

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
Boeing	GENERAL	<p>Given the number of comments submitted to the initial draft of TSO-C151c (released in June 2011), and the changes in this second version of the draft (released in January, 2012), we strongly recommend that the FAA hold a meeting with affected industry to discuss the changes proposed in this TSO.</p> <p>We also strongly recommend that the content of Appendix 1 of the draft TSO (as well as the additional proposed changes) be addressed as either an update to the existing RTCA Minimum Operational Performance Standards (MOPS) DO-161A, or in a separate TAWS MOPS. This is the appropriate place where changes to system performance should be made.</p>			<p>Acknowledged. Revisions to TSO-C151c have been minimized with the goal of incorporating the most beneficial safety enhancements. The FAA acknowledges the need to address more detailed changes to the GPWS and TAWS standards, and will support future industry consensus building activities.</p>
Rockwell Collins	<p>GENERAL</p> <p>Page 3, Paragraph 4.c;</p> <p>Page 8, Appendix 1, Paragraph 1.3.e</p>	<p>"and/or" is used here and a number of places throughout the document. The use of "and/or" is generally considered bad form in requirements writing because if you satisfy the "or" portion you don't have to satisfy the</p>	<p>Recommend selecting "and" or selecting "or" appropriately to preclude ambiguity.</p>		<p>Not Accepted: For paragraph 4.c this statement consistent with the current TSO template.</p> <p>Accepted for Mode 5.</p> <p>Accepted for Paragraph</p>

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	<p>Mode 5; Page 13, Appendix 1, Paragraph 3.3 Mode 5; Table 3;</p> <p>Page 18, Appendix 1, Paragraph 4.10.a ;</p> <p>Page 20, Appendix 1, Paragraph 4.11</p>	<p>"and". In some cases "or" is appropriate and in others "and" is appropriate, while the alternative is not appropriate.</p>			<p>4.10.a.</p> <p>Accepted for Paragraphs 1.3.e and 4.11.</p>
Garmin	<p>Pages 2 &amp; 3, Paragraph 3.b.</p>	<p>Includes the statements:</p> <p>Use the criteria listed below. Design the system consistent with these failure condition classifications.</p> <p>Wording needs to change to allow failure condition to be determined at the aircraft level.</p>	<p>We recognize that this comment was not accepted in the previous set of draft comments. We believe there is plausible reason to clarify the wording to ensure aircraft level analysis is the driver for determining failure classifications. EASA has recognized this using the following wording in ED Decision 2010/010/R 14/12/2010 Annex I Subpart A - General 2.4 Failure condition classification:</p> <p>"Develop the system to, at least, the design assurance level equal to the failure condition classifications provided in the ETSO. Development to a lower Design Assurance Level may be justified for certain cases and accepted during the ETSO process but will lead to</p>		<p>Not Accepted: Current FAA TSO policy requires the equipment to be developed to the design assurance level equal to the failure condition classification. A deviation in accordance with 14 CFR § 21.618 is required to develop the system to a lower design assurance level.</p>

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			installation restrictions."		
THALES	Page 1, Paragraph 3.b	Change in failure condition classification	"Malfunction of the function defined in paragraph 3.a. of this TSO is a major failure condition" Previously on TSO C151b, malfunction of function was considered in the frame of computer failure. Proposed revision suppress this limitation. In this case malfunction conditions for the function must be described in details as such functions are not deterministic by essence , i.e. that collision prevention cannot be ensured with a success rate of 100% . Failure to warn must not be considered as a malfunction of the function.		Accepted. The "due to a TAWS computer failure" language has been added back into paragraph 3.b.
Rockwell Collins	Page 1, Paragraph 3.b  Page 2, Paragraph 3.e	Addition of "At a minimum, develop the system to the design assurance level equal to these failure condition classifications." Coupled with deletion in paragraph 3.e of the option for using partitioning for maintenance software seems to indicate that partitioning maintenance software and using a lower DAL, for example, is no longer an accepted technique.	Add text to 3.e acknowledging that partitioning is still a valid technique.  If complex hardware associated with maintenance can be shown to be partitioned in a fashion to protect the operational functions then a similar statement should be included in paragraph 3.f		Partially Accepted. The change of language in paragraph 3.e. between TSO-C151b and TSO-C151c does not change the inherent requirements for software development. The software must be developed in accordance with RTCA DO-178B. Removal of the language on software partitioning should not be construed as a new requirement forbidding appropriate software

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					partitioning. No additional language is required for paragraph 3.e of the TSO.
Rockwell Collins	Page 2, Paragraph 3.e	Minor - spelling error. Last word of the note should be "data" not "date".	Correct spelling error		Accepted.
Garmin	Page 3, Paragraph 4.b.(2)	<p>Paragraph 4.b.(2) states:</p> <p>Each subassembly of the article that you determined may be interchangeable.</p> <p>This language is confusing.</p>	We acknowledge that the FAA will consider clarifying this text based on the disposition of this item in the previous draft comments. Our concern was that this could be interpreted to include circuit boards to be marked this way. Improved clarity is typically not a bad thing so we highly encourage the FAA to improve this wording or work with industry to do so.	Clarify Text.	<p>Not Accepted: Paragraph 4.b.(2) does not to require TSO marking of circuit boards. This language is part of Order 8150-1C and is not changed in this TSO.</p> <p>This comment was forwarded to the appropriate office for consideration in future updates to FAA TSO policy.</p>
Rockwell Collins	Page 3, Paragraph 5.a(1)	New text deletes references to terrain database updates. Terrain database update remains within the TSO and it is unclear why the data requirement to provide instructions on database update was removed.	Add: "The installation process by which the terrain database can be updated must be described in detail."		Accepted.

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Rockwell Collins	Page 3, Paragraph 5.a(2)	New text "Detailed description of any deviations" differs from previous version where the detailed description was not for the deviation but for any operational or installation limitations.	Replace "Detailed description of any deviations" with "Detailed description of operational or installation limitations of any deviations."		Not Accepted: The language and policy detailed in paragraph 5.a(2) is standardized per FAA Order 8150.1C.
Garmin	Page 4, Paragraph 5.a(4)(d)	This paragraph requires listing the "failure condition classification" in the installation manual which can be misleading to the installer and is inconsistent with the process of determining failure condition classification at the aircraft level	<p>Failure condition classification is determined by system safety assessment at the aircraft level and can vary based on installation. By providing a failure condition classification at the appliance level this creates an impression that the safety analysis for these functions is complete.</p> <p>Additionally, TSO paragraphs 5.a(4)(a) and 5.a(4)(b) already require the Manual(s) to contain the software and AEH design assurance levels that an installer needs to determine whether the equipment can support the aircraft level failure condition classification.</p>	Remove the requirement to list "failure condition classification" in the Manual(s).	Accepted: The paragraph has been removed.
Rockwell Collins	Page 4, Paragraph 5.a(4)(d)	New requirement to include failure condition classification (fcc). As the TSO calls out the fcc and the HW and SW design assurance levels are called out it is unclear what benefit requiring the fcc to be included in the data package provides.	Delete requirement 5.a(4)(d)		Accepted: The paragraph has been removed.

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Rockwell Collins	Page 4, Paragraph 5.a(5)	New wording requires "A summary of test conditions used for environmental qualification ..." but calls out the RTCA/DO-160G, Appendix A form as an example. The example form does not provide a "summary of test conditions". This difference could lead to differences of interpretation of what is required to be submitted.	Replace (5) first sentence with: "A summary of the environmental qualification tests performed for each component of the article."		Not Accepted: Providing the form described in RTCA/DO-160G, Appendix A, will meet the requirement of paragraph 5.a.(5).
Garmin	Page 4, Paragraph 5.f	TSO paragraph 5.f and its subparagraphs define required information to be supplied to the ACO for a non-TSO function. This guidance is inconsistent with Order 8110.4C CHG 4.	<p>We recognize that this comment was not accepted in the previous set of draft comments. It is important that the FAA work with industry to ensure that the policies and procedures are clear and well understood by both entities. We feel strongly that the inconsistencies pointed out here have significant impact on the quality and consistency of the TSO process. We highly recommend that the FAA work with industry to improve this type of wording rather than rejecting the request for improvement without interaction.</p> <p>TSO paragraph 5.f indicates that "you must ... include the following information with your TSO application" but the TSO 5.f subparagraphs which specify the required information to be supplied to the ACO for a non-TSO function are inconsistent with the Order 8110.4C CHG 4 paragraph 6-9.b.(3) "Manufacturer</p>	Work with industry to develop policies that are consistent and of value to the TSO process.	Not Accepted: The language in paragraph 5.f. represents the FAA's current policy on non-TSO functions.

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			<p>Data Submittal" requirements. For example, TSO paragraphs 5.f.(5) and 5.f.(6) require submittal of "Results of test/analysis" while Order 8110.4C CHG 4 paragraph 6-9.b.(3) requires submittal of "proposed test procedures"; while both sets of guidance use the word "test", otherwise there is no similarity.</p>		
Garmin	Page 5, Paragraph 5.f	<p>TSO paragraph 5.f and its subparagraphs include definition of non-TSO functions and the data to be submitted to the ACO for non-TSO functions. This guidance is inconsistent with Order 8110.4C CHG 4.</p>	<p>We recognize that this comment was not accepted in the previous set of draft comments. It is important that the FAA work with industry to ensure that the policies and procedures are clear and well understood by both entities. We feel strongly that the inconsistencies pointed out here have significant impact on the quality and consistency of the TSO process. We highly recommend that the FAA work with industry to improve this type of wording rather than rejecting the request for improvement without interaction.</p> <p>TSO paragraph 5.f states "Identify functionality or performance contained in the article not evaluated under paragraph 3 of this TSO (that is, non-TSO functions)." Use of the term "performance" in the definition of a non-TSO function is inconsistent with the Order 8110.4C CHG 4 paragraph 6-9.b.(1) and 6-9.b.(3)(a) guidance regarding how to define a non-TSO function. The issue is non-TSO should not be defined as "performance". It will create difficulty</p>	<p>Work with industry to improve wording that is viewed as confusing and inconsistent.</p>	<p>Not Accepted: The language and policy detailed in paragraph 5.f is standardized per FAA Order 8150.1C. and represents the FAA's current policy on non-TSO functions.</p>

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			<p>if these criteria are used. For example, if a TSO requires a minimum 10 watt transmitter and a company makes equipment that is robust at 11 watts, the performance exceeding the TSO is not called out under the TSO; consequently, by the paragraph 5.f "performance" definition, the 11 watt transmitter has a non-TSO 1 watt capability. The distinction of a "function that can be accomplished outside the TSO box" as is specified in Order 8110.4C CHG 4 paragraph 6-9 is critical to making non-TSO function work long term.</p>		
Garmin	Page 6, Paragraph 7.b	TSO paragraph 7.b contains wording that is inconsistent with Order 8110.4C CHG 4.	<p>We recognize that this comment was not accepted in the previous set of draft comments. It is important that the FAA work with industry to ensure that the policies and procedures are clear and well understood by both entities. We feel strongly that the inconsistencies pointed out here have significant impact on the quality and consistency of the TSO process. We highly recommend that the FAA work with industry to improve this type of wording rather than rejecting the request for improvement without interaction.</p> <p>TSO paragraph 7.b includes additional guidance about what furnished data should be provided to an operator or repair station when the equipment includes a non-TSO function. The problematic guidance states "include one</p>	Work with industry to improve wording that is viewed as confusing and inconsistent	Not Accepted: The language and policy detailed in paragraph 7.b. is standardized per FAA Order 8150.1C. and represents the FAA's current policy on non-TSO functions.

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			<p>copy of the data in paragraphs 5.f.(1) through 5.f.(4)." This guidance is inconsistent with Order 8110.4C CHG 4. Order 8110.4C CHG 4 paragraph 6-9.b.(6) defines the FAA-industry agreed data that must be provided to an installer when equipment includes a non-TSO function and it would be better if the TSO simply pointed to Order 8110.4C CHG 4 paragraph 6-9.b.(6).</p>		
Boeing	Page 8, Appendix 1, Paragraph. 1.3.e., 6th bullet	<p>The proposed text states: <b><i>"Altitude Callout: A voice callout ("Five Hundred") when the airplane descends to 500 feet above nearest runway threshold elevation. All TAWS equipment must provide the 500 foot voice call out."</i></b></p>	<p>Providing a <b><i>"Five Hundred"</i></b> callout when the airplane descends to 500 feet above runway threshold cannot be implemented using current airplane architecture for certain Boeing models. Implementing this feature would require modification to FMS, Displays, TAWS, and airplane wiring changes.</p> <p>A <b><i>"Five Hundred"</i></b> foot automated callout when the airplane descends to 500 feet above runway threshold is not consistent with some airlines standard operating procedures.</p> <p>Further, a <b><i>"Five Hundred"</i></b> foot automated callout above runway threshold would also create fleet variability for those operators who have selected an automated <b><i>"Five Hundred"</i></b> foot callout based on height above terrain.</p>	<p>We recommend reverting back to the text in TSO-C151b, Appendix 1, page 2, paragraph e.(6), which states: <b><i>"Voice callout "Five Hundred" when the airplane descends to 500 feet above the terrain or nearest runway elevation."</i></b></p>	<p>Accepted: The 500 foot voice callout requirement was restored to that which was stated in the previous version of the TAWS TSO, TSO-C151b.</p>

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ACSS	<p>Page 8, Appendix 1, Paragraph 1.3.e;</p> <p>Page 13, Appendix 1, Paragraph 3.3</p>	<p>The allowance to adjust or modify GPWS curves in order to reduce nuisance alert and still be in compliance with TSO C151c has not been restored.</p>	<p>The FAA stated in the disposition of the numerous comments received on the first C151c draft concerning the GPWS curves that they were restoring the allowance for manufactures to adjust or modify the GPWS alerting thresholds. However, by requiring the deviation process defined in 14CFR21.618 to be followed, the FAA is not actually granting such allowance. Indeed, an applicant is always free to not comply with any requirement of any TSO, provided the applicant follows the process defined in 14CFR21.618 and obtains the necessary approvals from the FAA. Just because the requirement in the TSO draft which says that new TAWS equipment must fall back to the 35-year-old GPWS MOPS definition includes a note that the requirement can be the subject of a deviation, doesn't make that requirement any less rigid than any other requirements in the TSO. If left with the current wording, the brand new TSO-C151c will still have the stated requirements of using 35 year old GPWS curves in order to obtain a non-deviated TSO approval. Presumably, most manufacturers will need to follow the deviation process for each release of each product until such time as a revision D of TSO-C151 is generated. This seems like a lot of additional work that will not result in any increase in safety.</p>	<p>An update to RTCA DO-161 which defines the GPWS curves should be generated and released to reflect the state of the art in TAWS functionality. The TAWS TSO could then require that the updated DO-161 be followed. That would achieve the stated desire of having TAWS manufacturers comply with the GPWS curves without generating a large quantity of deviations that would need be incorporated into a TSO-C151 Revision D.</p> <p>If the FAA feels that some wording change must be made in TSO-C151c, similar words to those used for the PDA function could be used. The PDA function is a function that the FAA requires, yet allows the manufacturer to design the specific function in a manner that is appropriate for the manufacturer's overall TAWS system. The requirement for GPWS curves could be stated similarly. For instance:</p> <p>"In addition to the TAWS</p>	<p>Not Accepted: A discussion on the GPWS curves should be done on a larger scale to get a broader review and consensus from industry on the matter before making changes within the TSO. However, it was never the FAA's intent, at the risk of safety, to allow for the modification of the GPWS curves without review and approval. For that reason, modifications to the GPWS curves in RTCA/DO-161A will be reviewed and approved through the deviation process.</p>

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				<p>Forward Looking Terrain Avoidance and PDA functions, the equipment must provide the GPWS functions listed below in accordance with TSO-C92c. Some GPWS alerting thresholds may be adjusted or modified to be more compatible with the FLTA alerting functions and to minimize GPWS nuisance alerts. There are numerous ways to accomplish the overall objectives of this requirement. This TSO will not define the envelopes for which alerting is required. The applicant must provide the alerting criteria and test results for each of the 5 GPWS Modes along with the test conditions used to evaluate the GPWS modes."</p>	
THALES	<p>Page 8, Appendix 1, Paragraph 1.3.e</p> <p>Page 13, Appendix 1, Paragraph 3.3</p>	Reference to DO161A is no longer relevant	As was indicated in previous THALES comments, DO161A is a very old document, to which no current TAWS and even former latest GPWS version were fully compliant, as it is a very old document(dated may 1976), almost obsolete. FAA should not require a deviation as long as an equivalent level of safety demonstration to current GPWS modes performance as implemented today is provided to FAA. Thales recall	. If FAA is willing to maintain explicit compliance to DO161A, THALES propose FAA to initiate an Ad'Hoc RTCA working Group to amend current DO161A in order to reflect experience accumulated on TAWS and GPWS mode over the years.	Not Accepted: The GPWS functionality contained in RTCA DO-161A is one piece of the CFIT avoidance technology incorporated into TAWS equipment. The FAA understands that industry has incorporated numerous enhancements to the requirements in DO-161A. The FAA encourages these

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			that predictive terrain functions of TAWS have been developed to supersede the very well-known insufficient performances of previous GPWS modes typically modes 1 & 2 (high nuisance alerts rate as well the high level of missed/unannounced alerts)		enhancements, however 14 CFR § 21.618 requires deviations from requirements to be reviewed and approved. The clarification in TSO-C151c highlights this regulatory requirement.  The FAA will support future industry efforts to update RTCA DO-161A.
THALES	Page 8, Appendix 1, Paragraph 1.3.e  Page 14, Appendix 1, Paragraph 3.3.c	Removal of radio altitude from callout logic is not appropriate	THALES propose to come back to previous C151b wording to maintain high above terrain (radio altitude) as an option for the generation of this callout. The sole use of elevation above runway may hide callout on approach in mountainous area for which the use of radio altitude seems beneficial		Accepted: The 500 foot voice callout requirement was restored to that which was stated in the previous version of the TAWS TSO, TSO-C151b.
Rockwell Collins	Page 8 Appendix 1, Paragraph 1.3.e	Requirement of a 500-foot voice call-out could lead to a confusing sequence of radio altitude callouts and the 500-foot callout when terrain elevation on final approach differs significantly from the runway threshold height or when the approach terrain is irregular.	Recommend reconsidering new requirement to have a 500-foot voice callout based on a comparison of the aircraft altitude to the runway threshold height. Alternatively, recommend rewording to accommodate this condition.		Accepted: The 500 foot voice callout requirement was restored to that which was stated in the previous version of the TAWS TSO, TSO-C151b.

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Universal Avionics Systems Corporation	Page 8, Appendix 1, Paragraph 1.3 e	Should be changed to include Mode 5 Alerting on any approach with a vertical component	Draft AC 20-138C 14-6.8 says "It is desirable to provide a glideslope warning function on any approach with vertical guidance."	Change to be in sync with AC 20-138C	Accepted: Wording added for consistencies between this TSO and the AC.
Hette HOEKEMA (EASA)	Page 8, Appendix 1, Paragraph 1.3.e	EASA welcomes the extension of the requirement to provide an alert for excessive deviation below glideslope (Mode-5) to LPV and GLS approaches	Maintain safety in the face of technological evolution	No change in text proposed	Acknowledged.
Qantas	Page 8, Appendix 1, Paragraph 1.3 e (Class A TAWS) "Altitude Callout"  Page 8, Appendix 1, Paragraph 1.3 f (Class B TAWS) "Altitude Callout"  Page 14, Appendix 1, Paragraph 3.3 c "Altitude Callouts"	Requiring the "500" altitude callout to be referenced to runway threshold elevation may create confusing and/or hazardously misleading information for the pilots when intermixed with other altitude callouts which are normally based on aircraft radio altitude above terrain.	On approach to runways where the terrain elevation on the approach path is significantly different to the runway threshold elevation will mean that the relative timing of altitude callouts based on radio altitude above the terrain will be offset compared to altitude callouts based on aircraft altitude above runway threshold elevation. This could be confusing for pilots and in the worst case could result in a "500" altitude callout out of sequence compared to other adjacent altitude callouts such as "800" or "400". This could be hazardously misleading for pilots.	Allow use of radio altitude height above terrain for the "500" callout or aircraft height above runway threshold as per existing TSO-C151b.  It may be consideration to make it a requirement that the altitude reference for the "500" callout may be either but MUST be the same as the altitude reference used for other altitude callouts on approach.	Accepted: The 500 foot voice callout requirement was restored to that which was stated in the previous version of the TAWS TSO, TSO-C151b.

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Qantas	<p>Page 8, Appendix 1, Paragraph 1.3 e (Class A TAWS) "Altitude Callout"</p> <p>Page 8, Appendix 1, Paragraph 1.3 f (Class B TAWS) "Altitude Callout"</p> <p>Page 14, Appendix 1, Paragraph 3.3 c "Altitude Callouts"</p>	<p>"nearest runway threshold" might not actually be the threshold of the runway on which the aircraft is intending to land.</p>	<p>At airports with closely spaced parallel runways with relatively offset runway thresholds, the runway threshold of the parallel runway might be closer to the aircraft at the point at which the "500" callout is required to be made than the threshold of the runway on which the aircraft is intending to land.</p>	<p>Change wording to "threshold of the runway on which the aircraft is about to land" or something equivalent</p>	<p>Accepted. Accepted: The 500 foot voice callout requirement was restored to that which was stated in the previous version of the TAWS TSO, TSO-C151b.</p>
Honeywell	<p>Page 8, Appendix 1, Paragraph 1.3.e (Altitude Callout)</p> <p>Page 14, Appendix 1, Paragraph 3.3.c</p>	<p>Having a 500-foot callout based on altitude above runway threshold height intermixed with radio altitude -based callouts will potentially give inconsistent callouts. The requirement to measure the height from the runway threshold is too exacting.</p>	<p>When an aircraft that is equipped with a system (TAWS or other) that provides radio altitude -based callouts approaches a runway where the threshold elevation is higher than terrain along the final approach path (e.g., KPAE, KHSP, RJFK, LPMA, KSEZ), then confusing callout sequences (e.g., "500", "1000", "200"... ) could result. Also, there are aircraft that do not have TAWS equipment capable of giving a call referenced to the runway threshold height (in reference to item 6.c of the TAWS TSO-C151c Highpoints - 2<sup>nd</sup> Public Comment document).</p>	<p>Revert to allowing a Radio Altitude -based 500-foot callout. (Also allow 500-foot callouts based on altitude above runway height.) Do not specify that the height has to be measured exactly at the runway threshold; simply say runway elevation.</p>	<p>Accepted. Accepted: The 500 foot voice callout requirement was restored to that which was stated in the previous version of the TAWS TSO, TSO-C151b.</p>

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			<p>Many TAWS equipment do not contain the exact runway threshold elevation in their database; they may extrapolate from the runway center elevation. The few feet or even a dozen feet of difference will not be noticed or relevant at 500 feet above—therefore the requirement should not be too specific as to where along the runway the height for the callout be measured.</p>		
ACSS	<p>Page 8, Appendix 1, Paragraph 1.3.e</p> <p>Page 14, Appendix 1, Paragraph 3.3.c</p> <p>Page 37, Appendix 2, Paragraph 9.1</p>	<p>ACSS strongly disagrees with the change that forces the "Five Hundred" callout to be based on height above nearest runway threshold rather than height above terrain ACSS believes there could be unintended consequences that negatively impact safety if this change is kept.</p>	<p>The rationale for making the proposed change was that at airports such as Telluride, Colorado, USA (KTEX) where the runway is higher than the terrain underlying the approach path the five hundred foot callout would occur later in the approach if it were based on radio altitude than it would be if it were based on height above the threshold. While this is true, the five hundred foot callout must be considered in context. First, just as there are airports like KTEX where the terrain underlying the approach is lower than the runway, there are also airports such as San Diego, California, USA (KSAN), Monterrey, California, USA (KMRY), Guam (PGUM), and Tegucigalpa, Honduras (MHTG) where the terrain underlying the approach is higher than the runway. Many historical CFIT's have occurred at airports with this type of topography. In these cases, altitude callouts would be given later if they were based on height above runway. Refer to the attached</p>	<p>Keep the requirements related to the five hundred foot callout as they were in the released TSO-C151b.</p>	<p>Accepted: The 500 foot voice callout requirement was restored to that which was stated in the previous version of the TAWS TSO, TSO-C151b.</p>

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			<p>illustration which shows how the callouts could provide misleading data resulting in a loss of terrain situational awareness in a scenario where the underlying terrain is higher than the runway.</p> <p>Second, unless all altitude callouts (such as at 1000ft) are referenced to height above runway, there will be cases where the callouts occur out of sequence which could cause confusion. Refer to the attached illustration which represents the terrain underlying the approach to Telluride runway 9. In this example the 500ft (above runway) callout would occur before the 1000ft (radio altitude) callout. Of course, making all altitude callouts based on height above runway rather radio altitude would be even worse. It would alleviate this particular problem, but it would magnify all of the other problems listed here.</p> <p>Third, there are areas where the aircraft is closer to a second airport when it is on approach to a first airport. For instance, aircraft on approach to runways 16 at Seattle-Tacoma, Washington, USA (KSEA-elevation 430) are actually closer to Boeing Field (KBFI-elevation 21ft) for most of the approach. If altitude callouts are tied to height above nearest runway then the altitude reference will be incorrect and misleading for most of the approach.</p>		

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			<p>Fourth, pilots which are accustomed to flying aircraft with TSO-C151b systems which have altitude callouts based on radio altitude could become confused when some aircraft in the future still have TSO-C151b systems and others have TSO-C151c systems.</p>		
Airbus	<p>Page 8, Appendix 1 Paragraph 1.3.e bullet 6</p> <p>Page 14, Appendix 1 Paragraph 3.3c</p> <p>Page 37, Appendix 2 Paragraph 9.1</p>	<p>Following Transport Canada comment during the first review process, the content of Appendix 1 §1.3.e bullet 6, Appendix 1 §3.3c &amp; Appendix 2 §9.1 have been modified to remove the possibility to generate the "five hundred" call-out by using Radio Altimeter data. This change in requirements has to be reassessed.</p> <p><i>Initial requirement: Appendix 1 §3.3.c Altitude Callouts. Class A equipment must provide an advisory voice callout of "five hundred" or equivalent when descending through 500 feet above the terrain or 500 feet above the nearest runway threshold elevation if the landing gear is in configuration for landing. Additional altitude callouts, such as "one hundred" or "two hundred" are acceptable, but not required.</i></p>	<p>The proposed change of requirements does not improve the safety of the operation as:</p> <p>It will introduce pilots' confusion because the other callouts (based on radio altitude) would be (particular case of the Telluride approach) out of sequence &amp; so would not be based on a consistent reference.</p> <p>In the case of higher terrain surrounding the airport, basing callouts on height above touchdown would result in misleading information to the pilot. The pilot would not be aware of the close proximity to the terrain immediately below the aircraft.</p> <p>QNH/QFE settings are subject to pilot error.</p> <p>Note also that Radio Altimeter data are more precise than Barometric data &amp; not subject to weather &amp; daily conditions. Using Radio altimeter data to define the "five hundred" call out ensures consistency at cockpit level with the</p>	<p>The current TSO definition has to be maintained as it ensures consistency between all the ACOs and has proven safety. The current design is well understood by pilots &amp; ensures consistency with the PFD.</p> <p>Changing the definition would introduce confusion to pilots who may fly some planes with certified TSO C151b systems and other planes with updated C151c systems.</p>	Accepted: The 500 foot voice callout requirement was restored to that which was stated in the previous version of the TAWS TSO, TSO-C151b.

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		<p><i>This voice callout will not be made at ascent, for example on a missed approach or departure.</i></p> <p>Updated requirement after review process Appendix 1 §3.3c <i>a. Altitude Callouts. Class A equipment must provide a voice callout of "five hundred" or equivalent when descending through 500 feet above the nearest runway threshold elevation during nonprecision approaches, but are recommended for all approaches. Additional altitude callouts, such as "one hundred" or "two hundred" are acceptable, but not required. This voice callout will not be made at ascent, for example on a missed approach or departure.</i></p>	<p>displayed information (PFD).</p> <p>All AIRBUS fleet "five hundred" call out installation is built on Radio Altimeter data.</p>		
Garmin	Page 8, Appendix 1, Paragraph 1.5	Extraneous space between the words "... of on-board ...".	Editorial comment.	Remove the extraneous space.	Accepted.

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
Rockwell Collins	Page 9, Appendix 1, Section 2.0 Definitions	The acronym "LPV" is used 6 places in Appendix 1 but it is not defined in Appendix 1 Section 2.	Recommend providing a definition of the form used for FLTA and GNSS.		Accepted.
Thales	Page 9, Appendix 1, Paragraph 2.4	Caution alert definition to be reworded	Caution definition must be compliant and refer to AC25-1322		Partially accepted. The caution alert definition has been updated to match 14 CFR § 25.1322.
Rockwell Collins	Page 9, Appendix 1, Paragraph 2.8	Definition as written is unclear. As worded it appears to apply to the lateral and vertical aspects of the flight path when it applies to look-ahead as well.	Replace the word "lateral" with "horizontal".		Not Accepted. Use of the term "lateral" is consistent with paragraphs 1.3a and 3.1 which described FLTA. The term is consistent with previous versions of the TAWS TSO.
Rockwell Collins	Page 9, Appendix 1, Paragraph 2.9	GNSS definition includes both the basic satellite processing and the augmentation systems, which are physically separate and the satellite portion operates independently. Definition is vague with respect to the GNSS performance requirements that are needed for TAWS.	Revise definition to clearly identify the performance requirements for TAWS. Optionally, provide separate definitions for satellite portion and augmentation portion and clarify performance requirements as it appears in the text.		Not Accepted. The definition for GNSS is consistent with the definitions in TSO-C145/C146() and TSO-C196. The definition in paragraph 2.9 conveys no requirements.

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Rockwell Collins	Page 9, Appendix 1, Paragraph 2.10	GLS definition as written is unclear. GLS requires augmentation information based on ground referenced measurements but the augmented information may or may not be conveyed by a ground-based station.	Replace definition with: "A system which integrates GNSS with the appropriate augmentation information to provide the position information required for approach and landing guidance."		Accepted: The definition was reworded.
ACSS	Page 10, Appendix 1, Section 2.14	The definition of Required Terrain Clearance an FLTA mode is not consistent with the rest of the document.	The term "Required Terrain Clearance (RTC)" is used throughout the TSO as a linear measure rather than as a specific function. For instance, in Table 3.1.1 in Appendix 1, values are given for RTC, such as 700ft when in level flight enroute.	Change the definition of Required Terrain Clearance to reflect its actual usage in the TSO. It is analogous to the Required Obstacle Clearance term used in TERPS. A better definition might be "the minimum amount of terrain clearance considered safe for the particular phase of flight and aircraft trajectory."	Partially accepted. RTC is being removed from the definitions section. RTC is a mode of the FLTA, and is described sufficiently in the RTC section. Required terrain clearance also has a literal meaning which does not require elaboration in the definitions section.
Rockwell Collins	Page 11, Appendix 1, Table 3.1.1, Note 3	Previous version of TSO used "decision height", which was changed to "decision altitude". As DH is referenced to height above terrain and DA is referenced to MSL, shouldn't the DA have been addition to DH rather than instead of?	Revise text to add decision height (DH) back into the text after "decision altitude (DA)".		Accepted.
Rockwell Collins	Page 11, Appendix 1, Paragraph 3.1.2	Last sentence calls out Table H, but in previous TSO version table reference is G. Reference appears to be incorrect.	In last sentence, replace "(Table H)" with "(Table G)".		Accepted. Table reference corrected.

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
Thales	Page 12, Appendix 1, Paragraph 3.1.4	Additional details on TAWS in RNP AR operation	THALES believes that the RNP AR subject would need more consideration, as the aircraft is to fly with greater proximity with terrain. In addition specific aspects of the recovery maneuver have also to be considered. Besides, as TAWS is part of the criteria to fulfill for RNP AR approach design, suppression of TAWS alerts for such procedures will not ensure that the approach path, as designed, is free from risk with terrain. More important than reducing potential nuisance alerts during RNP AR operations is the need to warn of potential risk of collision with terrain in those terrain challenging approaches.	THALES propose here also FAA to initiate an Ad'Hoc RTCA working Group to define the most appropriate Minimum Operational Criteria (MOPS) for TAWS behavior in RNP AR operation.	Accepted: The RNP paragraph is removed from the TSO. We feel that it is best to discuss the RNP TAWS requirements at a larger scale to get industry consensus on the matter before including a requirement in the TSO.
Hette HOEKEMA (EASA)	Page 12, Appendix 1, Section 3.1.4	RNP-AR operations rely on the use of TAWS as a means of mitigating operational risks (FOSA) or as a means of mitigating an inadequate design assurance level of the Flight Management System (FMS). Suppression of the TAWS FLTA alert potentially reduces the system alerting and warning times and consequently reduces the ability of the flight crew to timely respond to the threat.	The suppression appears to cancel some of the benefits of TAWS upon which RNP-AR operations rely as it seemingly assumes that the guidance which is provided will always be correct. EASA strongly believes that this is an erroneous assumption. We have difficulties understanding the need for the inclusion of these requirements	EASA requests FAA to reconsider the opportunity to include such material in the proposed TSO.	Accepted: The FAA has decided to remove this paragraph from the TSO. We feel that it is best to discuss the RNP TAWS requirements at a larger scale to get industry consensus on the matter before including a requirement in the TSO.

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
Garmin	Page 12, Appendix 1, Paragraph 3.1.4	<p>This section states: "TAWS FLTA imminent terrain impact caution and warning alerts may be suppressed during Required Navigation Performance Authorization Required (RNP AR) approaches..."</p> <p>Is it really the intent to only allow suppression of FLTA ITI alerts and not FLTA RTC alerts?</p>	Want to ensure the intended functionality is documented.	Review statement with intention. Modify if necessary.	Accepted: The FAA has decided to remove this paragraph from the TSO. We feel that it is best to discuss the RNP TAWS requirements at a larger scale to get industry consensus on the matter before including a requirement in the TSO.
Garmin	Page 12, Appendix 1, Paragraph 3.1.4	<p>The requirement "The GPWS Mode 5 alert must include the RNP AR glidepath" is somewhat buried here, and given that it's under a "may" allowance for RNP, it might be ignored if a TAWS manufacturer doesn't intend to inhibit TAWS during these approaches.</p> <p>If it is intended that glidepath alerts be issued on RNP approaches, it would be good for a specific requirement be specified in Appendix 1, Section 1.3.e and Appendix 1, Section 3.3.</p> <p>Other sections that could also be affected by the addition of the RNP AR glidepath requirement and may be</p>	Want to ensure the intended functionality is documented.	<p>Review statement with intention. Modify if necessary.</p> <p>Also, recommend harmonizing the TAWS alerting requirements for RNP AR procedures with draft AC 20-138C Appendix 2, which presently includes no information as to how TAWS alerting should function during an RNP AR procedure.</p>	Accepted: The FAA has decided to remove this paragraph from the TSO. We feel that it is best to discuss the RNP TAWS requirements at a larger scale to get industry consensus on the matter before including a requirement in the TSO.

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
		candidates for revising: (1) Appendix 1, Section 1.3.e, Mode 5 (2) Appendix 1, Section 3.3, Mode 5 (3) Appendix 1, Section 3.3.e (4) Appendix 1, Section 4.11			
Garmin	Page 12, Appendix 1, Paragraph 3.1.4	<p>Paragraph 3.1.4 begins with a statement indicating TAWS FLTA ITI alerts may be suppressed under the following conditions and then includes the following statement as one of the conditions:  <b>"If the RNP AR approach guidance becomes unavailable during the approach when a TAWS alert has been suppressed, the suppression must be terminated and the applicable TAWS alerts provided."</b></p> <p>Assuming the position source utilized for RNP AR approach guidance is also utilized for TAWS FLTA ITI alerts, what conditions that would cause RNP approach guidance to be unavailable would still allow TAWS to be operable?</p>	<p>There are several other sections that indicate a position source (e.g. a GPS) must be available for TAWS to operate:</p> <ul style="list-style-type: none"> <li>(1) Appendix 1, Section 5.0, TAWS Position Requirements</li> <li>(2) Appendix 1, Section 11.0, Table 7, FMS/RNAV or GPS column</li> <li>(3) Appendix 3, Section 1.2, Altitude Accuracy and Display</li> </ul> <p>Therefore, the quoted statement in the "Comment" column appears to be inconsistent in that it implies that TAWS FLTA ITI alerts will operate without a position source.</p> <p>We want to ensure the intended functionality is documented correctly.</p>	Review statement with intention. Modify if necessary.	Accepted: The FAA has decided to remove this paragraph from the TSO. We feel that it is best to discuss the RNP TAWS requirements at a larger scale to get industry consensus on the matter before including a requirement in the TSO.

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
		e.g., for RNP AR = 0.3, there is no requirement for inertial backup in case there is a loss of GPS. Yet this statement seems to imply that TAWS must continue to function without GPS.			
Rockwell Collins	Page 12, Appendix 1, Paragraph 3.2.a	Previous TSO specifically called out approaches that are not aligned within 30 degrees of the runway heading. These types of approaches still exist and deleting the callout may lead to misinterpretation.	Replace the last sentence from previous version of the TSO: "This includes approaches that are not aligned within 30 degrees of the runway heading."		Not Accepted: The statement "This includes approaches aligned within 30 degrees of the runway heading" was removed because this is the very definition of a straight-in approach which was already called out in the previous sentence. PDA must function for all approaches (straight-in, and circling.)
Rockwell Collins	Page 12, Appendix 1, Paragraph 3.2.b	Altitude called out in previous TSO was 800 feet. New altitude is 1000 feet but there are still airports with 800 foot pattern altitudes which may be accessed by operators with Class A or B TAWS.	Change 1000 back to 800.		Accepted.
ACSS	Page 13, Appendix 1, Paragraph 3.3.a	There is a reference to "Mode 4 warnings," however Mode 4 only has caution level alerts.	Mode 4 alerts are cautions, not warnings.	Reword to say "Mode 4 cautions" or "Mode 4 alerts".	Accepted.

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
Garmin	Page 13, Appendix 1, Paragraph 3.3, Mode 5 bullet	Extraneous spaces between the words "...GLS glidepath...".	Editorial comment.	Remove the extraneous spaces.	Accepted.
Rockwell Collins	Page 13, Appendix 1, 3.3?	Previous version of the TSO had a section on "Barometric Altitude rate" which has been deleted. It is unclear why this text has been removed as it still should be applicable when radio altitude is not available.	Restore text from previous version of the TSO regarding "Barometric Altitude Rate" (App 1, 3.2.d)		Barometric Altitude Rate information has been moved to Section 5 of the TSO.
Boeing	Page 14, Appendix 1, Paragraph 3.3.c	The proposed text states: <i>"Altitude Callouts. Class A equipment must provide a voice callout of "five hundred" or equivalent when descending through 500 feet above the nearest runway threshold elevation during nonprecision approaches, but are recommended for all approaches. Additional altitude callouts, such as "one hundred" or "two hundred" are acceptable, but not required. This voice callout will not be made at ascent, for example on a missed approach or departure."</i>	Providing a <i>"Five Hundred"</i> callout when the airplane descends to 500 feet above runway threshold cannot be implemented using current airplane architecture for certain Boeing models. Implementing this feature would require modification to FMS, Displays, TAWS, and airplane wiring changes. A <i>"Five Hundred"</i> foot automated callout when the airplane descends to 500 feet above runway threshold is not consistent with some airlines standard operating procedures. Further, a <i>"Five Hundred"</i> foot automated callout above runway threshold would also create fleet variability for those operators who have selected an automated <i>"Five Hundred"</i> foot callout based on height above terrain.	We request reverting back to the text in TSO-C151b, Appendix 1, page 6, paragraph 3.3.c., which states: <i>"Voice Callouts. Voice callouts of altitude above the terrain must be provided during nonprecision approaches per TSO-C92, but are recommended for all approaches. These advisories are normally, but are not limited to 500 feet above the terrain or the height above the nearest runway threshold elevation."</i>	Partially Accepted: The 500 foot voice callout requirement was restored to allow the callout to be 500' above the terrain or runway threshold. .

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
Garmin	Page 14, Appendix 1, Paragraph 3.3.d	Extraneous spaces between the words "...with RTCA...".	Editorial comment.	Remove the extraneous spaces.	Accepted.
Airbus	Page 14, Appendix 1, Paragraph 3.3.e.	The proposed text states: <b>"Mode 5 Glidepath Deviation Alerting. Class A TAWS equipment must provide Mode 5 alerting for localizer performance with vertical guidance (LPV) glidepath and GNSS landing system (GLS) glidepath, as well as, the ILS glideslope. The LPV and GLS envelope, deactivation, reactivation, arming, disarming, alert requirements must follow the Mode 5 requirements in RTCA/DO-161A. The glidepath aural alert should say "glidepath" or equivalent instead of "glideslope."</b>	LPV and GLS glidepath alerting has been implemented in TAWS and type certificated on various airplanes using the voice/term "glideslope" for several years. Requiring TAWS manufacturers to change this voice to "glidepath" would drive costs and variability into operators' fleets, without a commensurate increase in the safety benefit. In addition, on one of Boeing's models (787), the "glideslope" aural is driven by other equipment [specifically, the Displays/Crew Alerting System (DCA)]. Requiring such a change as proposed in the TSO would drive cost and variability into that equipment as well, again without any identified increase in the safety benefit. Another issue is that on that same aircraft model (787), there is a corresponding caution alert display message "GLIDESLOPE" and a "BELOW G/S" annunciator light on a flight deck control panel (ATP) that are annunciated concurrent with the "glideslope" aural. Also, a "G/S INHIBIT" selection is on another flight deck	We request eliminating the last sentence of this text, as follows: <b>"Mode 5 Glidepath Deviation Alerting. Class A TAWS equipment must provide Mode 5 alerting for localizer performance with vertical guidance (LPV) glidepath and GNSS landing system (GLS) glidepath, as well as, the ILS glideslope. The LPV and GLS envelope, deactivation, reactivation, arming, disarming, alert requirements must follow the Mode 5 requirements in RTCA/DO-161A. The glidepath aural alert should say "glidepath" or equivalent instead of "glideslope."</b>	Accepted: The last sentence in the paragraph is not a requirement. The language has been updated to clarify the "glidepath" aural is a recommendation versus a requirement.

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
Honeywell	Page 14, Appendix 1, Paragraph 3.3.e	Use of "should" in last sentence is not clear about whether "glidepath" aural alert is required or recommended.	"Glideslope" is also an appropriate alert message for LPV approaches.	Reword to clarify that "glideslope" as well as "glidepath" or equivalent is allowed for LPV approaches. State that "glidepath" is the recommended word.	Accepted. The sentence was reworded for clarification.
Honeywell	Page14, Appendix 1, paragraph 3.3.e	The TSO should allow the alerting for glideslope/glidepath to be disabled once the aircraft descends below decision height/altitude.	Aircraft are often flown manually once the runway environment becomes visible and will not stay exactly on glideslope/glidepath nor is it necessary, especially on approaches with high decision altitudes.	Add a statement allowing the Mode 5 alerting to be disabled below decision height/altitude.	The FAA will address changes to the RTCA/DO-161A requirements via the 14 CFR § 21.618 deviation process.  Additionally, the FAA will support industry efforts to update RTCA DO-161A.
Rockwell Collins	Page 14, Appendix 1, Paragraph 3.3.e	In Section 3.3, the bullet for Mode 5 includes ILS glideslope, as does Section 3.3.e. However, the text in Section 3.3.e expressly excludes use of "glideslope".	Recommend text clarifying that the use of "glideslope" for below LPV glidepath is acceptable. Alternatively, include text explaining why the use of "glideslope" is inappropriate.		Accepted. The sentence was reworded for clarification.
Honeywell	Page 14, Appendix 1, paragraph 3.4.a.	The mnemonic expression "Question Nil Height" is not the definition of "QNH".	QNH is a Q Code, not an abbreviation or acronym. Q codes were created in the era when Morse Code was used in shipping (and later, aviation) to make commonly asked questions (e.g., "QNH?" instead of "What is the barometric pressure at sea level at your location?") and commonly used expressions quick to transmit via telegraph or radiotelegraphy. "Question Nil Height" is somebody's way of remembering (mnemonic) what QNH stands for, not	Delete "Question Nil Height" and remove the parentheses from around "QNH". The text should simply say "... QNH (corrected) barometric altitude" not "...Question Nil Height (QNH) (corrected) barometric altitude."	Accepted.

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			any sort of official definition. Another mnemonic is "Query Newlyn Harbor".		
Garmin	Page 14, Appendix 1, Paragraph 3.4.a	Extra comma in the phrase "...GNSS altitude, (or equivalent)".	Editorial comment.	Remove extraneous comma after the word "altitude".	Accepted.
Rockwell Collins	Page 14, Appendix 1, Paragraph 3.4.a	Addition of GNSS altitude is unclear about under what conditions it will be acceptable to use GNSS altitude. Acceptable use should be limited to data which is accompanied by an acceptable Vertical Integrity Limit (VIL). The VIL that would be acceptable should be specified.	Add text or Note which clarifies use of GNSS altitude, including performance accuracy/integrity requirements.		Partially Accepted: A reference to RTCA/DO-229D was added to provide for clarification on accuracy requirements. However, the TSO does not convey specific accuracy requirements for horizontal position nor does not convey integrity requirements for horizontal or vertical position.
Rockwell Collins	Page 14, Appendix 1, Paragraph 3.4.b	Addition of GNSS altitude is unclear about under what conditions it will be acceptable to use GNSS altitude. Acceptable use should be limited to data which is accompanied by an acceptable Vertical Integrity Limit (VIL). The VIL that would be acceptable should be specified.	Add text or Note which clarifies use of GNSS altitude, including performance accuracy/integrity requirements.		Partially Accepted: A reference to RTCA/DO-229D was added to provide for clarification on accuracy requirements. However, the TSO does not convey specific accuracy requirements for horizontal position nor does not convey integrity requirements for horizontal or vertical

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
					position.
Garmin	Page 14, Appendix 1, Paragraph 4.2	With regard to the sentence: <i>"Exceptions to this requirement are allowed when suppression of aural alerts are necessary to protect pilots from nuisance aural alerting, but a visual alert is still appropriate"</i> , the phrase <i>"suppression of aural alerts <u>are</u> necessary"</i> should be changed to <i>"suppression of aural alerts <u>is</u> necessary"</i> for prepositional phrase/case agreement.	Editorial comment.	See comment.	Accepted.
Rockwell Collins	Various Tables	Table references are mixed. First table is Table 3.1.1 and the next table is Table 3. Seems like this would be a good time to provide consistent table references.	Update Table numbers.		Accepted: The Table numbers have reverted back to the numbering scheme in TSO-C151b.
Honeywell	Page 17, Appendix 1, Table 3 (Mode 2B)	Table implies that Visual Alert should be given regardless of gear up/down.	There is no Mode 2 <u>Warning</u> when flaps & Gear down. What you get is a continuous caution level "Terrain" voice and associated amber visual.	Add " <u>for gear up</u> " following the newly added 'Visual Alert' in the Warning column	Accepted.

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Rockwell Collins	Page 17, Appendix 1, Table 3 row 5	There is no Mode 2 Warning when flaps and gear are down. Instead the TAWS outputs a continuous caution level "Terrain" aural message and associated amber visual annunciation.	Recommend adding text to stipulate "for gear up" following the newly added 'Visual Alert' (Red text message that is obvious, concise, and must be consistent with the Aural message. - For Gear Up)		Accepted.
Honeywell	Page 18, Appendix 1, Table 3 (Altitude Callout row)	Allow other aural alerts besides "Five Hundred".	Some current TAWS equipment provide "Five Hundred Above". This should be allowed, as well as possibly other equivalent callouts.	Add "or equivalent" after "Five Hundred"	It is acceptable for the TAWS system to make additional callouts, but it must make the 500 foot callout
Rockwell Collins	Page 18, Appendix 1, Table 3	Added Visual Alert description to "Ground Proximity Excessive Closure Rate (Landing Configuration) Mode 2B Class A. Shouldn't this be qualified with gear status just like the aural alert?	Add clarification on when visual alert is required. To be clear, that it applies regardless of gear status if that is the desired requirement.		Accepted: Clarification was made.
Rockwell Collins	Page 18, Appendix 1, Table 3	Previous version stated "Don't Sink and Too Low Terrain" while the new version states "Don't Sink and/or Too Low Terrain." Could this lead to inconsistent operation in the flight deck?	Determine if operational differences are acceptable. If not, replace "and/or" with previously used "and".		Accepted: Wording reverts back to TSO-C151b to allow for commonality in the flight deck.
ACSS	Page 18, Appendix 1, Paragraph 4.10, Table 4	Comment column on this table can be unclear to the reader. Particularly, when a blank entry appears alongside a given alert, should that alert not be 'continuous', as the	This comment was previously made in the July 2011 review. The FAA rejected the comment, stating that the column was "self explanatory". While we appreciate the fact that many people may find the column to be self explanatory, we	Adding explanatory text and filling in blank cells appropriately will help reduce any possibility of misinterpretation. Additional explanation	Not Accepted: The FAA believes that it is best to discuss the prioritization issue at a larger scale to get industry consensus on the matter before modifying

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		others are noted as being continuous?	maintain that not everyone will find it self explanatory. Indeed, it was not self explanatory to us.	should not negatively impact those readers to whom the existing description was already self explanatory.	TSO requirements. The alert durations specified in the table are requirements. Those priorities which have blank comment sections, were left blank because there was no required duration and thus the duration is left up to the discretion of the manufacturer.
ACSS	Page 18, Appendix 1, Paragraph 4.10, Table 4	It appears that too many separate alerts with different priorities are included in the table.	Item 9 is referred to as a "pull up caution". The alerts which generate an aural of "pull up" are all warnings, not cautions. Also, separate priority levels are given for FLTA (RTC) warnings and FLTA (ITI) warnings, when in fact some TAWS systems don't have the aircraft performance models to be able to accurately differentiate between an imminent terrain impact scenario and a reduced terrain clearance scenario. Moreover, if a TAWS system could differentiate between the two, it would seem that an imminent terrain impact alert would be a higher priority than a reduced terrain clearance alert.	Combine all FLTA Pull Up warnings into a single priority (4). Combine all FLTA cautions into a single priority (9).	Not Accepted: The FAA recognizes the confusion that the changes to Table 4 caused with industry. TSO-C151c reverts back to the priority table in TSO-C151b. Discussion of the prioritization issue in a broader industry forum is necessary before making changes within the TSO.
Rockwell Collins	Page 19, Appendix 1, Table 4	Table 4 comments  i) No definition of "ITI" - section 3.1.2 does use "Imminent Terrain Impact". What is the distinction between	Recommend modification of text in Table 4 for these items to correct or clarify the intended meaning without ambiguity.		Not Accepted: The FAA recognizes the confusion that the changes to Table 4 caused with industry. The FAA made the decision to revert back to the priority table in TSO-C151b. We feel that it is best to discuss the

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		<p>the ITI vs. RTC here.</p> <p>ii) Priority 4 seems odd: Honeywell FLTA Warning is priority 7. So what are the implications of item 4?</p> <p>iii) Priority 9 description is wrong (rev b is also wrong here). This entry should be Mode 2 Excessive Closure Terrain Caution (flaps/Gear down) - it is not FLTA.</p> <p>iv) Priority 18 needs to be deleted. It is the alert listed as priority 9.</p> <p>vi) Priority 11: Long time error here. Terrain caution repeat period is, and has always been, 10 seconds (there is a 7 second pause between phrases).</p> <p>Priority 20: Long time error here. Glideslope being continuous with</p>			<p>prioritization issue at a larger scale to get a broader review and consensus from industry on the matter before making changes within the TSO.</p>

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
		a 3 second period is only applicable to excessive deviation below 300 feet			
Garmin	Page 19, Appendix 1, Paragraph 4.10.b, Table 4, Priority 4 item	"Pull-Up" is not the FLTA RTC warning annunciation. Either "Terrain, Terrain; Pull-Up, Pull-Up" or "Terrain Ahead, Pull-Up; Terrain Ahead, Pull-Up" is the correct annunciation.	Incorrect specification of FLTA RTC warning annunciation.	Change the text <b>FLTA (RTC) "Pull-Up" Warning</b> to <b>FLTA RTC Warning</b> for correct specification of materials.	Not Accepted: The FAA recognizes the confusion that the changes to Table 4 caused with industry. The FAA made the decision to revert back to the priority table in TSO-C151b. We feel that it is best to discuss the prioritization issue at a larger scale to get a broader review and consensus from industry on the matter before making changes within the TSO.
Garmin	Page 19, Appendix 1, Paragraph 4.10.b, Table 4, Priority 7 item	"Pull-Up" is not the FLTA ITI warning annunciation. Either "Terrain, Terrain; Pull-Up, Pull-Up" or "Terrain Ahead, Pull-Up; Terrain Ahead, Pull-Up" is the correct annunciation.	Incorrect specification of FLTA ITI warning annunciation.	Change the text <b>FLTA (ITI) "Pull-Up" Warning</b> to <b>FLTA ITI Warning</b> for correct specification of materials.	Not Accepted: The FAA recognizes the confusion that the changes to Table 4 caused with industry. The FAA made the decision to revert back to the priority table in TSO-C151b. We feel that it is best to discuss the prioritization issue at a larger scale to get industry consensus on the matter before including a requirement in the TSO.

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
Garmin	Page 19, Appendix 1, Paragraph 4.10.b, Table 4, Priority 9 item	"Pull-Up" is not the FLTA RTC caution announcement. Either "Caution, Terrain; Caution, Terrain" or "Terrain Ahead; Terrain Ahead" is the correct announcement.	Incorrect specification of FLTA RTC caution announcement.	Change the text <b>FLTA (RTC) "Pull-Up" Caution</b> to <b>FLTA RTC Caution</b> for correct specification of materials.	Not Accepted: The FAA recognizes the confusion that the changes to Table 4 caused with industry. The FAA made the decision to revert back to the priority table in TSO-C151b. We feel that it is best to discuss the prioritization issue at a larger scale to get a broader review and consensus from industry on the matter before making changes within the TSO.
Honeywell	Page 19, Appendix 1, Table 4, Priority 9	Description of priority 9 is incorrect.	This entry should be Mode 2 Excessive Closure Terrain Caution (flaps/Gear down) - it is not FLTA.	Change description to: Mode 2: "Terrain Terrain" Caution	Not Accepted: The FAA recognizes the confusion that the changes to Table 4 caused with industry. The FAA made the decision to revert back to the priority table in TSO-C151b. We feel that it is best to discuss the prioritization issue at a larger scale to get a broader review and consensus from industry on the matter before making changes within the TSO.
Garmin	Page 19, Appendix 1, Paragraph 4.10.b, Table 4, Priority 11 item	Suggest removing the parenthesis from around the "(ITI)" if the above three comments are accepted for consistency.	Consistency of presented material.	Change the text <b>FLTA (ITI) Caution</b> to <b>FLTA ITI Caution</b> for consistency, if the prior 3 comments are accepted.	Not Accepted: The FAA recognizes the confusion that the changes to Table 4 caused with industry. The FAA made the decision to revert back to the priority table in TSO-C151b. We feel

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					that it is best to discuss the prioritization issue at a larger scale to get a broader review and consensus from industry on the matter before making changes within the TSO.
Honeywell	Page 19, Appendix 1, Table 4 priority 11	Comment for priority 11 is incorrect.	Terrain caution repeat <u>period</u> is, and has always been 10 seconds (there is a 7 second pause between phrases).	Change "7 s" to "10 s".	Not Accepted: The FAA made the decision to revert back to the priority table in TSO-C151b. We feel that it is best to discuss the prioritization issue, including the comment section of the table, at a larger scale to get industry consensus on the matter before making additional changes within the TSO.
Honeywell	Page 20, Appendix 1, Table 4, priority 18	Priority 18 needs to be deleted.	It is the alert listed as priority 9.	Delete priority 18.	Partially Accepted: The FAA made the decision to revert back to the priority table in TSO-C151b so this issue as been overcome by events.
Honeywell	Page 20, Appendix 1, Table 4, priority 20	Comment for priority 20 is not always applicable.	Glideslope being continuous with a 3 second period is only applicable to excessive deviation below 300 feet.	Delete comment "3 s period"	Not Accepted: The FAA recognizes the confusion that the changes to Table 4 caused with industry. The FAA made the decision to revert back to the priority table in TSO-C151b. We feel that it is best to discuss the prioritization issue at a larger scale to get a

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					broader review and consensus from industry on the matter before making changes within the TSO.
Garmin	Page 20, Appendix 1, Paragraph 4.10.b, Table 4, Priority 20 item	For consistency of the presented materials, the quotes should be adjusted to be around the words "Glideslope" and "Glidepath", since they are two different alerts.	Consistency of presented material.	Change the text <b>Mode 5: "Glideslope or Glidepath" Caution</b> to <b>Mode 5: "Glideslope" or "Glidepath" Caution</b> for correct specification of materials.	Accepted: Though the FAA has reverted back to the prioritization table provided in TSO-C151b, quotations were placed as suggested.
Garmin	Page 20, Appendix 1, Paragraph 4.10.b, Table 5, Priority 2 item	"Pull-Up" is not the FLTA RTC / ITI warning annunciation. Either "Terrain, Terrain; Pull-Up, Pull-Up" or "Terrain Ahead, Pull-Up; Terrain Ahead, Pull-Up" is the correct annunciation.	Incorrect specification of FLTA RTC / ITI warning annunciation.	Change the text <b>FLTA (RTC or ITI) "Pull-Up" Warning</b> to <b>FLTA RTC/ITI Warning</b> for correct specification of materials.	Not Accepted: The FAA recognizes the confusion that the changes to Table 4 caused with industry. The FAA made the decision to revert back to the priority table in TSO-C151b. We feel that it is best to discuss the prioritization issue at a larger scale to get a broader review and consensus from industry on the matter before making changes within the TSO.
Garmin	Page 20, Appendix 1, Paragraph 4.10.b, Table 5, Priority 3 item	"Pull-Up" is not the FLTA RTC / ITI caution annunciation. Either "Caution, Terrain; Caution, Terrain" or "Terrain Ahead; Terrain Ahead" is the correct annunciation.	Incorrect specification of FLTA RTC / ITI caution annunciation.	Change the text <b>FLTA (RTC or ITI) "Pull-Up" Caution</b> to <b>FLTA RTC/ITI Caution</b> for correct specification of materials.	Not Accepted: The FAA recognizes the confusion that the changes to Table 4 caused with industry. The FAA made the decision to revert back to the priority table in TSO-C151b. We feel

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					that it is best to discuss the prioritization issue at a larger scale to get a broader review and consensus from industry on the matter before making changes within the TSO.
Honeywell	Pages 20-21, Appendix 1, Paragraphs 5.2 and 5.3	These sections need to allow for TAWS systems with an internal GPS position source that does support the TAWS intended function but may not meet the entire applicable TSO requirements (TSO-C129a, C145, C146, C196). The wording of these sections implies that the TAWS computer with an internal GPS must be TSO authorized per one of these applicable TSOs.	For some existing TAWS computers (with internal GPS) it is not possible to meet the entire applicable TSO(s). For example in many TAWS computers the GPS position data is not provided outside of the TAWS computer and thus the TAWS computer cannot meet the entirety of the TSO-C129a requirements. Please note that these TAWS computers with an internal GPS position source are adequate for TAWS functionality (as demonstrated by past TSO/STC approvals) as they support the TAWS intended function.	Retain the wording of Section 5.3 of TSO-C151b for internal GPS position sources.	Not Accepted: The FAA is requiring that a TAWS computer with internal GPS meet TSO-C129a, TSO-C145(), TSO-C146(), or TSO-C196. .
AIRBUS	Page 21, Appendix 1, Paragraph 5.3	Appendix 1 §5.3 allows that <i>"TAWS equipment intended for installation in aircraft operating under 14 CFR § 121 may be configurable to operate solely on a non-GNSS position source. "</i>	This allowance should be extended to Airlines operating under other national regulations than 14 CFR § 121 in order to accommodate the needs of non US Authorities accepting TSO equipment.		Acknowledged. Operations in other states with requirements equivalent to 14 CFR Part 121 could be appropriate with a non GNSS position source. The TSO allows a manufacturer to design and produce TAWS equipment which is capable of operating without a GNSS position source. Use of this type of equipment in another states

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					equivalent 14 CFR part 121 operations is possible, but can't be implemented in this TSO.
Rockwell Collins	Page 21, Appendix 1, Paragraph 5.5	New text on Vertical Position Sources does not provide the acceptable performance for GNSS altitude. As GNSS altitude accuracy is dependent on the geometric relationships of the satellites and the receiver, some guidance on performance appear to be warranted.	Add text providing guidance relative to acceptable GNSS altitude accuracy and integrity performance.		Partially Accepted: A reference to RTCA/DO-229D was added to provide for clarification on accuracy requirements. However, the TSO does not convey specific accuracy for horizontal position nor does not convey integrity requirements for horizontal or vertical position.
ACSS	Page 21, Appendix 1, Paragraph 5.6	In the disposition of the previous round of comments, the FAA indicated that they would remove the reference to providing an indication for a "degraded" position source, however such a change was not incorporated.	The FAA indicated they would remove the reference to a degraded mode.	Remove the reference to a degraded mode.	Accepted. The reference to a degraded mode is removed.
Garmin	Page 22, Appendix 1, Paragraph 6.4	Includes the statement: "Updating of self-contained, front-instrument panel-mounted and pedestal-mounted terrain, obstacle, and airport databases accomplished in accordance with 14 CFR § 43 does not	While Garmin appreciates the intent of this statement, Garmin's recent comments on "Docket No. FAA-2011-0763; Notice No. 11-05 Pilot Loading of Navigation and Terrain Awareness Database Updates" indicated that use of the phrase "self-contained, front-instrument panel-mounted and	Suggest revising the Appendix 1, Paragraph 6.4 statement to: "Updating of terrain, obstacle, and airport databases accomplished in accordance with 14 CFR § 43 does not require a change to the	Accepted:

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		require a change to the TSO authorization."	pedestal-mounted" was too specific as current Garmin products need to distribute "terrain, obstacle, and airport databases" throughout an integrated avionics system. Garmin's comments on the NPRM were to revise § 43.3 (k) to state:  (k) The holder of a pilot certificate issued under part 61of this chapter may perform updating of airborne system databases that the airborne system manufacturer has determined are pilot-updateable provided-	TSO authorization."	
Garmin	Page 26, Appendix 2, Paragraph 1.1	In the text "refer to appendix 1, paragraph 10.0 of Appendix 1", the text "of Appendix" is redundant and can be removed.	Editorial comment.	See comment.	Accepted.
Rockwell Collins	Page 26, Appendix 2, Paragraph 1.2.a	Last sentence references appendix 3, which it was in previous version. But since the appendix itself moved from 3 to 2 shouldn't this be appendix 2?	Correct number of the appendix.		Accepted: The reference was corrected.
ACSS	Page 32, Appendix 2, Paragraph 1.7, Table F	Test cases with a criteria of "may alert" should be removed.	In the previous round of commenting we submitted a comment regarding these test cases, but the comment was not clearly worded and as a result it appears to have been misunderstood. The comment is that the test cases for the "may alert" region should be removed. We are not suggesting that the "may	Keep the "must alert" and "must not alert" thresholds where they are, keep the test cases that ensure those thresholds are met, but remove the test cases between the two thresholds where either an alert or no	Not Accepted: The FAA acknowledges that a test where either an alert or non-alert outcome meets the requirement has limited value. However, as both rounds of public comment to this TSO revision have

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			<p>alert" region be removed. In the disposition of the earlier comment, the FAA correctly pointed out that some tolerance was required between the "must alert" threshold and the "must not alert" threshold in order to allow design flexibility. ACSS agrees 100%. However, given that a system can either alert or not alert in that gray area between the two thresholds, ACSS maintains that it does not make sense to have TSO test cases pass whether the system alerts or not. No benefit is gained by performing those tests.</p>	<p>alert is acceptable.</p>	<p>demonstrated, simple changes can have unintended interpretations. Thus, the FAA is postponing removal of these particular test cases until such a time where a broader review and consensus from industry can be accomplished.</p>
ACSS	Page 32, Appendix 2, Paragraph 2.2	Change the altitude error from "-100 feet or -200 feet" to "-200 feet."	<p>In the previous draft, the test requirement was for an altitude error of -100ft AND an altitude error of -200ft to be tested. ACSS commented that testing with a -200ft altitude error was a more demanding case than the -100ft altitude error case and therefore showing adequate alerting in the -200ft case was sufficient. The FAA accepted the comment but instead of removing the -100ft case they changed the AND to an OR. This could result in a manufacturer just testing the -100ft error case.</p>	<p>Remove the -100ft error case. Require the test be performed with a -200ft error.</p>	<p>Accepted.</p>
ACSS	Page 32, Appendix 2, Paragraph 2.2	Provide an example of how the error should be applied.	<p>ACSS wishes to reiterate a comment from the July 2011 review which the FAA indicated "not accepted" with no explanation. The current wording is ambiguous. Applying an "altitude error" in this Table G could be done 4 different ways - could be treated as FTE or</p>	<p>Provide an example of how the error should be applied, such as the following: "For example, in the case of the test run altitude of 9000 feet, place the physical aircraft at 9000</p>	<p>Not Accepted: This requirement can be clarified, however as both public comment periods have demonstrated, clarifications have led to perception that the requirement has</p>

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			<p>equipment error. Then, it could be taken in a positive direction or a negative direction. Negative direction appears obvious here, however applying a negative altitude as an equipment error actually causes the alert to occur sooner, which makes it a less demanding test. One illustrating example would clarify this. While it is true that the current wording without an example may be self explanatory to some readers, it could be made clearer to help more readers understand it correctly.</p>	<p>feet for purposes of determining the escape trajectory and have the reported altitude provided to the TAWS unit at 9200 feet for purposes of generating the alert."</p>	<p>changed or led to unintended interpretations. With this in mind, the FAA is deferring clarification of this requirement until we can get broader review and consensus from industry.</p>
Rockwell Collins	Page 35. Appendix 2, Paragraph 6.1	Last sentence has ";" misplaced but it is the same as previous version of TSO. ";" should be after "(height above terrain)" instead of in front of it.	Correct placement of ";" so that the text reads "(9) radio altitude (height above terrain); (10) gear position; and (11) flap position."		Accepted.
Garmin	Page 36, Appendix 2, Paragraph 7.0	<p>Propose the following sentence be re-written for better sentence construction as well as for clarification:</p> <p><b>Instead of using height of terrain as determined by a radio altimeter, determine the value by subtracting the terrain elevation (from the terrain database) from the current QNH (corrected) barometric altitude, GNSS altitude, or equivalent, if a radio altimeter input is</b></p>	Editorial comment - both are used in the same sentence: "...as determined by a radar altimeter..." and "...if a radio altimeter input...".	<p>Suggest revising the sentence to:</p> <p>If a radar altimeter input is unavailable, determine the height of terrain by subtracting the terrain elevation (as obtained from the terrain database) from the current QNH (corrected) barometric altitude, the GNSS altitude, or an equivalent source.</p>	Accepted.

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		unavailable.			
Garmin	Page 36, Appendix 2, Paragraph 7.0	Extra space in the phrase "...excessive descent".	Editorial comment.	Remove extraneous space.	Accepted.
Rockwell Collins	Page 36, Appendix 2, Paragraph 7.0	Text refers to GNSS altitude. May be ok if GNSS altitude performance is addressed elsewhere in TSO, if not, then additional text pertaining to GNSS altitude performance requirements should be added.	Add text related to GNSS altitude performance requirements.		Partially Accepted: A reference to RTCA/DO-229D was added to provide for clarification on accuracy requirements. However, the TSO does not convey specific accuracy for horizontal position nor does not convey integrity requirements for horizontal or vertical position.
Rockwell Collins	Page 42, Appendix 3, Paragraph 1.2.c	Table reference is "per appendix 4, table 3-1 (ROC)" but appendix 4 was changed to appendix 3 and table 3-1 was replaced with 3.1.1. Also, the table is not titled with "(ROC)" rather it is titled with "(RTC)".	Correct table reference.		Partially Accepted: The appendix and table references were corrected. However, the 'ROC' reference was not referring to the title of the table, but the first column of the table.

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Rockwell Collins	Page 44, Appendix 3, Paragraph 1.6.c	Table reference is "per appendix 4, table 3-1 (ROC)" but appendix 4 was changed to appendix 3 and table 3-1 was replaced with 3.1.1. Also, the table is not titled with "(ROC)" rather it is titled with "(RTC)".	Correct table reference.		Partially Accepted: The appendix and table references were corrected. However, the 'ROC' reference was not referring to the title of the table, but the first column of the table.