 or greater."* The same question applies to the equivalent values in paragraphs 1.3(a)2) and 1.3(a)3).	**Non concur.** No change made. These turbulence performance requirements were recommended by the Industry ATDS WG for this TSO MPS. These requirements are consistent with the detection performance criteria in Table A1 of the TSO. As proposed by the commenter, the "Must Indicate" requirement > 0.3g RMS is open ended since it does not specify an upper limit. If RMS-g in the "Must Indicate" requirement is increased (e.g., to 0.5g RMS or higher) relative to a given turbulence threshold, the Missed Indication error will shrink toward 0 (no Missed Indication error, and this is not possible for a pulse radar). For "Must Indicate" minimum performance requirement, 0.3g RMS was conservatively chosen as the lower limit of severe turbulence for Aircraft Class 1 (ATDS WG, referenced NASA/CR-2009-215769). The applicant may wish to provide detection and display of the turbulence level that is established based on somewhat higher than 0.3g RMS (e.g. 0.34g) which exceeds the requirement. As proposed by the commenter, the "Must Not Indicate" requirement > 0.1g RMS is not correct. For example, use 0.4g RMS for "Must Not Indicate" will conflict with the "Must Indicate" requirement ≥ 0.3g RMS as proposed by the commenter. The "Must Not Indicate" requirement with < 0.1g RMS is open ended since it does not specify lower limit. We don't want specifying = 0g (no turbulence). We also don't want specifying < 0.1g RMS (e.g., 0.01g, 0.05g) since we don't want to address the very light turbulence events that are not consequential to the aircraft, and the radar sensor produces nuisance indications with "little bumps" that will impact credibility of the sensor and the pilots will finally ignore. For the "Must Not Indicate" requirement, 0.1g RMS was rigorously chosen for "Must Not Indicate" requirement (ATDS WG, referenced NASA/CR-2009-215769). If RMS-g in the "Must Not Indicate" requirement is decreased (e.g., to 0.05g or less) relative to a given turbulence threshold, the Nuisance Indication error will shrink toward 0 (no Nuisance Indication error, and this is not possible for a pulse radar). Furthermore, if the mean 0.1g is reduced to 0.05g, the radar detection error would be about the same as the detected turbulence measurement (Referenced NASA/CR-2009-215769), this is underperforming radar.

TSO-C63d Comment Disposition

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57	Boeing Commercial Airplanes	Page 10 Appendix 1 Para. 1.3(e)	The proposed paragraph states that the probability of an un-annunciated failure in the radar turbulence function shall be ***10-5***, *or less, per flight hour of system operation.*	We question whether this a typo or a new decision made between revisions of the MOPS? Please clarify.	We note that all prior versions of the minimum operational performance standard (MOPS) were ***10-3***.	
58	Boeing Commercial Airplanes	Page 10 Appendix 1 Para. 1.4.	The proposed text stated: *"**1.4. TESTS.** A combination of statistical analysis and simulation is acceptable to demonstrate compliance with the requirements of this TSO. …"*	Suggestion for clarification.	We recommend revising the text as follows: *"1.4. TESTS. A combination of statistical analysis and simulation is acceptable to demonstrate compliance with the requirements of **Appendix 1 of** this TSO."*	**Concur.** Changes made per recommendation.
59	Boeing Commercial Airplanes	Page 11 Appendix 1 Para. 1.4(b)(1)	The proposed text states: *"(1) The manufacturer shall demonstrate system performance, defined in Table A1, by simulating radar signals returned from specific weather models. …"*	Suggestion for clarification.	We recommend revising the text as follows: "(1) The manufacturer shall demonstrate system performance, defined in Table A1, by simulating radar signals returned from specific weather models ***[reference paragraph 1.4.(b)(3) of this Appendix]***. …"	**Concur.** Changed per recommendation.

TSO-C63d Comment Disposition

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60	Boeing Commercial Airplanes	Page 12 Appendix 1 Para. 1.4(b)(3)	The proposed text states: *"(3) The radar simulations used for the demonstration in 1.4(b) 1) shall be ..."*	Editorial comment: apparent typo.	In the paragraph reference, there is a missing. It should state: " … 1.4(b)(1) … "	**Concur.** Changed per recommendation.
61	Boeing Commercial Airplanes	Page 13 Appendix 1 Para. 1.4(f)	The proposed text states: *"1.4(f) ... and within 2 km of the peak of the aircraft radar observable truth field as defined in 1.4.2(e). ..."* Currently says, "….truth field as defined in 1.4.2(e)…"	Editorial comment: apparent typo.	There is a typo in the paragraph reference. It should state: *"...truth field as defined in **1.4(e).** ..."*	**Concur.** See comment 17.
62	Boeing Commercial Airplanes	Page 13 Appendix 1 Paras. 1.4(i) and 1.4(j)	Paragraphs 1.4(i) and 1.4(j) in Appendix 1 are repeats of 1.4(f) and 1.4(g), respectively.	Editorial comment: duplicate .	We recommend deleting Paragraphs 1.4(i) and 1.4(j).	**Concur.** See comments 18 and 19.
63	Boeing Commercial Airplanes	Page 15 Appendix 2 Para. 3	The proposed text states: ***"3. Paragraph 2.2.2.5 –*** *Manufacturers providing radar systems using modulation techniques which decouple pulse length from range resolution shall ensure that the range resolution."*	Editorial comment - missing information.	The statement appears to be incomplete. It should be revised to fully state what is intended.	**Concur.** See comment 20.