AC 20-WXR, Airworthiness Approval for Aircraft Weather Radar Systems
(Public Coordination) Comment Matrix

	Commenter/ Organization	Comment Summary	Proposed Resolution	Disposition
1.	Embraer	In regards to item 7(b)(1) [Ground and Flight Test]: Not all modifications on the windshear detection computers, software and radar transmitter units should require both ground and flight tests. Depending on the modification, only ground tests should suffice. Suppose, for instance, an obsolescence issue for a certain passive electronic component (e.g.: a resistor), which gives rise to a minor modification on the radar transmitter unit. It does not seem reasonable that such a small modification should lead to a flight test. Another example would be a minor software modification that corrects the format of a display annunciation. Or some other software modification that corrects maintenance messages. In the end, there are a plethora of situations that do not substantiate the need to perform flight tests. Embraer believes that only major modifications should require both ground and flight tests. Also, the text *"(c)onduct ground and flight tests for (…) combinations which could change the windshear detection capability"* might induce the reader to think that any sort of software modification would require both ground and flight tests, since any sort of software modification could, theoretically and inadvertently, change the windshear detection capability (and that is why one approaches civil airborne software certification through Design Assurance Levels [DAL] and its correspondent designed processes). Therefore, it would be best if the text could be more assertive, to not lead to this sort of wide interpretation.	To change the text passage: *Conduct ground and flight tests for new or modified windshear detection computers, software, radar transmitter units, and radome antenna combinations which could change the windshear detection capability.* Into: *Conduct ground and flight tests for new windshear detection computers, software, radar transmitter units, and radome antenna or any major modification of these components or any sort of combination which changes the windshear detection capability.* *Other modifications that are not deemed as major must be subjected to analysis or simulations or bench tests, as applicable.*	**Accepted.** Agree that simulation, analysis, laboratory tests, ground and flight tests may be conducted, as appropriate, for the aircraft windshear system. The intent of § 7(b)(1) was to address ground and flight tests for each initial installation or when major modification of the aircraft windshear radar system was done in such a manner that changed the detection capability and performance. Revised § 7.b to address the TSO installation instructions providing installed windshear performance considerations, and installation test of the forward looking windshear function often relies on general weather radar functional test and integration test. The referenced advisory materials in § 7.a provide general guidance on testing and analysis for the initial installation or modification to the radar system. Revised § 7.b to read: "**Forward-Looking Windshear Detection.** Follow the TSO installation instructions to verify performance of the forward looking windshear function. Installation testing of the forward looking windshear function often relies on general weather radar functional testing, as described in paragraphs 7 and 7.a. of this AC, and integration testing, versus dedicated forward looking windshear flight testing." Deleted § 7(b)(1) and renumbered §§ 7(b)(2) and 7(b)(3).

2.	Embraer	In regards to item 7(b)(2) [Penetration Flight Test]: Means of compliance should also consider a combination of analysis and simulation depending on the airborne weather radar equipment qualification and its correspondent aircraft system installation. Demonstration only through flight testing would create an unreasonable burden to the aircraft OEM, since adequate performance can be demonstrated through other means, as in the case of the FAA TSO-63d, which accepts analysis and simulation. Penetration flight test may be one mean of compliance, but not the only mean. As for flight testing: the FAA itself has recognized the hazardous potential of the penetration flight test, when it wrote down: *"(f)lying in or near storm cells can be extremely hazardous."* Therefore, if such a test is indeed necessary, it is best to minimize the occurrence of it to the necessary minimum. Thus, if it cannot be avoided, penetration flight test should be performed only for the first-time installation approval on an aircraft. First-time installation approval should serve as a basis for subsequent installation approvals on the same type of aircraft and also for other aircraft types.	To change the text passage: *(2) Penetration Flight Test. Verify the forward-looking windshear detection capability by flying in areas of convective activity. Verify the forward-looking windshear performance using Terminal Doppler Weather Radar (TDWR), or equivalent. Onboard measurements are also an acceptable validation method, if these measurements represent the actual (un-biased) windshear conditions. Flying in or near storm cells can be extremely hazardous. It is important for flight crews to exercise good judgment based on knowledge of their own abilities and of the capability of the aircraft when considering approaching or penetrating any storm cell or turbulent area.* Into: *(2) Penetration Flight Test. The forward looking windshear detection capability can be verified by a combination of analysis or simulation or by flight testing.* *If the applicant chooses to perform flight test, the first-time installation approval will serve as a basis for subsequent installation approvals on the same type of aircraft and also for other aircraft type installations. In order to assure that subsequent installation approvals may take credit from previous installation approvals, the following assessments must be made:* *a. Analyze the radome characteristics and make sure it meets the airborne weather radar equipment manufacturer requirements (reference RTCA DO-213: Minimum Performance Operational Standards for Nose-Mounted Radomes, dated January 14, 1993, for radome performance information).* *b. Make sure that the weather radar unit that was subject to the first-time installation approval is equivalent to the one from the subsequent installation.*	**Accepted.** It is acceptable to use previously approved test data generated during the TSO authorization, previous certification effort, or flight evaluation data to satisfy the penetration flight requirement, instead of an FAA flight test. Changed paragraph 7.b.(2) and renumbered as 7(b)(1) to read: "**(1) Penetration Flight Evaluation.** Penetration flights will typically be accomplished by the radar manufacturer as part of the TSO authorization. If penetration data and analysis is available and you determine it is applicable, you do not need to conduct penetration flight tests. Previously approved test data generated during the TSO authorization or previous certification effort is acceptable. If the forward-looking windshear capability has not been previously demonstrated, then the detection capability of the forward-looking windshear system must be verified by flying in areas of convective activity that can be verified by in-situ measurements, appropriate ground based radar systems, or equivalent. **Note:** Flying in or near storm cells can be extremely hazardous. Flight crews should exercise good judgment for safe flight based on knowledge of their own abilities and of the capability of the aircraft when considering approaching or penetrating any storm cell or turbulent area." (See disposition to comments 12, 14, 28, and 36.)

2.	Embraer		*c. Make sure that the Doppler-radar detection algorithms and implementation from the first time installation approval is equivalent to the one from the subsequent installation.* *d. Make sure that the transmitter/receiver radio from the first-time installation approval is equivalent to the one from the subsequent installation.* *e. Verify that the aircraft that was the test bed for a first-time installation approval is on the same class of the one subject to subsequent installation approval.* *f. For the purpose of this AC, the word "equivalent" means the same functionality and design of the first-time installation approval save for some minor changes, if applicable.* *If the applicant chooses to perform flight test, for first-time installation approval, verify the forward-looking windshear detection capability by flying in areas of convective activity. Verify the forward-looking windshear performance using Terminal Doppler Weather Radar (TDWR),or equivalent. Onboard measurements are also an acceptable validation method, if these measurements represent the actual (un-biased) windshear conditions. Flying in or near storm cells can be extremely hazardous. It is important for flight crews to exercise good judgment based on knowledge of their own abilities and of the capability of the aircraft when considering approaching or penetrating any storm cell or turbulent area.*	

3.	Embraer	In regards to item 7(c) [Turbulence detection]: The same reasoning for item 7(b)(2) applies here. Means of compliance should also consider a combination of analysis and simulation depending on the airborne weather radar equipment qualification and its correspondent aircraft system installation. Demonstration only through flight testing would create an unreasonable burden to the aircraft OEM, since adequate performance can be demonstrated through other means, as in the case of the FAA TSO-63d, which accepts analysis and simulation. Turbulence detection flight test may be one mean of compliance, but not the only mean. Flying in turbulent environments may create some unintended hazards (e.g.: inadvertent increase of the angle of attack, with an inadvertent stick-pusher activation) and therefore, it should be avoided. However, if such a test is indeed necessary, it is best to minimize the occurrence of it to the necessary minimum. Thus, if it cannot be avoided, turbulence detection flight test should be performed only for the first-time installation approval on an aircraft. First-time installation approval should serve as a basis for subsequent installation approvals on the same type of aircraft and also for other aircraft types.	To change the text passage: *c. Turbulence Detection. Conduct flight tests to demonstrate the turbulence detection function for each initial installation or follow on installation on different aircraft types. Make a reasonable attempt to evaluate the turbulence detection functionality during actual flight test. Penetration flights into areas where turbulence is indicated by radar are not recommended.* Into: *(2) Turbulence Detection. The turbulence detection capability can be verified by a combination of analysis or simulation or by flight testing.* *If the applicant chooses to perform flight test, the first-time installation approval will serve as a basis for subsequent installation approvals on the same type of aircraft and also for other aircraft type installations. In order to assure that subsequent installation approvals may take credit from previous installation approvals, the following assessments must be made:* *a. Analyze the radome characteristics and make sure it meets the airborne weather radar equipment manufacturer requirements (reference RTCA DO-213: Minimum Performance Operational Standards for Nose-Mounted Radomes, dated January 14, 1993, for radome performance information).* *b. Make sure that the weather radar unit that was subject to the first-time installation approval is equivalent to the one from the subsequent installation.* *c. Make sure that the Turbulence Detection and Display algorithms and implementation from the first-time installation approval is equivalent to the one from the subsequent*	**Accepted.** Revised § 7.c to address the TSO installation instructions providing installed turbulence performance considerations, and installation test of the turbulence function often relies on general weather radar functional test and integration test. Similar methods can be used to demonstrate aircraft radar detection of turbulence or weather hazard (e.g., hail, lightning). Changed paragraph 7.c to read: "**c. Turbulence Detection or Weather Hazard Awareness.** Follow the TSO installation instructions to verify performance of turbulence detection or weather hazard awareness functions. Weather hazard awareness functions could include, but are not limited to, hail and lightning awareness. Installation testing of these functions often relies on general weather radar functional testing, as described in paragraphs 7 and 7.a. of this AC, and integration testing, versus dedicated flight testing. You should attempt to evaluate the performance of these functions against operationally significant weather when weather is reasonably available and you can do so without placing the aircraft in the hazardous weather. This performance evaluation should ensure the depiction of turbulence or weather hazard is consistent with the actual weather phenomenon."

3.	Embraer		*installation.* *d. Make sure that the transmitter/receiver radio from the first-time installation approval is equivalent to the one from the subsequent installation.* *e. Verify that the aircraft that was the test bed for a first-time installation approval is on the same class of the one subject to subsequent installation approval.* *f. For the purpose of this AC, the word "equivalent" means the same functionality and design of the first-time installation approval save for some minor changes, if applicable.* *If the applicant chooses to perform flight test, for first-time installation approval, conduct a flight test to demonstrate the turbulence detection function. Make a reasonable attempt to evaluate* *the turbulence detection functionality during actual flight test. Penetration flights into areas where turbulence is indicated by radar are not recommended.*	
4.	Boeing	Page 2 Section 4 (General), paragraph a. *The meaning of the weather radar system displays* (for example, display format, colors, labels, data formats, and interaction with other display parameters) should be clear and unambiguous. The current wording could lead to confusion as to whether this is a weather radar requirement or a displays requirement.	Suggest clarification similar to as follows, "*The expected pilot response to data provided by the weather radar system* (for example, display format, colors, labels, data formats and interaction with other display parameters) should be clear and unambiguous."	**Accepted.** The term weather radar system display in paragraph 4.a refers to the radar display whose primary function is to show weather radar system information to the flight crew. The paragraph is changed as follows: The display of weather radar alerts, graphical depictions of weather or hazard, and the expected flight crew response to information provided by the weather radar system (for example, display format, colors, labels, data formats and interaction with other display parameters) should be clear and unambiguous.

5.	Boeing	Page 3 Section 4 (General), paragraph e, Note. Note: AC 20-68B, Recommended Radiation Safety Precautions for Ground Operation of Airborne Weather Radar, provides information on radar hazards and determining minimum safe distances. Boeing recommends updating this to a more recent standard as AC 20-68B does not include the most recent MPEL. IEEE standard, C95.1 and/or FCC document OET Bulletin 65 are more current and relevant.	Note: IEEE standard C95.1, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz" and Federal Communications Commission OET Bulletin 65, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", provide information on radar hazards and determining minimum safe distances.	**Accepted.** Revised paragraph 4.e to read: "You must document any areas where radar emissions could be harmful to people or wildlife. The following three standards provide acceptable guidelines for safe radar operation and determining minimum safe distances: (1) AC 20-68B, *Recommended Radiation Safety Precautions for Ground Operation of Airborne Weather Radar*. (2) IEEE standard C95.1, *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*. (3) Federal Communications Commission OET Bulletin 65, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields.*"
6.	Boeing	General Comment Multiple paragraphs in sections 4, 5 and 6. Throughout the document, the term 'ensure' is used but not defined in section 1(b) on page 1 of the document. It is unclear as to the intent of the requirements with 'ensure' included. Please either define 'ensure' in section 1(b) or change each 'ensure' in the document to 'must', 'should' or 'recommend' as appropriate.	Update section 1(b) on page 1 to define the intent of 'ensure' OR replace all requirement instances of 'ensure' with 'must', 'should' or 'recommend' as appropriate.	**Accepted.** Added "You should" or "You must" at the beginning of each "Ensure" statement as appropriate. For example: "You must ensure all of the aircraft's alerts are prioritized."
7.	Boeing	Page 3 Section 5 (Airborne Doppler Weather Radar Systems with Forward-Looking Windshear Detection), paragraph a(2). *Ensure* the forward-looking windshear function is capable of automatic activation no later than the start of the takeoff roll to allow timely takeoff abort, unless the automatic function is disabled by the flight crew. 'Start of takeoff roll' is somewhat ambiguous and may not be required in certain applications. Boeing believes the key is being able to prove your given activation scheme meets the intent of the requirement, which is to allow timely takeoff abort.	Recommended Change: "*The applicant should show* the forward-looking windshear function is capable of automatic activation to allow timely take-off abort, unless the automatic function is disabled by the flight crew."	**Accepted.** Revised paragraph 5.a(2) to read: "You must ensure the forward looking windshear function automatically activates for takeoff so that timely takeoff warnings are provided."

8.	Boeing	Page 4 Section 5 (Airborne Doppler Weather Radar Systems with Forward-Looking Windshear Detection), paragraph b(2). Ensure the system *provides* windshear alerts from ground level to 1200 feet above ground level (AGL). Clarification requested to ensure it is acceptable for operators to inhibit alerts at some altitudes below 1200 feet.	Recommended Change: "Ensure the system *is capable of detecting* windshear alerts from ground level to 1200 feet above ground level (AGL)."	**Accepted.** Changed the sentence to read: "You must ensure the system is capable of detecting windshear alerts from ground level to 1200 feet above ground level (AGL)."
9.	Boeing	Page 4 Section 5 (Airborne Doppler Weather Radar Systems with Forward-Looking Windshear Detection), paragraph c(1). During takeoff, the system must be able to inhibit aural and visual alerts at a specified aircraft speed prior to rotation and re-enable the alerting capability after liftoff. Set the takeoff alerting inhibits per installation manual instructions and ensure the inhibits coincide with aircraft type specific takeoff alert inhibit criteria. Aural messages which are currently being annunciated during the transition between <1200 ft AGL and >1200 ft AGL should not be cut-off.	Add the word "new" as follows: "During takeoff, the system must be able to inhibit *new* aural and visual alerts at a specified aircraft speed prior to rotation and re-enable the alerting capability after liftoff. Set the takeoff alerting inhibits per installation manual instructions and ensure the inhibits coincide with aircraft type specific takeoff alert inhibit criteria."	**Accepted.** Revised paragraph 5.c(1) to read: "During takeoff, the system must be able to inhibit all new aural and visual alerts at a specified aircraft speed prior to rotation and re-enable the alerting capability after liftoff. Set the takeoff alerting inhibits per installation manual instructions and ensure the inhibits coincide with aircraft type specific takeoff alert inhibit criteria."
10.	Boeing	Page 4 Section 5 (Airborne Doppler Weather Radar Systems with Forward-Looking Windshear Detection), paragraph c(2). During final approach, ensure the system aural and visual alerts are inhibited from 50 feet AGL until touchdown. Ensure the systems automatic range scaling prevents annunciation of a windshear threat beyond the touchdown zone. Aural and Visual message for alerts already in place prior to entering the inhibit region should remain on the display and the aural should go to completion.	Add the words "all new" as follows: "During final approach, ensure *all new* system aural and visual alerts are inhibited from 50 feet AGL until touchdown. Ensure the systems automatic range scaling prevents annunciation of a windshear threat beyond the touchdown zone."	**Accepted.** Clarified the first sentence paragraph 5.c(2) to read: "During final approach, you must ensure all new system aural and visual caution and warning alerts are inhibited from 50 feet AGL until touchdown."

11.	Boeing	Page 5 Section 5 (Airborne Doppler Weather Radar Systems with Forward-Looking Windshear Detection), paragraph c(3). Ensure all aural and visual alerts are inhibited above 1200 feet AGL. Aural messages which are currently being annunciated during the transition between <1200 ft AGL and >1200 ft AGL should not be cut-off.	Add the word "new" as follows: "Ensure all *new* aural and visual alerts are inhibited above 1200 feet AGL."	**Accepted.** Clarified the sentence to read: "You must ensure all new aural and visual alerts are inhibited above 1200 feet AGL."
12.	Boeing	Page 7 Section 7 (Test and Evaluation), paragraph b. Forward-Looking Windshear. The initial airworthiness certification of a TSO'd system must include ground test, flight test, penetration flight test, and clutter suppression flight test. Follow-on type certification must accomplish the ground test and flight test. Penetration and clutter suppression tests are not required on follow-on airworthiness approvals unless changes to the radar system are major. It should be made clear that penetration flight test and other hazardous testing or testing which cannot be reasonably conducted on a production aircraft, can be conducted by the radar manufacturer during flight test demonstrations/evaluations provided the results can be shown to be applicable to the installation configuration under consideration.	Boeing recommends adding clarity to the last statement as follows, *"Certification Credit on airplane installations for penetration, clutter suppression and other potentially hazardous flight test evaluations can be claimed from the initial airworthiness certification of the TSO testing and are not required to be demonstrated during airplane flight test evaluation of the WXR installation."*	**Accepted.** See disposition to comment 2.
13.	Boeing	Page 7 Section 7 (Test and Evaluation), paragraph b(1). Conduct ground and flight tests for new or modified windshear detection computers, software, radar transmitter units, and radome antenna combinations which could change the windshear detection capability. Methods other than direct Ground AND Flight test have proven to be sufficient in some situations. It should not be mandated that ground AND flight test by the OEM are required for all levels of change to the windshear system.	Recommend change as follows: "*Analysis, Simulation, Lab test, ground test or flight test should be conducted* for new or modified windshear detection computers, software, radar transmitter units, and radome antenna combinations which could change the windshear detection capability."	**Accepted.** See disposition to comment 1.

14.	AIRBUS	Comment on sub-section 7.b Forward-Looking Windshear This subsection defines ground and/or flight tests for the forward-looking windshear applicable to the applicants under TC, STC, ATC or ASTC process. The requested tests can be performed by the A/C manufacturer and/or the WXR supplier, as identified in FAA interim certification document SLR 10.2.	It should be clarified in this paragraph that the requested ground and/or flight tests could be shared between the A/C manufacturer and the WXR supplier and that credit from the test activities performed with the frame of TSO-C63 approval could be claimed by A/C manufacturer when relevant.	**Accepted.** See disposition to comment 2.
15.	AIRBUS	Comment on Sub-section 7.b (1) Ground and Flight Tests Ground and flight tests are requested *"for new or modified windshear detection computers, software, radar transmitter units and radome antenna combinations which could change the windshear detection capability"*. Laboratory tests and/or analysis may be sufficient for such verification and validation activities. This is for example the case for the verification of radome/antenna integration.	Laboratory tests and analysis should be referred to in the paragraph as an acceptable means for compliance demonstration.	**Accepted.** See disposition to comment 1.
16.	AIRBUS	Comment on sub-section 9. b *"All repair to radomes, no matter how minor, should return the radome to its original condition, both electrically and structurally"*. It is not possible that the radome will come back after repair to its original condition (especially considering that we certify Class A Radome, instead of Class C required, to take into account Radome repairs and ageing).	Modify Sub-section 9.b as follows: *"All repair to radomes, no matter how minor, should return the radome* **to the minimum performances required for radar predictive windshear operation".**	**Accepted.** All repairs to radomes should return the radome to the minimum performances required for the operation of the aircraft weather radar system (weather and ground mapping, forward-looking windshear, and turbulence detection). Changed the sentence to read: "All repair to radomes, no matter how minor, should return the radome to the minimum performances required for aircraft weather radar system operation."
17.	Honeywell	Section 4.b, 2nd sentence: repeated words, "in the".	Revise as follows: Ensure the use of color for display of weather radar system information follows the guidance in the ~~in the~~ latest revisions of the following ACs…	**Accepted.** Changed the sentence as commented.
18.	Honeywell	Section 4.d.: grammar	Revise as follows: Ensure the weather radar system does not adversely affect the functioning of, ~~or be~~ and is not adversely affected by, other aircraft systems.	**Accepted.** Changed the sentence as commented.

19.	Honeywell	Section 4.e, Note: Determination of minimum safe distance.	Consider also listing IEEE Std C95-1 as a source. General consensus from the OEMs in attendance at the SC-230 Plenary meeting indicated a preference for using the IEEE standard.	**Accepted.** See disposition to comment 5.
20.	Honeywell	Section 4.g This implies that it is hazardous to turn the radar on while taxiing, because marshalers or tug operators may be in close proximity to the radome. This may be true at the gate or on the ramp, but there should not be such a concern when on the taxi-way.	Clarify. Having the radar operate while on the taxi-way should not cause concern. The only concern may be at the gate or on the ramp.	**Accepted.** Clarified the last sentence in paragraph 4.g to read: "A hazard assessment should be done for the automatic activation feature of the forward-looking windshear function taking this type of operation or any automatic ground activation feature of the windshear function into account."
22.	Honeywell	Section 5.a.(2). If auto-activation can be disabled by the flight crew, then what is the point of auto-activation?	Consider removing the phrase, "unless the automatic function is disabled by the flight crew."	**Not accepted.** Flight crews often do not turn on the radar manually unless they are concerned about a specific weather threat. The auto-activation feature ensures valuable alerting is available. Allowing the flight crew to disable the auto-activation provides flexibility.
23.	Honeywell	Section 5.b.(1), 1st sentence: missing word	Revise as follows: "…and the guidance in the latest revision of the following ACs…"	**Accepted.** Changed the sentence as commented.
24.	Honeywell	Section 5.b.(1) (d) and Section 5.b.(1) (e): This section is on windshear alerting. Section 1.a specifically excludes windshear detection for rotorcraft, so it is not appropriate to list the rotorcraft ACs here.	Delete 5.b.(1) (d) and 5.b.(1) (e)	**Accepted.** Deleted 5.b.(1) (d) and 5.b.(1) (e).
25.	Honeywell	Section 5.b.(4)(c): TSO-C63 does not directly define the windshear threat area. That is defined in the MOPS (DO-220) called out by the TSO. Is it okay to have that sort of indirect reference in the AC?	Question only – no action needed if indirect references are okay. If not, then consider directly referencing DO-220.	**Not accepted.** The TSO invokes DO-220. Referencing the TSO in paragraph 5.b.(4)(c) is appropriate.
26.	Honeywell	Section 5.c.(2). This is really two requirements. Also, the second part (range scaling requirement) is already covered in DO-220, which is required by the TSO. It would be difficult to test at the aircraft level, and has already been confirmed as part of the TSO/MOPS testing.	Delete the second sentence of 5.c.(2).	**Accepted.** Deleted the second sentence of paragraph 5.c.(2).

27.	Honeywell	Section 5.e.(5): Missing words.	Revise as follows: If other windshear symbology is used, you must demonstrate that this symbology provides a clear and substantial benefit to the flight crew.	**Accepted.** Changed the sentence as commented.
28.	Honeywell	Section 7.b. requires a penetration flight test for initial airworthiness certification. This will require either 1. the OEM to fly their new airplane through windshear, which may be extremely impractical, expensive, and unsafe, or 2. the manufacturer to obtain an STC on their test airplane. This is, again, expensive and of dubious added value. We agree that the indicated testing should be performed, but disagree that it should have to be done under a TIA.	Consider allowing manufacturer's flight evaluation data to be used to satisfy the penetration flight requirement, instead of requiring an FAA flight test.	**Accepted.** See disposition to comment 2.
29.	Honeywell	Appendix A, Note 1: missing word	Revise as follows: "…icon is provided as a weather hazard position indication and…"	**Accepted.** Changed the sentence as commented.
30.	Honeywell	Section 9.b and Appendix B-2: Should RTCA/DO-213 be referenced?	Consider adding references to RTCA/DO-213.	**Accepted.** Added references to RTCA/DO-213 as followed: If you are repairing or replacing the radome in conjunction with the radar installation refer to the latest revisions of AC 43-14, *Maintenance of Weather Radar Radomes*, and RTCA/DO-213, *Minimum Operational Performance Standards for Nose-Mounted Radomes*, for additional information.

31.	Dassault Aviation	Subject: Table 1 Appendix A (called in §5.b (3)) As encounter with a windshear event is rare, the aural alerts shall be clearly explicit and understandable by the crew. Additionally predictive windshear caution alert occurs in final approach phase (< 1200 ft AGL) with high work load, one way of directly informing the crew of the nature of the threat could be an aural containing the “windshear” keyword.	The word “windshear” shall be allowed in the aural Caution PWS alert (Appendix A Table 1) "Caution Windshear" may be proposed as an example of Caution Audio alert in the Table 1 (Appendix A).	**Not accepted.** The forward-looking windshear aural caution alert results in chime or message, for example “Monitor Radar Display”, not containing the words caution windshear. The caution alert is provided for a detected windshear located outside the windshear warning alert region, i.e. a detected windshear beyond the range or off to the side of the aircraft flight path such that the threat is not immediate. Unlike the aural warning alert, which is provided with a voice that says “Go-around Windshear Ahead” once for approach and go-around, and “Windshear Ahead” twice for takeoff roll and climb, the aural caution alert does not contain the word windshear since the threat is not immediate. The caution alert requires immediate flight crew awareness and the flight crew has time to evaluate the hazard by monitoring radar display, whereas the warning alert requires immediate corrective action by the flight crew. In past forward-looking windshear certification programs, the FAA has accepted chime or message, not containing the word windshear for forward-looking windshear aural caution alert. Service experience has indicated that this aural caution alert works, and meets human factor considerations.

32.	Dassault Aviation	Subject: Table 1 Appendix A (called in §5.b (3)) Windshear alert occurs during high workload phase and requires from the crew a quick understanding. When the predictive warning and reactive warning alerts are issued, the same operational procedure is recommended to the crew. In order to have consistency between windshear alerts and associated operational procedures, play the same aural for the predictive warning and reactive warning alerts shall be allowed.	"Windshear Windshear" or “Warning Windshear” should be proposed as Warning Aural alert in the Table 1 (Appendix A).	**Not accepted.** The forward-looking windshear aural warning alert is provided with a voice that says “Go-around Windshear Ahead” once for approach and go-around, and “Windshear Ahead” twice for takeoff roll and climb. The forward-looking windshear warning alert is provided for a detected windshear threat before the actual encounter. The forward-looking windshear system does not provide escape guidance information to the pilot. The reactive windshear aural warning alert is provided with a voice that says “Windshear Windshear” or “Warning Windshear”. The reactive windshear warning alert is provided once a windshear is encountered. The windshear warning and escape guidance system provides the pilot with timely warning and adequate flight guidance for the escape maneuver. In past forward-looking windshear certification programs, the FAA has accepted forward-looking windshear aural warning alert as described in appendix A, table 1. Service experience has indicated that this aural warning alert works, and meets human factor considerations.

33.	Dassault Aviation	Subject: §5.b (5) In case of an integrated dual windshear detection capability installed (reactive function and predictive function), two types of failure alerting could be considered: - Only one windshear detection capability is failed : because the other capability is still available, such failure does not necessarily need to have a dedicated annunciation directly visible to crew but could be signaled as a lower level of service available, allowing crew to access further details of failure in a dedicated interface, if needed. - Both windshear detection capabilities are failed (reactive and predictive): in such case, an adequate annunciation directly visible to crew would be justified to properly alert the crew.	The §5.b (5) shall be adapted in order to consider this type of installation to adequately signal the possible different levels of degradation of the integrated windshear detection capability, and not directly expressing dedicated requirements on a particular mode of the overall system.	**Accepted.** The AC language does not prevent the integration of predictive and reactive windshear failure annunciations you describe. For clarification, the term windshear detection system is changed to windshear detection capability. Clarified §5.b (5) to read: "(5) You must ensure the annunciation of the failure of the windshear detection capability is readily visible to the flight crews from their normal seated position on the flight deck."
34.	Bombardier Aerospace	5(d)(1) calls for prioritization of alerts with TSO-C151c being cited as an acceptable example. 5(d)(2) states that reactive windshear system caution alerts must be disabled where a predictive windshear system is also installed. It is not clear why this function should be disabled when TSO-C151c prioritizes a PWS Caution over an RWS Caution anyway. We see a benefit in retaining the RWS caution alerting function in the event of failure of the PWS system, while prioritization of the PWS Caution will ordinarily override the RWS Caution and avoid confusing messaging. The justification for superseding the alert prioritization of 5(d)(1) should be referenced in the AC.	Clarify reasoning behind need to disable RWS Caution in 5(d)(2) instead of simply using the prioritization scheme in TSO-C151C.	**Acknowledged.** When the forward-looking windshear warning alert is annunciated, often time the reactive windshear caution alert is annunciated at a similar time, or there is overlap between the two alerts, which could cause confusion. Thus the reactive caution must be disabled on aircraft with a forward-looking system. The AC language does not prevent issuing a reactive windshear caution alert when the forward-looking windshear system is inoperative. The following text is added to paragraph 5.d.(2): "It is acceptable to issue reactive windshear caution alerts if the forward-looking windshear system is inoperative."
35.	Rockwell Collins	If according to section 1, "Purpose", "This AC does not address forward-looking windshear and/or turbulence detection capability for rotorcraft." why does section 5 part b. have references to part 27 and 29?	Modify Section 5.b to remove references to part 27 and 29 Rotorcraft. The Section 5 title includes "with Forward –Looking Windshear Detection". As such, the references to Part 27 and Part 29 rotorcraft are not applicable.	**Accepted.** See disposition to comment 24.

36.	Rockwell Collins	Paragraph 7.b currently states, "The initial airworthiness certification of a TSO'd system must include ground test, flight test, penetration flight test, and clutter suppression flight test. Follow-on type certification must accomplish the ground test and flight test. Penetration and clutter suppression tests are not required on follow-on airworthiness approvals unless changes to the radar system are major."	The term, "flight test" may imply a conformed flight test in the sense of a TC or STC which would then require a dangerous windshear penetration on OEM aircraft. Suggest that the term "flight test" be changed to "evaluation flight test" and comments added to clarify that the flight tests may be performed on radar vendor aircraft without TC or STC. The OEM can then verify that the radar vendor installation is representative of the OEM installation and subsequently use radar vendor flight test data as part of the OEM certification package.	**Accepted.** See disposition to comment 2.
37.	Rockwell Collins	Paragraph 1.b defines terms "should" and "recommend". The word "ensure" is also used throughout the document without definition.	Define the term "ensure". More specifically, does the word "ensure" require compliance similar to the word "shall"?	**Accepted.** See disposition to comment 6.
38.	Rockwell Collins	In section 4g The last statement in this paragraph states- "A hazard assessment should be done for the automatic activation feature of the forward-looking windshear function taking this type of operation into account." Does this mean "any" auto-activation feature or this specific type of auto activation feature using the transponder?	The statement should be clarified to indicate that any automatic ground activation feature should be assessed for hazard, not just the specific transponder related activation.	**Accepted.** Clarified the last sentence in paragraph 4.g to read: "A hazard assessment should be done for the automatic activation feature of the forward-looking windshear function taking this type of operation or any automatic ground activation feature of the windshear function into account when the aircraft is at the gate or on the ramp."
39.	Rockwell Collins	Section 5.a.2 states that that the system must "Ensure the forward-looking windshear function is capable of automatic activation no later than the start of the takeoff roll to allow timely takeoff abort, unless the automatic function is disabled by the flight crew." Aircraft weight, pilot takeoff roll acceleration, etc. may affect the radar's ability to perform adequate windshear detection before takeoff abort speed.	The statement should be changed to "Ensure the forward-looking windshear function is capable of automatic activation or manual activation no later than the start of the takeoff roll to allow timely takeoff abort." This will allow OEM's to address short range takeoff cases through radar operational guidance.	**Not accepted.** The system must have the capability to automatically activate. This paragraph is updated in response to comment # 7.
40.	Rockwell Collins	Figure 1. Include multiple vendor windshear Icon pictures to illustrate acceptance of minor image variation.	Rockwell Collins can provide an image of a windshear Icon to illustrate another implementation of the wind shear Icon. Please contact me if you still need examples. Otherwise, we may submit examples at a later date.	**Accepted.** Added another example of icon implementation to figure 1 in appendix A. The note in figure 1 states: "These images are provided only as examples of possible icon implementations. Other implementations may be used…."

41.	Rockwell Collins	Section 5.C.3 states, “Ensure all aural and visual alerts are inhibited above 1200 feet AGL.” However, change 1 to DO-220 (section 2,2,2,13) reads "All level II and level III aural and visual alerts shall be inhibited above 1200 feet AGL. It is permissible to display the icon at any altitude at which the system is armed in the windshear mode".	Please resolve the discrepancy between AC20 and DO-220 change 1 by rewording the 5.c.3 requirement to refer to level II and level III alerts only.	**Accepted.** Changed paragraph 5.c.3 to read, “You must ensure all new aural and visual caution and warning alerts are inhibited above 1200 feet AGL.”
42.	Garmin	The AC appears to have been developed primarily for Part 25 installations and does not provide “right-sized” guidance that is more appropriate to Part 23 installations.	Consider augmenting guidance to allow for reduced installation and flight test requirements for Part 23 aircraft.	**Acknowledged.** Much of the guidance in this AC addresses compliance for part 25 installations with forward-looking windshear requirements as originally documented in the System Level Requirement (SLR) 10.2 document, and turbulence requirements described in TSO-C63d. As unique requirements for smaller radar systems for part 23 installations are incorporated into future revisions of TSO-C63d based on the updated DO-220A by the RTCA SC-230, this AC will be updated accordingly.
43.	Garmin	The minimum AFM/AFMS information in section 8 for display devices is excessive compared to what historically has been accepted for MFD products that control/display radar.	Relax the language “at a minimum” or remove the information in section 8b, 8c, 8d, 8g and 8h, which historically has not been included in an AFM/AFMS for MFD products that control/display radar. Instead, this information has been contained in other documentation required to be on board the aircraft such as a cockpit reference guide or pilots guide.	**Accepted.** Changed the first sentence in paragraph 8 to read: “Follow AC 23-8, Chapter 6, Section 3 for small airplane flight manual updates. Follow AC 25.1581-1, *Airplane Flight Manual*, for transport category airplane flight manual updates. Follow AC 27-1 and 29-2 as appropriate for rotorcraft flight manual updates. You should incorporate the following radar specific information in the AFM/S: ”

FAA POC: Mr. Lee Nguyen 202-385-4676 or lee.nguyen@faa.gov