General Comment Response #1: The FAA received numerous comments regarding removal of the TSO-C151b Appendix 1, paragraph 3.3 statement that said: "*Some GPWS alerting thresholds may be adjusted or modified to be more compatible with the FLTA alerting functions and to minimize GPWS nuisance alerts*." The FAA also received numerous comments on the GPWS modifications in the proposed TSO-C151c paragraph 3.4. In response to these comments the FAA is taking the following actions the second public comment version of TSO-C151c:

1. The allowance in TSO-C151b to adjust or modify the GPWS alerting thresholds is restored in the second public comment draft of TSO-C151c. The FAA does provide clarifying language that deviations to the standards need to be accomplished in accordance with 14 CFR § 21.618.
2. Paragraph 3.4 in the proposed TSO-C151c has been removed. Public comment highlighted the fact that multiple vendors have solved GPWS nuisance alert issues in different, yet safe, approaches. The second public comment draft of TSO-C151c will not prescribe changes to RTCA/DO-161a. Applicants can pursue all pertinent changes through the 14 CFR § 21.618 deviation process.

General Comment Response #2: 500' Call: There were numerous comments regarding the 500' voice call out requirements. The FAA has made the following changes in the final version of TSO-C151c:

1. The requirement in the draft version of TSO-C151c to make the Class A 500' voice call out on all approaches has reverted to the TSO-C151b requirement to make the call out on non-precision approaches.
2. Clarification was added that all TSO'd TAWS equipment must be able to make the 500' voice call out.
3. The reference for the Class A 500' callout. TSO-C151b and the draft version of TSO-C151c both allowed for the 500' callout to be made based on radar altimeter height above terrain, or by a comparison of current altitude (barometric or GNSS) above the runway threshold height. The second public comment version of TSO-C151c requires the 500' voice call out to be a comparison of current altitude (barometric or GNSS) above the runway threshold height. The allowance to make the voice callout based solely on a radio altimeter height above terrain has been removed. The rationale is that all TAWS equipped aircraft have the capability to make the call referenced to the runway threshold height, and that this provides a consistent call out.

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ATA	Entire document.	The content of this draft TSO should be subject to rulemaking, or it should retain the effectivity of earlier revisions of the TSO.	This draft TSO would rescind the acceptability of FMS as the navigation source for TAWS. In doing so, it would contravene a significant decision made in the rulemaking process, and should be subject to rulemaking. As one example, the draft TSO would require a GNSS navigation source (eg, GPS or WAAS) and disallow	Earlier revisions of TSO-C151 should remain effective	Not Accepted: The FAA recognizes that where the original version of a TSO is referenced in the rules (14 CFR parts 91.223, 121.354, and 135.154) , the rule is interpreted to

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			FMS without justification. This prescription would come at a time when navigation sources, system integration and accuracies should be driven by NextGen requirements, still in development. Accordingly, earlier revisions of TSO-C151 should remain effective providing air carriers an opportunity to decide on navigation source equipment and integration based on more certain and substantive navigation source requirements. Beyond the precedent set by this type of proposal, we note that TAWS integrated with FMS sources may actually yield safety advantages over GNSS when transiting RAIM holes. In addition, there are questions of whether TSO-C151 ever was properly incorporated by reference in the TAWS Rule. See the Administrative Procedures Act, 5 USC 552(a)(1)(E), 1CFR 51.1, and the "Federal Register Document Drafting Handbook".		include any subsequent version of that document. Equipment compliant with TSO-C151, C151a, and C151b may still be produced under existing TSOAs. This equipment also continues to satisfy 14 CFR § 91, 121, and 135 TAWS operational requirements.
THALES	General comment	Any enforcement of this new TSO is limited by TAWS Intellectual Property not being freely available on the market. Any of the below changes which attempt to require a given behavior beyond 151b is subject to deviation for patent reasons alone.	Though the goal of this new TSO version is to rationalize and integrate within this TSO C151 the acceptable deviations commonly requested up to now, Thales would like to point out that		Accepted: The intent of the changes in TSO-C151c was not to infringe on intellectual

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			such a need is probably not pertinent as long as TAWS Intellectual Property is not freely available on the market. We would like to remember that THALES, as the original designer of such a TAWS function owns a portfolio of patents still in-force on TAWS design.		property rights. Instead of prescribing allowable deviations, which were based at a high level on two vendors deviation requests, the final version of the TSO reverted to the TSO-C151b language allowing GPWS modification, restored, with a caveat that a deviation must be requested when making those adjustments and modifications.
THALES	General comment	Though this new version of TSO is now addressing explicit vertical position integrity, other TAWS aspects have not been addressed yet - one such aspect is assuring sufficient clearance for "Pull-Up alerting" Definition of the appropriate procedure to perform and corresponding testing requirements in dynamic and turning situations, which are likely encountered in hazardous terrain environment would be highly recommended for this TSO release.	Basically, operational escape maneuver upon TAWS warning on which are derived TAWS requirements in this TSO is based on a "Wing-level and Pull Up" procedure. However, operational situations exist where upon a TAWS warning a "Wing-level and Pull Up" procedure will not ensure a safe recovery due to high terrain in front the aircraft trajectory. Though the TSO testing is based on a stabilized straight flight		Although the FAA is not incorporating new standards for dynamic escape maneuvers in this TAWS revision, we will support an industry sponsored effort to develop new standards incorporating additional dynamic terrain escape maneuvers.

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			(eventually descending or ascending), such operational situations are mostly resulting from dynamic change of the aircraft trajectory and position, such as starting or halting a turn or, initiating a descent movement (typically in severe terrain environment) , which effect is to sense the terrain hazard in a direction different from the direction of the escape maneuver. In Thales design, situations where insufficient clearance is forecasted drive for a specific warning message "Avoid terrain" different from the "classical" "Pull-Up" message, which, if followed, will nevertheless drive to a CFIT accident. Such aspect is not yet addressed in current TSO C151b nor it is in the proposed TSO C151c.		
THALES	General comment	Definition of the appropriate design and testing requirements in such low RNP procedures to be considered.	TAWS is required for supporting low RNP operations. However there are no specific TSO requirements for such operations (typically in severe terrain environment) which are currently requiring some relaxation of detection rate performance for minimizing nuisance alerts. Additionally TAWS is used as a design criteria for Low RNP approach procedures.		Partially Accepted. The FAA has added optional standards for suppressing a TAWS FLTA alert when certain RNP AR procedures are in place.

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			Clarification should therefore be provided if the TAWS design could rely on the low RNP approach procedure definition, or remaining an independent device to ensure proper CFIT detection. Consideration of previous point should also be addressed for such operations, since those approaches are in general performed (if not for noise considerations) in very severe terrain environment where a safe escape is not always ensured.		
THALES	General comment	Definition of the acceptable nuisance alert rate and miss-detection on final approach is to be considered.	TSO C151 requirements are modulated according to the phase of flight. However those requirements are not fully applicable for the very end of the approach. There is a need for defining what would be an acceptable nuisance alert rate and miss-detection on this final part of the approach, taking into account position and altitude uncertainties, while recognizing that those rate would be higher than in the rest of the approach (since a landing is a systematic voluntary CFIT). Those rate could be modulated as a function of the remaining distance/altitude to the runway/touch point.		Defining minimum nuisance alert rates and maximum missed detection rates is one approach to defining the TAWS requirements. The existing TAWS standard has taken a different approach. The FAA is willing to explore the potential of defining a standard based on missed and nuisance alert rates. This type of shift in the TAWS

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					standard must be coordinated across industry, and the FAA is willing to support an industry sponsored effort to develop appropriate missed and nuisance alert rates.
THALES	General comment	All along this new version of TSO remains some ambiguities relying from the confusing use of TAWS : - whether for all the FLTA, PDA and GPWS functions - or just the predictive functions FLTA & PDA			Accepted: Clarification was made throughout the document for consistency.
ACSS	General - Several examples within App 1 3.3, 3.4	Strongly disagree with removal of sentence "*Some GPWS alerting thresholds may be adjusted or modified to be more compatible with the FLTA alerting functions and to minimize GPWS nuisance alerts*" and replacement with specific thresholds of DO-161 for Modes 1 through 5.	The GPWS alert envelopes defined in DO-161A reflect some of the best thinking and best data available in 1976. All alerts were based on radio altitude together with another parameter in a two variable study. These alert tables did not account for access to terrain maps contained within the memory of the TAWS, the higher accuracy position of GPS or many other innovations which have occurred in the last 35 years. Nonetheless, the early GPWS systems were plagued with high nuisance alert rates. A study from a European carrier in the mid-1990s showed 73 unique Mode	Restore the philosophy to allow adjustments or modifications to the DO-161A alerting. Alternately, if the FAA desires requirements for each current implementation, some consolidation of the different implementations is needed. ACSS will transmit separately the GPWS alterations performed on our current TAWS product for your review and inclusion in the TSO-C151C.	Partially Accepted: See General Comment Response #1

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			2 nuisance alerts over a 3 year period. An Internet search of "GPWS Flowchart" will reflect some of the early pilot perceptions about GPWS alerting. These charts are humorous because they are based on the reality of those early GPWS systems. It is good that the changes to 151C include reference to the nuisance rate concern of DO-161A. An enormous amount of research and study has been conducted in the 35 years since 1976 and has identified various improvements to the GPWS alerting logic. Manufacturers have worked with certification authorities to demonstrate and explain the improvements. Different improvements have been made by different manufacturers. Updating TSO C151 now to force all TAWS manufacturers back to a 35-year-old standard with only a few rigidly defined variations would likely cause an unintended consequence of increasing nuisance alerts with no demonstrated increase in safety. Some suppliers have conducted studies which show an equivalent level of safety existing with unique		

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			implementations, while minimizing the nuisance risk. We believe that the current wording in TSO C151B should be kept in C151C that allows applicants to deviate from the envelopes in DO-161A in order to minimize nuisance alerts. The good intent to standardize the GPWS type of alerting may have the unintended consequence of reintroducing these high nuisance rates. If the FAA feels that a strict definition of the GPWS alerting envelopes needs to be included in the TAWS TSO, then the FAA should ask RTCA to update DO-161 in order to come up with a new GPWS MOPS that reflects the experience the entire industry has gained over the past 35 years. A return to the 1976 GPWS thresholds without a thorough knowledge of these past GPWS nuisance cases seems risky.		
ACSS	General	As an optional function, include the concept of performance climb capability in the TSO.	In Appendix 3, Imminent Terrain Impact and Known Accident Case studies show a reference to a 6 degree climb gradient, While consistent application of a 6 degree climb gradient produces	As an optional function, include the concept of performance climb capability in the TSO.	Although the FAA is not incorporating new standards for performance climb maneuvers in this TAWS revision, we

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			results which are comparable, real life cases can have actual climb capabilities far different than these. The effect of having high climb capability can delay an undesirable nuisance situation and a lower climb capability can demand an alert to occur sooner to permit the equivalent terrain clearance. Specifying this feature as an optional function can allow the supplier to avoid the additional paperwork and the ACO the additional approval work of this particular TAWS specific function.		will support an industry sponsored effort to develop new standards incorporating performance climb standards.
ACSS	General	As an optional function, include the concept of a lateral maneuver/climb alert in the TSO.	In Appendix 3, the Imminent Terrain Impact alerting section describes specific scenarios where alerting is to be conducted and a certain clearance achieved. However, it is conceivable that aircraft are at lower levels compared to the terrain in question and thus a pull up maneuver would not yield sufficient clearance. There are dynamic CFIT scenarios where the standard "roll wings level and climb" escape maneuver is not the best choice. For these cases, the introduction of an alert that suggests a lateral maneuver in addition to a climb can prove valuable. Specifying this feature	As an optional function, include the concept of a lateral maneuver/climb alert in the TSO.	Although the FAA is not incorporating new standards for lateral guidance in this TAWS revision, we will support an industry sponsored effort to develop new standards incorporating lateral guidance standards.

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			as an optional function can allow the supplier to avoid the additional paperwork and the ACO the additional approval work of this particular TAWS specific function.		
ACSS	General	The FAA should ensure that allowances are made for Low RNP operations such that no "Must Alert" requirements from TSO Table 14 (Imminent Terrain Impact) conflict with the approach procedure construction guidelines in FAA Order 8260.52.	Low RNP approaches present a challenge to TAWS. AC 90-101 states "An operable Class A Terrain Awareness Warning System (TAWS) is required for all RNP SAAAR procedures. It is recommended that the TAWS use altitude that is compensated for local pressure and temperature effects (e.g., corrected barometric and GNSS altitude), and include significant terrain and obstacle data." However, approaches designed with low RNP values can create conditions which are also "must alert" in TSO cases such as Table 14 (formerly Table I – Imminent Terrain Impact). Please see turn conditions found in FAA 8260.52 RNP Procedure Construction. Some guidance regarding conflicting conditions between allowable routes and required TAWS alerting is desirable.	Offer guidelines regarding proper alerting in a Low RNP environment	Partially Accepted. The FAA has added optional standards for suppressing a TAWS FLTA alert when certain RNP AR procedures are in place.
ACSS	Appendix 2, General	Keep table lettering.	It has become common parlance to refer to these Tables as "A" through "H". For example, a	Restore Tables A through H as the table titles in this section.	Accepted: Tables are renamed as in the previous

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			reference to the testing of Table G instantly correlates to Imminent terrain Impact tests for many of us. Changing to a numerical numbering system can create confusion around these tables which essentially haven't changed.		version of the document.
ACSS	General	In the TAWS area there are many cases where intellectual property/patents may exist for specific implementation details. When creating specific requirements, such as the GPWS alerting found here, there may be conflicts with existing patents. If possible, it would be beneficial to ensure that all suppliers agree that no patent issues exist for requirements listed herein.			Accepted: The specific GPWS modifications listed in the public comment version of TSO-C151c have been removed. The statement that allows for adjustments and modification to the GPWS alert thresholds was restored, but with a caveat that a deviation must be requested when making those adjustments and modifications.
Transport Canada (TCCA)	General	The term "pop-up" and 'auto-range" are not used or defined in the TSO, but they are referenced in AC 25-23. These features, which are included in most modern TAWS equipment, are normally integral to the TAWS, and should be addressed in the TSO, rather than being left solely to the AC for the installation of the TAWS equipment.			Although the FAA is not incorporating new standards for pop up and auto-ranging in this TAWS revision, we will support an industry sponsored

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		Typically, TAWS uses a single discrete to set the pop-up logic to valis, resulting in the terrain display "popping-up" on a multi-function display, when that display did not previously show the terrain. Many TAWS also offer an "auto-range" feature, where coincident with the "popping-up" of the terrain display, the map range will be automatically reset to a range selected during the installation and configuration process. If terrain is already selected for display, then the auto ranging functionality typically applies to any display showing terrain. "Pop-up mode –switching funtionality" is addressed in paragraph 13.c of AC 25-23; Auto range functionality is addressed in paragraph 13.d. Several issues have been identified with the pop-up and auto-range functionality.			effort to develop new standards for display pop up and auto-ranging.
Transport Canada	General	On most aircraft, the pop-up of terrain will cause the removal of weather radar information. On other installations, the pop-up of terrain may cause the removal of TCAS or other selected information. Terrain alerts may be more urgent than weather radar information, and thus justify a higher priority, as recoginzed in Table 4 of Appendix 1 of the AC. However, after the terrain alert has cleared and there is no longer a need for the display of terrain information, it is easy for pilots to overlook the re-selection of weather radar information if there is no prompt to the pilots. For example, if a crew is completing an approach on a dark amd stomy night and	AC 25-23 paragraph 13c.(e) and (f), respectively, state: (e) manually switching back to the original mode of operation shoud require minimal effort. (f) Automatic switching back to the original mode of operation after the caution or warning ceases should not be allowed unless it is plookart of the aircraft design philosophy. TCCA believes that if automatic switching back to the original mode of operation is not enables, then there should be a prominent		Although the FAA is not incorporating new standards for pop up and auto-ranging in this TAWS revision, we will support an industry sponsored effort to develop new standards for display pop up and auto-ranging.

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		they get a terrain alert, their displays would pop-up to the terrain display. But once a climb is initiated and/or the terrain alert has cleared, there would be nothing to prompt the pilots to re-select the Weather Radar for display.	indication to the crew that the display is not in the mode in which it was before the terrain alert occurred. An example of a prominent indication might be a flashing amber message, presented on the terrain display some after (e.g. 10 seconds) the removal of the terrain alert, to the effect of "WX RDR NOT SELECTED".		
Transport Canada	General	TCCA considers that, given that terrain pop-ups may remove valuable information from the displays, they should only occur when the terrain display will show alerted terrain. But most current TAWS set the pop-up discrete for all TAWS cautions and warnings, regardless of whether those alerts result in alerted terrain cells. Popping up the terrain display does not provide critical information during Mode 5 (Glideslope), Mode 4A (Too Low Gear) and Mode 4B (Too Low Flaps) alerts, and this TCCA suggestions that pop-up for these modes should not occur. Further, since Mode 1, Mode 2, Mode 3, and Mode 4 usually would appear in combination with an FLTA or PDA alert, it would be reasonable to suppress the terrain pop-up for all classic GPWS modes.			Although the FAA is not incorporating new standards for pop up and auto-ranging in this TAWS revision, we will support an industry sponsored effort to develop new standards for display pop up and auto-ranging
Transport Canada	General	Most existing TAWS will automatically change the range on the terrain display, when a TAWS alert is triggered. The :auto range" value is usually a configurable value selected at installation; 10 Nm is a typical number. Obviously, it makes a lot of sense to reduce		TCCA suggests that under such circumstances, the auto range function should be inhibited.	Although the FAA is not incorporating new standards for pop up and auto-ranging in this TAWS revision, we

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		the range to a lower range is a TAWS alert is triggered. However, if the display of terrain is already slected, and is set to a range less than the auto range default, then to :auto range" to a larger range setting may not be desirable, as this will cause the display to show less detail than what the pilot had manually slected.			will support an industry sponsored effort to develop new standards for display pop up and auto-ranging.
Transport Canada	General	Paragraph 1.4 of the TSO notes that obstacles may be included in the TAWS database as an optional feature, but if included, alerting for obstacles shall meet the same requirements as alerting for terrain. One problem observed with existing TAWS, however, is that the alerted terrain cell or cells, associated with the obstacle, may not be of sufficent size to be porminent, or even seen, on the terrain display, under some circumstances. TCCA suggests that the alerted terrain cells for any terrain or obstacle alert should cover some minimum area such that the amber or red alerted terrain will be visible on the terrain display when the display range is at values likely to be used in the approach phase, or at the range value selected by the auto pop-up function.			Although the FAA is not incorporating new standards for obstacle display in this TAWS revision, we will support an industry sponsored effort to develop new standards for obstacle display.
AIRBUS	General	TSO C151b mentionned that deviations from RTCA-DO161A are acceptable provided the nuisance alert rate is minimized. This concept is suppressed in draft TSO C151c. The current GPWS envelopes implemented by Honeywell and ACSS vary from the DO161A curves (see AI comments	The current GPWS envelopes implemented by Honeywell and ACSS vary from the DO161A curves & current designs are assessed as acceptable.	As in TSO C151b, add a dedicated note/disclaimer to explain that deviations from RTCA DO-161A are acceptable provided the nuisance alert rate is minimized as already identified for Mode 1 &	Partially Accepted: See General Comment Response #1

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		below on Mode 5 & Mode 2 deviations).		Mode 2 in Paragraph 3.4	
AIRBUS	General Mode 5 deviation to RTCA DO-161A	Add a dedicated paragraph to deal with Mode 5 deviations to RTCA-DO161A, as done for the Mode 1 & Mode 2 in §3.4. Mode 5 alerting design as specified in RTCA DO-161A has demonstrated nuisance alerts. Further work has been done during previous certification exercises which resulted in the following modifications of the Mode 5 envelope to reduce nuisance alerts: - Mode 5 is inhibited below 50 ft (instead of 30ft). - In steep approach operation: Mode 5 is inhibited below 130 ft.	In service experience to reduce Mode 5 nuisance alerts. The proposed Mode 5 implementation is currently implemented in ACSS T3CAS and will be implemented in next Honeywell EGPWS/ACSS T2CAS standards.	Add a dedicated paragraph in TSO C151c to deal with proposed Mode 5 deviations to RTCA DO-161A.	Partially Accepted: See General Comment Response #1
AIRBUS	General	TSO C151c should include specific requirements to cover Final Approach phase.	Airbus noticed significant performance differences in terrain detection in the final approach segment (0.5 to 3 NM) depending on TAWS product. From an aircraft manufacturer perspective, it seems questionable that conflicting terrain may not trigger an alert between 0.5 to 3 NM. There is a need for defining terrain detection performance for this particular flight phase based on acceptable nuisance alert rate, miss detection ...	Define requirements applicable at TAWS equipment level to properly cover terrain detection performance in Final Approach phase.	Although the FAA is not incorporating new standards for the final approach phase in this TAWS revision, we will support an industry sponsored effort to revise approach performance standards.
AIRBUS	General	TSO C151c should include specific requirements to cover Low RNP operations	Airbus noticed that low RNP operation (typically in moutainous area) causes significant burden	Define requirements applicable at TAWS equipment level to properly	Partially Accepted. The FAA has added

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			(nuisance alerts) and requires design adaptation. There is a need for defining terrain detection performance requirement (in particular, time to alert) for low RNP operation, taking into account the appropriate metrics (cross-track error, ...).	cover terrain detection performance for Low RNP operations.	optional standards for suppressing a TAWS FLTA alert when certain RNP AR procedures are in place.
AIRBUS	General	Question: Is there a plan to update TSOC92c according to TSOC91c updates ?	Consistency between TSO C92c & TSO C91c.		At this time there is no plan to update TSO-C92c, however the FAA will support an industry effort to update RTCA DO-161a and would subsequently update the TSO.
Garmin	General	Given the number of substantive changes between TSO-C151b and TSO-C151c, it would seem appropriate that the FAA request the RTCA to form a special committee to develop a consensus of the minimum performance standards as it is unclear what basis FAA is using to drive these substantial changes.	See comment.	See comment.	Not Accepted: The final version of TSO-C151c changes are reduced in scope. The FAA feels that the standards contained in TSO-C151c are sufficient for TAWS systems, however the FAA will support an industry driven effort to update

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					TAWS standards.
Garmin	General	Given the significant issues that Garmin has identified in draft TSO-C151c, the FAA should make available a new draft of this document for public comment prior to final publication.	See comment.	See comment.	Accepted.
Garmin	General	Should we consider stating that TSO-C151c (this TSO) is intended for fixed-wing applications, whereas TSO-C194 is intended for rotorcraft applications?	General observation.	Add text to the beginning of the document that this TSO is intended for fixed-wing aircraft. Perhaps even mention that TSO-C194 is intended for rotorcraft.	Accepted: Wording added to clarify this document is intended for fixed-wing applications only.
Garmin	General	For example, the references to TSO-C106 in Appendix 1, paragraph 5.4 do not have the TSO title *Air Data Computer* following, but the reference before this (Appendix 1, paragraph 5.3) does have the title. Other TSO and RTCA/DO document titles are similarly inconsistent, with some having the document title, others not, and still others that sometimes have the document titles.	Document inconsistency.	Use a uniform reference format/scheme throughout the entire document for TSO and RTCA/DO documents.	Not Accepted: We customarily identify the title of a document the first time the document is referenced. Subsequently, we only reference the document number.
Garmin	General	The terms "glide slope" (with a space) and "glideslope" (no space) are used in this document. Suggest using one or the other for consistency. Whichever way is selected, also suggest using same style for "glide path" / "glidepath".	Inconsistent use of terminology.	Change all uses of "glide slope" to "glideslope". Change all uses of "glide path" to "glidepath".	Accepted: Change made for consistency through the document.

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ATA	Page 1, Paragraph 2.a.	Revise the first sentence as shown.	Clarity	**a.** All prior revisions to this TSO are no longer effective **for purposes of applying for a TSOA or LODA**. Generally, we will not accept applications **per t**he previous revision after the effective date of this TSO.	Not Accepted: Paragraph 1 of the TSO specifies that the TSO is for manufacturers applying for a TSOA.
ATA	Page 1, Paragraph 2.a.	Revise the second sentence as shown.	Consistency with the first comment, above.	Generally, we **may** not accept applications **per t**he previous revision after the effective date of this TSO.	Not Accepted: Our policy is that all new TAWS TSO authorization applications will use the newer standard as of the effective date of TSO-C151c. The statement in 2b provides some relief for a limited time period for manufacturers who were previously working against the previous standard.
ATA	Page 1, Paragraph 3	Insert as the first sentence the text recommended on the right.	There is an ongoing risk of misinterpretation and recurring compliance issues in using TSOs – a changeable, technical certification document for components (eg, avionics) manufacturers -- to specify aircraft "system" requirements, and in turn, to mandate operating rule requirements.	**The original TSO-C151 establishes the regulatory requirements for TAWS under 14 CFR sections 91.223, 121.354 and 135.154. Subsequent revisions of TSO-C151, including this revision, exceed those requirements and may be used to provide regulatory**	Not Accepted: The FAA recognizes that where the original version of a TSO is referenced in the rules (14 CFR parts 91.223, 121.354, and 135.154) , the rule is interpreted to include any

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			Extended discussions with AFS regarding the "500" callout eventually concluded that the original TSO-C151 sets the minimum operating rule requirements for TAWS. There have been assertions that operators are required to comply with later revisions of the TSO,. Since the TSO is used to specify operating rule requirements, the status of revisions to the TSO with respect to operating rule requirements must be imminently clear.	**compliance.**	subsequent version of that document.
Garmin	Page 1, Paragraph 3.b	Misplaced comma after the word "Appendix 1".	Editorial comment.	Move the space from in front of the comma to behind the comma.	Accepted: Change made within document.
Garmin	Page 1, Paragraph 3.b	TSO paragraph 3.b defines the failure condition for the functionality. "Malfunction of the function defined in paragraph 3.a. of this TSO is a major failure condition." In most cases failure conditions should be determined by aircraft level safety analysis.	This statement implies the failure condition classification of an appliance is determined by the TSO regardless of mitigations employed to meet aircraft level safety requirements such as redundant appliances/systems. Unless the DAL cannot be affected by the installation, the aircraft System Safety Assessment should determine the failure classification and by extension, the design assurance level (DAL) requirement. The aircraft FHA/SSA ultimately	We recommend that no failure classification/DAL requirement be included in a TSO when the installation can affect or mitigate the hazard level and therefore consideration should be given to revising paragraph 3b in this TSO to the following general guidance in the suggested change: (Note that TSO-C112c is an example where a classification/DAL may be appropriate as a	Not Accepted: Based on the intended function of the TAWS equipment, the TAWS must be designed to a minimum failure condition classification of major.

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			determines the DAL requirement for a particular installation. Specifying the DAL at the appliance level without the benefit of the specific aircraft level FHA/SSA means that in some cases the DAL will undoubtedly be higher and more costly than necessary. This will have a chilling effect on the installation of new, safety enhancing technologies since the cost will be greater than necessary. It is possible to build and certify a TSOA appliance that cannot be approved for installation in one or more aircraft types because it does not have the required DAL. Similarly, just because the appliance meets a TSO DAL does not mean it can be approved for installation.	transponder output is used by the national airspace system and the installation has no ability to mitigate the safety risk.) Suggest changing to the following wording: "Develop each system to at least the design assurance level required by the anticipated installation for the function defined in paragraph 3a"	
Honeywell	Page 2, Paragraph 3.d	Manufacturers are still making changes to TAWS equipment that was approved by the FAA before the effective date of TSO-C151c. These legacy Terrain Awareness Warning System should not be required to be subjected to test conditions specified in a later revision of RTCA/DO-160, even if a (non-hardware) design change is made to the equipment.		Add the following: FAA-approved TAWS equipment previously certified to the FAA certification requirements specified in RTCA/DO-160C, or other revision in effect at the time of TSO-C151 authorization, must be considered in compliance with TSO-C151c for the purposes of environmental	Not Accepted: The FAA will accept DO-160D with Changes 1-3 incorporated, or any subsequent revision of DO-160. Additionally, with an approved deviation in accordance with 14 CFR § 21.618, manufacturers may

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				qualification, unless the electronic hardware has undergone a TSO Major change."	use DO-160 D or previous. Companies can continue to manufacturer TAWS equipment under the previous revision of this TSO and meet the requirements of that revision.
Garmin	Page 2, Paragraph 3.e	Paragraph 3.e states: **Software Qualification.** If the article includes software, develop the software according to RTCA, Inc. document RTCA/DO-178B, Software Considerations in Airborne Systems and Equipment Certification, dated December 1, 1992 to the design assurance level consistent with the failure condition classifications defined in paragraph 3.b. of this TSO. If agreed to remove the DAL from paragraph 3.b first sentence then this statement needs to change.	Same as comment for paragraph 3.b	Suggest the following wording: The software design assurance level should be commensurate with the requirements of the proposed aircraft installations	Not Accepted: Based on the intended function of the TAWS equipment, the TAWS must be designed to a minimum failure condition classification of major. The software design assurance level must be consistent with this failure condition classification.
Honeywell	Page 2, Paragraph 3.f	TAWS equipment that was approved by the FAA before RTCA/DO-254 was introduced as guidance and is not undergoing a hardware change should not be required to meet RTCA/DO-254.		Add the following: FAA-approved TAWS equipment previously certified prior to adoption of RTCA/DO-254 must be considered in	Not Accepted: TAWS equipment developed to TSO-C151c must be developed in

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				compliance with TSO-C151c for the purposes of electronic hardware qualification if the complex custom airborne electronic hardware has not changed."	accordance with DO-254. TSO-C151b equipment being upgraded to TSO-C151c and previously developed to other airborne electronic hardware standards may apply for a deviation in accordance with 14 CFR § 21.618 to use the previous hardware standard. Companies can continue to manufacturer TAWS equipment under the previous revision of this TSO and meet the requirements of that revision. If the companies decides to make a major change to it must meet the requirements of the newest version, TSO-C151c.
Garmin	Page 2,	Paragraph 3.f states:	Same as comment for paragraph	Suggest the following	Not Accepted:

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	Paragraph 3.f	**Electronic Hardware Qualification.** If the article includes complex custom airborne electronic hardware, develop the component according to RTCA, Inc. Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware to the design assurance level consistent with the failure condition classifications defined in paragraph 3.b. of this TSO. If agreed to remove the DAL from paragraph 3.b first sentence then this statement needs to change.	3.b	wording: The complex custom airborne electronic hardware assurance level should be commensurate with the requirements of the proposed aircraft installations	Based on the intended function of the TAWS equipment, the TAWS must be designed to a minimum failure condition classification of major. The hardware design assurance level must be consistent with this failure condition classification.
Garmin	Page 3, Paragraph 4.b.(2)	Paragraph 4.b.(2) states: Each subassembly of the article that you determined may be interchangeable. This language is confusing.	The language for this requirement is confusing. This could mean that a stuffed printed circuit board needs the TSO number.	Suggest removing the statement or if removing causes problems work with industry to establish wording that is better understood.	Not Accepted: Paragraph 4.b.(2) does not to require TSO marking of circuit boards. This language is part of Order 8150-1B Change 1 and is not changed in this TSO, however we will consider clarification of this section in future revisions to the Order.

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Honeywell	Page 4, Paragraph 5.d	A TSO applicant for TAWS equipment that was approved by the FAA before RTCA/DO-254 was introduced as guidance and is not undergoing a hardware change should not be required to provide a plan for hardware aspects of certification (PHAC), hardware verification plan, and hardware accomplishment summary.	TAWS equipment developed to TSO-C151c must be developed in accordance with DO-254 and provide the data listed in the TSO. Applicants making software only changes to TSO-C151b equipment to update them to TSO-C151c may coordinate with the applicable ACO to utilize the hardware documentation previously submitted. Depending on the scope, this may require a deviation in accordance with 14 CFR § 21.618.	Add the following: FAA-approved TAWS equipment previously certified prior to adoption of RTCA/DO-254 must be considered in compliance with TSO-C151c for the purposes of electronic hardware qualification if the complex custom airborne electronic hardware has not changed. Therefore, a PHAC, hardware verification plan, and hardware accomplishment summary are not required for TSO authorization	Not Accepted: TAWS equipment developed to TSO-C151c must be developed in accordance with DO-254 and provide the data listed in the TSO. Applicants making software only changes to TSO-C151b equipment to update them to TSO-C151c may coordinate with the applicable ACO to utilize the hardware documentation previously submitted. Depending on the scope, this may require a deviation in accordance with 14 CFR § 21.618.
Garmin	Page 4, Paragraph 5.f	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	TSO paragraph 5.f states "Identify functionality or performance contained in the article not evaluated under	Reword to point to Order 8110.4C CHG 4 paragraph 6-9.b.(1) and 6-9.b.(3).(a) for the definition of non-TSO	Not Accepted: By definition, a non TSO function does not support or

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		inconsistent with Order 8110.4C CHG 4.	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 if these criteria are used. If, for example, a TSO says 10 watt transmitter and I make one that is robust at 11 watts. So the performance is not called out under the TSO so now my 11 watt transmitter has a non-TSO 1 watt capability etc. The distinction of a "function that can be accomplished outside the TSO box" is critical to making non-TSO work long term.	function.	affect the hosting article's TSO function(s), and could technically be implemented outside of the TSO article. Exceeding the performance standards of this TSO, such as building an 11 watt transmitter when a 10 watt transmitter is the minimum, is not considered non TSO functionality. The intent of the language in Order 8110.4c Change 4 and Order 8150.1b Change 1 is consistent.
Garmin	Page 4, Paragraph 5.f	TSO paragraph 5.f and its subparagraphs define required information to be supplied to the ACO. This guidance is inconsistent with Order 8110.4C CHG 4.	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 Data Submittal" requirements.	Reword to point to Order 8110.4C CHG 4 paragraph 6-9.b.(3).	Not Accepted: Submittal of both test procedures and test results is appropriate. The guidance in 8110.4c Change 4 does not relieve the applicant from the requirement to provide data on

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			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.		test results for non-TSO functionality for this TSO.
Honeywell	Page 6, Paragraph 6.h	A TSO applicant for TAWS equipment that was approved by the FAA before RTCA/DO-254 was introduced as guidance and is not undergoing a hardware change should not be required to provide RTCA/DO-254 hardware life cycle data.		Add the following: FAA-approved TAWS equipment previously certified prior to adoption of RTCA/DO-254 must be considered in compliance with TSO-C151c for the purposes of electronic hardware qualification if the complex custom airborne electronic hardware has not changed. Therefore, hardware life cycle data as specified in RTCA/DO-254 are not required for TSO authorization."	Not Accepted: TAWS equipment developed to TSO-C151c must be developed in accordance with DO-254. TSO-C151b equipment being upgraded to TSO-C151c and previously developed to other airborne electronic hardware standards may apply for a deviation in accordance with 14 CFR § 21.618 to use the previous hardware standard.
Garmin	Page 6, Paragraph 7.b	TSO paragraph 7.b contains wording that is inconsistent with several FAA Orders.	TSO paragraph 7.b includes additional guidance about what	Reword to point to Order 8110.4C CHG 4 paragraph 6-	Not Accepted: The requirement to

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			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 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).	9.b.(6).	furnish the data in paragraphs 5.f.(1) through 5.f.(4) is appropriate.
ATA	Page 6, Paragraph 8.c.	TSO-C151 is not posted on the URL cited, but should be.	TSO-C151 sets minimum operating rule requirements.	Please post TSO-C151 under the "Active Historical" TSO category on the URL cited, or provide it on another URL and cite that URL in Para 8.c.	Accepted:
ATA	Page 7, Appendix 1. Paragraph 1.3	Revise the last sentence as recommended on the right.	Per the TAWS rule (14 CFR § 121.354 (a)), the minimum operating requirements for TAWS are specified in the original TSO-C151. This new TSO should make clear that its specifications apply only to TAWS systems marked "TSO-C151c". It does not apply to "all" TAWS systems	The basic TAWS functions **for TAWS systems approved under this TSO** include the following:	Accepted: Sentence was added.

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Airbus	Page 7, Appendix 1, Paragraph 1.3	Paragraph 1.3.e 6th bullet explains that: *"The altitude callout is not defined in RTCA/DO-161A but is a requirement for the TAWS system. The altitude callout requirements are defined in paragraph 3.3.c. of this appendix"* Some aircraft installations have altitude call-out managed by other computer than the TAWS system or by operational procedure (SOP). On AIRBUS aircraft, the Flight Warning System (FWS) manages & performs the 500ft altitude call-out to ensure an homogoneous alerting cockpit philosophy (priroity management, intelligibility, ...) at aircraft level. TSO C151c shall allow to disable the altitude call out capability on TAWS products for aircraft having this capability implemented in another system (as FWS on Airbus aircraft).	Altitude call-out is an aircraft level requirement that should be managed and introduced in the cockpit by taking into account of the whole alerting cockpit design (priority management, intelligibility, ...). Alternate design for the implementation of 500ft altitude call-out should be acceptable. .	Add a specific note to explain that TAWS 500ft call-out function can be inhibited at TAWS equipment level when this function is performed by another computer at aircraft level. In current TAWS equipment standards, the altitude call out capability is activable by pin programming.	Not Accepted: All TAWS equipment must be able to make the 500 foot voice call out. Inhibiting the 500' call out should be addressed at the installation level.
Honeywell	Page 7, Appendix 1, Paragraph 1.3	We recommend allowing inhibiting Mode 5 for LPV and GLS approaches below MDA or DH. This is to reduce nuisance alerts during short final, when the aircraft is being flown visually.			Partially Accepted: See General Comment Response #1
Garmin	Page 7, Appendix 1,	With regard to the sentence "The basic TAWS functions for all TSO-approved	The sentence is unclear and	Consider re-writing the sentence to be clear and	Not Accepted:

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	Paragraph 1.3	systems include the following". What are the "basic TAWS functions" and where is this term defined (e.g. what does the term "basic" refer to)? This sentence states "for all TSO-approved systems", but that is untrue based on the subordinate information (e.g. some are only applicable to TAWS-A systems).	inaccurate.	accurate.	Section 1.3 has adequate clarity and the organization is consistent with TSO-C151a and TSO-C151b. Specifically, subparagraphs a-c apply to Class A&B. - Subparagraphs d-e apply to Class A. - Subparagraph f applies to Class B
THALES	Page 7, Appendix 1, Paragraph 1.3b	Does such a change implies that the PDA function must always be assessed with a 3° approach path angle or could be assessed with the effective approach angle for that runway (which in general is 3° but could be different at some locations) ?			Accepted: The language was reverted back to the language in TSO-C151b.
THALES	Page 7, Appendix 1, Paragraph 1.3e General comment on GPWS mode emphasis	This new version of TSO is a. requiring full implementation of DO161A (App.1 §1.3.) b. eliminating the provision to adjust or modify without a deviation the GPWS envelopes to minimize nuisance alerts (App.1 §1.3.e and §3.3) Though GPWS modes have been a significant improvement in reducing CFIT, it should be remembered that TAWS concept has been promoted and widely endorsed by the worldwide community as a solution for alleviating well-known limitations in the late			Partially Accepted: See General Comment Response #1

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		90's (1995-2001) of GPWS modes 1 & 2, typically : - a very high nuisance alert rate alleviating crew confidence in corresponding alerts, driving at that time, crew to ignore those alerts in some situations - insufficient rate of protection provided by GPWS modes 1 & 2, which were estimated (by an analytical study provided by Thales to FAA in 2004) to be not greater than 25% for Mode 1 and 50% for Mode 2, whereas protection rate provided by the FLTA/PDA function could be as close to 100% depending of the design (95 to 100% detection rate of effective CFIT situations).			
THALES	Page 7, Appendix 1, Paragraph 1.3e	Rather than referring to DO 161A, proposed TSO C151c annex should integrate (as deemed acceptable by FAA) the revised envelopes and modes (with the suppression of unjustified mode subcategories which are not explicitly called for in §1.3.e and/or §3.3) taking into account the 30+ years of GPWS modes operational exposure.	DO161A is a very old document (May 1976) published at the early days of GPWS has been maintained and this new TSO version has not grab the opportunity to discard any reference to that document, since DO161A does not take into account all the mode envelopes and sub-categories improvements gained over the years since 1976 (when this document has been issued) up to the mid 90's thanks to the former GPWS operational exposition. As a result, in the current TSO'ed TAWS and even in the latest GPWS versions (in the mid 90's timeframe), the		Partially Accepted: See General Comment Response #1 The FAA will take into consideration the possibility of reconvening a RTCA committee in the future to revise RTCA/DO-161A to incorporate the numerous improvements made over the years.

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			different mode envelopes were and are no more implemented as described in such a document for long. Additionally Mode 3 and 4 sub-categories are specific to one vendor implementation.		
THALES	Page 7, Appendix 1, Paragraph 1.3e	Previous allowance to adjust or modify the GPWS envelopes to minimize nuisance alerts, or even to desensitize GPWS Modes 1 and/or 2 must be kept as far as an equivalent level of safety can be substantiated. However, if explicit deviations are included in this new TSO version, they should consider not only one implementation, but must also take into consideration current approved designs (including DO161A adjusted and/or modified envelopes).	Though explicit allowances for eliminating GPWS nuisance alerts (App.1, §3.4) are included in this proposed TSO 151c version, "elimination of the provision to adjust or modify without a deviation the GPWS envelopes to minimize nuisance alerts" which was included in previous TSO C151 versions, is a significant backward approach, denying the GPWS past history and rationale for the TAWS mandate (superseding the previous GPWS mandate as a result of the too high GPWS nuisance rate driving lack of confidence of crew in corresponding alerts). The explicit allowances for eliminating GPWS nuisance alerts (App.1, §3.4) are specific to one vendor implementation (Honeywell EGPWS). Suppression of the previous TSO C151b "provision to adjust or modify without a deviation the GPWS envelopes to minimize		Partially Accepted: See General Comment Response #1

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			nuisance alerts" (App.1 §1.3.e and §3.3) will restrict explicit allowances to a specific proprietary design and drives to non-compliance, with regard to this new TSO C151c version, of existing TSO C151a/ b approvals already granted (with adjusted or modified without a deviation the GPWS envelopes) and currently in operational service with high efficiency records.		
ACSS	Page 7, Appendix 1, Paragraph 1.3e	Consistent with first comment, ACSS disagrees with requiring the TAWS to meet all conditions defined in DO-161A.	See first comment above.	A return to the language of "Some GPWS alerting thresholds may be adjusted or modified to be more compatible with the FLTA alerting functions and to minimize GPWS nuisance alerts" is requested.	Partially Accepted: See General Comment Response #1
Cessna	Page 8, Appendix 1, Paragraph 1.3.e, Bullet 5	Current Wording: Mode 5: Excessive downward deviation from an Instrument Landing System (ILS) glide slope, LPV, and/or GLS glide path. Note: DO-161A glideslope requirements are incorporated for GLS and LOV glide paths for TAWS Class A systems reference paragraph 3.3.f.		Proposed Wording: Mode 5: Excessive downward deviation from an Instrument Landing System (ILS) glide slope, Localizer Performance with Vertical guidance (LPV), Area Navigation (RNAV) (GPS) Vertical Navigation (VNAV), (or RNAV Required Navigation Performance (RNP)) vertical deviation, and/or Global Positioning Landing System (GLS) glide	Not Accepted. The TAWS system may be designed to provide deviation alerting for RNAV and RNP approaches, but it is not included as a minimum requirement for TAWS systems.

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				path. Note: DO-161A glideslope requirements are incorporated for GLS and LOV glide paths for TAWS Class A systems reference paragraph 3.3.f.	
Transport Canada	Page 8, Appendix 1, Paragraph 1.3.e, Bullet 6	The requirement for the 500' callout should be based solely on the nearest runway elevation. If it is based on height above terrain, then when flying into a plateau airport such as Telluride (KTEX), the 500' callout would not be heard until very short final.			Accepted Because the TAWS will have knowledge of the nearest runway elevation it is appropriate to base this call out on the runway elevation.
Garmin	Page 8, Appendix 1, paragraph 1.3.f	The altitude callout for Class B TAWS is defined as 500 feet above the nearest runway elevation. The altitude callout for Class A TAWS is defined in paragraph 1.3.e as 500 feet above the terrain or nearest runway elevation. Appendix 1, paragraph 3.5.c defines the Class B TAWS altitude callout as 500 feet above terrain or nearest runway elevation, so it is unclear whether the Class B TAWS altitude callout can alert using either reference.	Document inconsistency	Change paragraph 1.3.f to match the text of 1.3.e.	Partially Accepted: Text will be changed to match which is stated in Paragraph 1.3.e. which reverts back to the wording in TSO-C151b
Garmin	Page 8, Appendix 1, paragraph 1.4	It does not seem necessary to quote "human-made" in the context of obstacles.	Editorial comment	Remove quotes.	Accepted: Quotation marks removed.

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Garmin	Page 8, Appendix 1, paragraph 1.5	Singular/plural disagreement with "an onboard terrain and airport databases"	Editorial comment	Remove 'an'	Accepted: Word will be removed.
ATA	Page 8, Appendix 1, Paragraph 2.0.	Add a new definition as recommended on the right.	The TSO should define "advisory" and "informational" alerts as it uses those terms.	**2.2 Advisory Alert. The level or category of alert provided to the flight crew for information.**	Partially Accepted: An advisory alert definition was added but in accordance with the definition in AC 25-1322-1.
ATA	Page 9, Appendix 1, Paragraph 2.0.	Add a new definition as recommended on the right.	The TSO should define "advisory" and "informational" alerts as it uses those terms.	**2.10 Informational Alert. The level or category of alert provided to the flight crew for information.**	Not Accepted. It was not the intent of this AC to convey a new category of informational alerting. The information provided by the V1, 500 foot, and minimums call outs is just that, information. These call outs are part of normal operations, and thus don't qualify as alerts. Although the definitions section is not being updated, Appendix 1 is being updated to remove the inference that

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					there is an informational alert.
THALES	Page 9, Appendix 1, Paragraph 2.3	The appropriate caution definition should be clarified or revised.	Caution definition has been revised by introducing " and subsequent flight crew response". This addition seems not compatible with the SAE ARP 4102-4 and/or AC 25-1322-1 definitions.		Accepted: The caution definition was revised.
ACSS	Page 9, Appendix 1, Paragraph 2.3	Cautions and warnings are defined, but not Advisories.	Callouts are referred to as advisories elsewhere in C151C. Because there is this definition section, it would be consistent to include the advisory definition. The definition should be consistent with FAR 25.1322 and AC25-1322.	Add a definition for advisories.	Accepted: A definition for advisories was added.
Garmin	Page 9, Appendix 1, Paragraph 2.3	The definition for Caution and Warning Alert were changed from TSO-C151b and are now very similar (both use the phrase "immediate flight crew awareness"). Is this what was intended?	The two definitions are very similar.	Consider the two definitions and see if they should be revised.	Accepted: The definitions were changed in accordance with those specified in AC 25-1322-1.
THALES	Page 9, Appendix 1, Paragraph 2.11	"Obstacle" word should be suppressed from the terrain cell definition. This definition should also allow for a fixed or variable margin over the real terrain elevation.	A definition for terrain cell has been added, but such definition is referring to obstacle elevation. Though this is in line with that fact that TERPS are defining required Obstacle clearance (ROC), this definition is not consistent with the statement that "human-man" obstacles are considered as an added feature as per §1.4. What is called "terrain"		Accepted.

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			is an envelope over the effective real earth surface, without "human man obstacles". Additionally, although the terrain cell is generally the highest terrain elevation in the grid of a geographical area, such TSO is too much prescriptive and should allow that terrain cell may include the height of a fixed or variable margin over the aforementioned highest terrain elevation (such as Safety Altitudes).		
ACSS	Page 9, Appendix 1, Paragraph 2.11	Disagree with terrain cell definition of "highest terrain elevation and/or obstacle elevation within a defined geographical area".	If terrain cells and obstacle cells are independent through separate database updates, then obstacle heights are not represented in the terrain cell. Strike obstacle from this definition. As this is an "and/or", we might be OK choosing not to honor the "or", but the meaning of "and/or" is not clear. The "or" could mean, if an obstacle exists in this region then the height of that obstacle must be included in the terrain database.	Phrase this as "highest terrain elevation within a defined geographical area. If a supplier desires, obstacle height can be included in the terrain elevation.	Accepted: Changes made to paragraph.
ACSS/THALES	Page 9, Appendix 1, Paragraph 2.11	Adding the definition of ROC and RTC can be helpful in this section.	It is perceived that the TERPS use of ROC applies here and does not refer to obstacles in the sense of man-made structures.	Add definition of ROC and RTC.	Accepted: Definitions were added.
ATA	Page 11, Appendix 1, Paragraph 3.2, second and	Noted that by not defining the surfaces, the alert mechanization would not be standard and would allow wide variations in alerting the crew to the state of the aircraft.	Alerts to crew would not be standard and could vary significantly.	None	Not Accepted: This TSO, as with previous revisions of the TSO,

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	third sentences from the end				defines a high level PDA requirement, but leaves the actual design up to the manufacturer.
THALES	Page 11, Appendix 1, Paragraph 3.2.a	PDA alert should be allowed anytime an aircraft is coming down far from a runway, with an appropriate approach angle, without consideration of any runway heading.			Accepted: The statement "It also 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.)
Garmin	Page 12, Appendix 1, Paragraph 3.2.d	Extra space before the "/" in the phrase "…airport /runway…".	Typo.	Remove the extraneous space.	Accepted.
ATA	Page 12, Appendix 1, Paragraph 3.3, Altitude Callout bullet.	Noted that the TSO would make the 500 callout a requirement for the TSO-C151c marking. ATA maintains that the original TSO did not make the callout an operating rule requirement. Further, a 500 callout would not be standard with existing Airbus practices, which use "400" callouts.	Consistency with comment # 1.	See comment # 1.	Not Accepted: The 500' call out is an explicit requirement for the TSO.

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THALES	Page 12, Appendix 1, Paragraph 3.3	Cf comment Page 7/ App 1 - 1.3 e on allowance for adjustment of GPWS envelopes			Partially Accepted: See General Comment Response #1
THALES	Page 12, Appendix 1, Paragraph 3.3	It should be clearly clarified that application for TSO C151c will not additionally require for TSO C92c application.	Note related to TSO C92c has been discarded, as TSO C92c has been superseded by TAWS rules. Therefore references to TSO C92c, as in §3.3, are no more appropriate.		Accepted. A note has been added to Appendix 1, Section 11, stating that the TSO-C92c requirements apply to TAWS equipment, however a separate TSO authorization is not required.
ACSS	Page 12, Appendix 1, Paragraph 3.3	Strongly disagree with removal of sentence "*Some GPWS alerting thresholds may be adjusted or modified to be more compatible with the FLTA alerting functions and to minimize GPWS nuisance alerts*" and replacement with specific thresholds of DO-161 for Modes 1 through 5.	References first ACSS general comment.	A return to the language of "Some GPWS alerting thresholds may be adjusted or modified to be more compatible with the FLTA alerting functions and to minimize GPWS nuisance alerts" is requested.	Partially Accepted: See General Comment Response #1
ACSS	Page 12, Appendix 1, Paragraph 3.3	The current reference to height above threshold elevation can be confusing.	The new wording is ambiguous. It is not clear if the "OR" clause is an option, or if this means that if the gear is down the 500 callout must be referenced to nearest runway.	Reword to: "Class A equipment must provide an advisory voice callout of "five hundred" or equivalent when descending through 500 feet above the terrain. Optionally, when the landing gear is down, the equipment may instead base the 500ft callout on height above the nearest airport or nearest	Partially Accepted: The wording was clarified and reverted to TSO-C151b wording. The 500 foot call out has the following changes: 1. It is no longer called an "advisory" call out, as advisory

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				runway."	could be construed to mean advisory alert, and because the 500' callout is a routine callout, it can not be classified as an alert. 2. The requirement has been reworded to clarify that the TAWS must make a voice call out at 500 feet. 3. The requirement to make the 500 foot call on all approaches has been changed back to the TSO-C151b requirement for a 500 foot call out on non precision approaches. 4. The requirement has been clarified to state that the 500 foot call out must be made above the runway elevation, versus the TSO-C151b allowance for the runway threshold elevation or

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					terrain.
Garmin	Page 12, Appendix 1, Paragraph 3.3.a	TSO-C92c, Section a.(2).(iv), contains the following statement: ***A separate guarded control may be provided to inhibit Mode 4 warnings based on flaps being in other than the landing configuration.*** TSO-C151c, Appendix 1, Section 3.3a, contains the following statement: ***A separate guarded control may be provided to inhibit GPWS alerts based on flaps being other than the landing configuration.*** The only significant difference in these two requirements is that the term "Mode 4 warnings" has changed to "GPWS alerts". The change in terminology from "warnings," as used in TSO-C92c, to "alerts" in TSO-C151c is understandable because TSO-C151c adds a severity of caution, and the word "alerts" can cover both levels of severity. However, the change from "Mode 4" to "GPWS" could be interpreted to mean that flap alerting inhibition is extended to Modes 2 and 3, because both of those alerting functions can generate alerts based on flaps being other than landing configuration.	Unclear specification.	Change "GPWS" to "Mode 4" in the sentence "A separate, guarded control may be provided to inhibit GPWS alerts based on flaps being other than landing configuration."	Accepted.

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ATA	Page 12, Appendix 1, Paragraph 3.3.c.	Insert the condition recommended on the right after the first sentence.	Clarity of a significant change in alerting logic. Unlike earlier TSO versions, this revision is proposing altitude callouts regardless of whether an approach is in progress. The only criteria for alert activation would be: 1. Descending through altitude threshold, and 2. Landing gear (ie, wheels) down. This would preclude "Smart Callouts".	**("Landing gear" excludes flight control surfaces.)**	Accepted: The final version of TSO-C151c reverts to the TSO-C151b requirement for a 500' call out only on non precision approaches, versus all approaches. Additionally, the landing gear status has been removed from the requirement.
Transport Canada	Page 12, Appendix 1, Paragraph 3.3.c	This subsection would benefit from increased explanation. The intent appears to be to prohibit functions such as Honeywell's "Smart 500" callout, which suppresses the 500' callout when on a glideslope. TCCA agrees that the 500' callout should occur regardless of the type of approach.			Not Accepted: The requirement for a 500 foot callout for all approaches was removed. The 500 foot callout requirement for non-precision approaches was restored. The 500 foot call out is still recommended for all approaches.
Transport Canada	Page 12, Appendix 1, Paragraph 3.3.c	Per previous comment, the requirement for the 500' callout should be based solely on the nearest runway elevation. If it is based on height above terrain, then when flying into a plateau airport such as Telluride (KTEX),			Accepted.

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
		the 500' callout would not be heard until very short final.			
Honeywell	Page 12, Appendix 1, Paragraph 3.3c	Many aircraft (e.g., Airbus A320, A330, A340, and A380) have another system besides TAWS that provides a 400- or 500-foot callout. We suggest adding a note that allows TAWS equipment without a 500-foot altitude callout to be authorized under this TSO in these installations without requiring a deviation from the TSO.			Not Accepted: All TAWS equipment must make the 500 foot voice call out.
Transport Canada	Page 13, Appendix 1, Paragraph 3.3.d	The benefit of retaining the option for sweep tones with new TAWS equipment is unclear.			Not Accepted: The sweep tones continue to provide an attention getting aural alert for terrain alerts.
Transport Canada	Page 13, Appendix 1, Paragraph 3.3.e	Suggest changing "may" to "should", i.e. "The glide path aural alert, should say "glide path" or equivalent instead of "glideslope" ...			Concur: The change was made.
THALES	Page 13, Appendix 1, Paragraph 3.4 General comment on this section	Consideration and the need to alleviate inherent Mode 1 and/or 2 nuisance alerts, has driven the design for a breakthrough solution (called TAWS) departing from previous GPWS method for CFIT prevention. TAWS in its original concept (providing a capability encompassing both FLTA/PDA) was designed and certified to fully replace Mode 1 & Mode 2 as long as its functionality is			Partially Accepted: See General Comment Response #1

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		operative. Putting now strong emphasis on those Modes is significantly departing backwards from the benefits provided by the TAWS functionality (in particular significant CFIT reduction altogether with significant air travel safety improvement).			
Honeywell	Page 13, Appendix 1, Paragraph 3.4	Relative to DO-161A, Honeywell has made numerous improvements to reduce nuisance alerts. Most of these improvements were implemented in GPWS computers in the 1980s and were carried into the EGPWS.		Add the following: **Aural Declutter** Real-world experience with early GPWS products showed that the continuous aural alerts required by DO-161A were considered a nuisance by pilots. Aural declutter reduces the repetitious aural alerts for Modes 1, 3, 4, and 5 by implementing a ratcheting function whereby a follow-on aural alert only occurs when the condition worsens sufficiently (i.e., the aircraft penetrates a warning envelope further). **ILS Mode 2B** To reduce nuisance Mode 2 alerts during approach, the	Partially Accepted: See General Comment Response #1

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				Mode 2B curve is selected when the aircraft is performing an ILS, LPV, or GLS approach and is within 2 dots on glideslope (vertical deviation) and localizer (lateral deviation), even when flaps are not in the landing configuration. **Mode 3 (takeoff) Transition to Approach Mode** The FAA has introduced noise abatement takeoff procedures for specific airports (e.g., Orange County). Use of the simple DO-161A Approach Mode Transition requirements in these cases can cause Mode 3 protection to be disabled while the aircraft is still in the takeoff phase of flight. This can lead to Mode 4 becoming armed and producing nuisance GPWS alerts during takeoff. To ensure Mode 3 remains armed during noise	

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				abatement takeoff procedures, Honeywell implemented a new takeoff-to-approach algorithm that essentially integrates height and time to extend Mode 3 coverage. **Alternate Mode 4 Lower Envelope (Mode 4B)** This option, when enabled by program pin, activates an alternate Mode 4 curve when the flaps are in a landing configuration. The purpose of this option is to allow more maneuvering room during marginal performance go-arounds (e.g., engine inoperative) by selecting Flap Override and thus avoiding nuisance Mode 4 alerts. **Mode 4 Airspeed Expansion** EGPWS provides an expanded Mode 4 protection envelope that is	

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
				related to airspeed. This airspeed expansion exceeds the minimum performance required by DO-161A and provides improved ground proximity alerting. **Envelope Modulation** When this feature is enabled via a program pin and the required inputs are available, it provides modulation of certain warning envelope parameters in certain geographical locations to either enhance standard Mode 1-5 warning times or reduce known chronic nuisance warnings.	
THALES	Page 13, Appendix 1, Paragraph 3.4.a	Modification of the mode 1 alert should go beyond the steep approach only.	Allowance for change in mode 1 envelope is limited for steep approaches. Though it is an operational case for which mode 1 envelope has to be adjusted, such adjustment is not by itself sufficient to address and deeply reduce Mode 1 nuisance alerts for		Partially Accepted: See General Comment Response #1

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
			those which are not specific to "steep approach". Other adjustments, if not Mode 1 deactivation while FLTA and PDA are active, may be needed		
ACSS	Page 13, Appendix 1, Paragraph 3.4a	The rationale for the modifications to the Mode 1 curve is unclear.	The reversion to a specific DO-161A envelope, altered in a specific manner runs counter to the original authors' intent in the previous version's "*Some GPWS alerting thresholds may be adjusted or modified to be more compatible with the FLTA alerting functions and to minimize GPWS nuisance alerts*". See first comment above.	Remove the specific Mode 1 alteration.	Partially Accepted: See General Comment Response #1
Transport Canada	Page 13, Appendix 1, Paragraph 3.4.a	The affected airports should not be restricted to only those airports listed, but should include any airports meeting specific criteria. Presumably the key criteria would be the approach path angle. Approach path angles up to 4.5° generally should not require "steep approach" envelopes.			Partially Accepted: See General Comment Response #1
Garmin	Page 13, Appendix 1, Paragraph 3.4.a	Suggest that the idea of listing specific airport/approaches in a TSO is a poor practice, as airports and approaches come and go.	Airport/approaches frequently change while TSO revisions infrequently change. The usefulness of TSOs is dramatically decreased when they provide outdated data.	Suggest turning the list into a list of example problem approaches and instead using other criteria to have manufacturers be able to identify steep approach candidates, such as the glideslope/glide path angle as published in the aviation	Partially Accepted: See General Comment Response #1

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
				database.	
Honeywell	Page 13, Appendix 1, Paragraph 3.4.a	We suggest deleting Table 2b or adding text to indicate that Table 2b is an example, to allow for automatic enabling of the modified Mode 1 Envelope 3 for possible future steep approaches not listed in the table. We suggest adding Mode 5 to the list of changes		Add the following as subsection 'c': "**Mode 5, Excessive Downward Deviation from an Instrument Landing System (ILS) Glideslope, LPV, and/or GLS Glide Path.** Operational experience has shown that nuisance Mode 5 alerts occur at low altitudes, near the glideslope transmitting equipment. To reduce nuisance alerts, the lower threshold of the Mode 5 envelope may be set to 50 feet. In addition, it may be further increased to 130 feet when an approved aircraft is performing an approved steep approach."	Partially Accepted: See General Comment Response #1
ACSS	Page 13, Appendix 1, Paragraph 3.4a, Table 2b	Refer to the table.	It is unclear if the table represents examples of steep approach cases. If they are examples, are these meant to be test cases? As there could be new steep approaches released in years to come, clarify that this	Add sentences describing the use of Table 2b. The preferred position is that these are several examples of steep approaches.	Partially Accepted: See General Comment Response #1

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
			list is not comprehensive.		
Transport Canada	Page 13, Appendix 1, Paragraph 3.4.a, Table 2b	It's not understood why KSAN Rwy 27 is included in this list, as the approach path angle for both the LOC and the RNA V (GPS) to Rwy 27 is 3.14°.			Partially Accepted: See General Comment Response #1
Transport Canada	Page 13, Appendix 1, Paragraph 3.4.a, Table 2b	Stephenville, NF, did have an ILS with a steep glideslope (in excess of 4°). But quite a few years ago, this was reduced to 3.5°; thus CYJT should be removed from this list.			Partially Concur: Paragraph 3.4.a and Table 2b were removed from the final TSO.
Transport Canada	Page 13, Appendix 1, Paragraph 3.4.a, Table 2b	For reference, glideslope for 32R is 4.0°. Presumably this means that these approaches should be removed from this list.			Partially Concur: Paragraph 3.4.a and Table 2b were removed from the final TSO.
Transport Canada	Page 13, Appendix 1, Paragraph 3.4.a, Table 2b	For reference, glideslope is 4.46°. Presumably this means that this approach should be removed from this list.			Partially Concur: Paragraph 3.4.a and Table 2b were removed from the final TSO.
Garmin	Page 14, Appendix 1, Paragraph 3.4.a, Table 2b	The city *Chambery* is spelled incorrectly as *Chambry*.	Typo	Change *Chambry* to *Chambery* in table 2b.	Partially Concur: Paragraph 3.4.a and Table 2b were removed from the final TSO.
THALES	Page 13, Appendix 1, Paragraph 3.4.b		Allowance for change in mode 2 envelope is most probably insufficient to address and deeply reduce Mode 2 nuisance alerts, since by principle using downward		Partially Accepted: See General Comment Response #1

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			looking to predict forward risks is prone to erroneous assessment of the CFIT or not situation, moreover when taking into account the dynamic character of the flight path and of the overflown terrain		
THALES	Page 13, Appendix 1, Paragraph 3.4.b	Clarification or correction required	First 5 bullets at the end of App.1 §3.4 b are not related with this paragraph and should be spread in more relevant paragraphs. Additionally : first bullet : timing and other conditions at which FLTA and PDA must be active and inhibited are not defined ("may be inhibited" is not an effective requirement). second bullet : FMS solely based on GPS position is not consistent with §5.1 c third bullet : see next specific comment on "geometric altitude" fourth bullet : "may not have detected " is not an effective requirement. fifth bullet : "sufficient terrain" is not self-explanatory sixth bullet: same remark about reference to strict DO161A (cf Page 7/ App 1 - 1.3e above)		Partially Concur: Paragraph 3.4. b was removed.
THALES	Page 13, Appendix 1,	Recommendation is whether to provide a clear definition not relying on Honeywell	This wording is not defined and may be confused with the		Partially Concur: Paragraph 3.4.b was

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	Paragraph 3.4.b	definition or to use an alternate wording such as "MSL altitude".	Honeywell patented technology using that term.		removed. The statement that allows for adjustments and modification to the GPWS alert thresholds was restored, but with a caveat that a deviation must be requested when making those adjustments and modifications.
ACSS	Page 14, Appendix 1, Paragraph 3.4b, bulletized list	The bulleted points are not introduced and therefore it is difficult to see how they pertain.	We believe that this listing is a set of installation requirements that must be in place first, before modifications to the Mode 2 curve are allowed. If this is the correct interpretation, a lead in sentence would be helpful.	Add a sentence prior to the bulletized list reading "In order to modify the Mode 2 alerting envelope, suppliers must first ensure the following installation conditions are present;"	Partially Accepted: See General Comment Response #1
ACSS	Page 14, Appendix 1, Paragraph 3.4b, first bullet	The expression "FLTA and PDA features …may not be inhibited" is unclear as a requirement around allowing modification to the Mode 2 envelope.	Some suppliers have altered Mode 2 curves whether FLTA and PDA features are active or not. The same potential for nuisance alerts exists whether FLTA and PDA are active or not. This wording would allow modifications only if FLTA and PDA **are** active. Thus, the overall intent of reducing deviations for existing equipment is not met if this sentence is maintained.	Drop this sentence from the bullet list.	Partially Accepted: See General Comment Response #1
ACSS	Page 14, Appendix 1,	The term "suitable" seems vague here.		Cross reference "suitable" as being compliant with the	Accepted: The GPS requirement has

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	Paragraph 3.4b, second bullet			GPS requirements of App 1 – Section 5.1.	been reworded to reflect the previous requirement in TSO-C151b. Aircraft operated in 14 CFR § 121 operations may continue to use a non-GNSS position source as their only horizontal position source.
ACSS	Page 14, Appendix 1, Paragraph 3.4b, third bullet	The term "suitable" seems vague here.		Cross reference "suitable" as being compliant with the GPS requirements of App 1 – Section 5.2.	Partially Accepted: Paragraph 3.4.b was removed.
ACSS	Page 14, Appendix 1, Paragraph 3.4b, fourth bullet	Add more information on the satellite failure information.		Include reference that satellite failure is commonly obtained from HIL variable.	Partially Accepted: Paragraph 3.4.b was removed.
ACSS	Page 14, Appendix 1, Paragraph 3.4b, fifth bullet	Sufficient terrain seems confusing.	Is this number of terrain cells, granularity of height of terrain cells, etc? Could be replaced by term like "must have terrain data present in forward view of aircraft".	Cross reference "sufficient terrain" as being compliant with the terrain DB requirements of App 1 – Section 6.0.	Partially Accepted: Paragraph 3.4.b was removed.
ACSS	Page 14, Appendix 1, Paragraph 3.4b,	Consistent with first comment, ACSS disagrees with requiring the TAWS to meet all conditions defined in DO-161A.	Some suppliers have altered Mode 2 curves whether FLTA and PDA features are active or not. The	Drop this sentence from the bullet list.	Partially Accepted: Paragraph 3.4.b was removed.

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	sixth bullet		same potential for nuisance alerts exists whether FLTA and PDA are active or not. This wording would allow modifications only if FLTA and PDA **are** active. Thus, the overall intent of reducing deviations for existing equipment is not met if this sentence is maintained.		
AIRBUS	Page 14, Appendix 1, Paragraph 3.4.b	Paragraph 3.4b of draft TSO C151c provides very detailed design definition for Mode 2A and seems to impose a supplier implementation (the Honeywell one).	Alternative solutions exist and have been approved in other products (ACSS T2CAS/T3CAS).	Review TSO C151c §3.4b to remain requirements oriented and not design oriented.	Partially Accepted: See General Comment Response #1
AIRBUS	Page 14, Appendix 1, Paragraph 3.4.b	TSO C151c requires to use GPS input as a primary horizontal source. Due to this requirement, the aircraft shall be equipped with a GPS. As a result, airlines without GPS-equipped aircraft would not be able to upgrade their TAWS. While FAA may have issued such requirement, EASA did not.			Accepted: The GPS requirement has been reworded to reflect the previous requirement in TSO-C151b. Aircraft operated in 14 CFR § 121 operations may continue to use a non-GNSS position source as their only horizontal position source.
Honeywell	Page 14, Appendix 1,	In addition to the modification of the Mode 2A envelope described in the draft TSO-C151c and the ILS Mode 2B feature		Change wording as follows: **Mode 2, Excessive Closure Rate to Terrain.**	Partially Accepted: See General Comment Response

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	Paragraph 3.4.b	described above, Honeywell's EGPWS will select the Mode 2B curve when the conditions listed in paragraph 3.4.b are met and the aircraft is within 10 nautical miles laterally and 3500 feet vertically of an airport.		Operational experience has shown that occasional nuisance RTCA/DO-161A Mode 2A alerts occur between 1250 feet and 1000 feet above ground level (AGL) during approach before the gear and flaps are configured for landing. These alerts occur during air traffic control vectoring for approach at established safe minimum terrain clearance altitudes. To reduce these nuisance alerts the RTCA/DO-161A Mode 2A envelope must be modified when the gear and flaps are not in landing configuration and the conditions below persist. The Mode 2A gear up tolerance when initiating the test from 2450 feet is modified such that the maximum height above terrain is 950 feet versus 1250 feet. Also, the Mode 2B curve may be selected when the flight is in the terminal or approach phase	#1

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				and the conditions below persist."	
Garmin	Page 14, Appendix 1, Paragraph 3.4b	The tolerance specification is unclear as it is written. Does this imply a shifting of the entire GEAR UP dashed line curve (RTCA/DO-161A mode 2A envelope) downward by 300 feet? A flat top at 950 feet? Some other scheme of adjustment?	This specification is not verifiable. Ideally, a nominal envelope and tolerance envelopes are given, but a manufacturer can work backwards from the tolerance to define their nominal envelope based on the performance of their system by adding at least the worst-case tolerance required to the given tolerance envelope (as is done for RTCA/DO-161A Mode 1, Envelope 3), but only if the tolerance envelope is specified.	Clarify the nominal alert and tolerance envelope specifications. Recommend providing a graphical representation of what is required, or a list of control points, similar to what was provided for the Mode 1 steep approach adjustments. If aspects of the envelope are left to the manufacturer to define, clearly state which parts are open to definition.	Partially Accepted: See General Comment Response #1
ACSS	Page 14, Appendix 1, Paragraph 3.5.a	QNH needs no expansion.	QNH seems well understood throughout industry, where the Question Nil Height is archaic.	Strike "*Question Nil Height*"	Not Accepted: Within our documents we are required to spell out all acronyms.
Honeywell	Page 14, Appendix 1, Paragraph 3.5.a	Change "Question Nil Height (QNH) barometric altitude		Suggested change: QNH (corrected) barometric altitude".	Accepted.

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Transport Canada	Page 14, Appendix 1, Paragraph 3.5.a	Suggest referring to the "alerts for excessive descent rates" as "Mode 1 alerts", per section 1.3(f).			Accepted: Additional wording added for clarification.
Transport Canada	Page 14, Appendix 1, Paragraph 3.5.a	Most pilots have never heard of "Question Nil Height", and the inclusion of this term only serves to confuse matters. Most pilots are nonetheless quite familiar with the term QNH, but the origin of this Q-code, and what it might stand for, is irrelevant to the subject. Suggest that this reference NOT be changed from the wording in TSO C151b.			Not Accepted: Within our documents we are required to spell out all acronyms
Transport Canada	Page 14, Appendix 1, Paragraph 3.5.a	The use of the expression "QNH barometric altitude (or equivalent)" has not changed from C 151 b, but perhaps it should. Barometric altitude is subject to errors such as altimeter mis-sets and cold temperature effects, which can be significant. It is thus preferable, where possible, to use non-barometric sources of altitude fort AWS alerts. Basing Mode 1 alerts on a GPS-derived altitude would be preferable to basing them on QNH barometric altitude, but it's a stretch to say that a GPS-derived geometric altitude is "equivalent" to QNH barometric altitude.			Not Accepted. This TSO allows either the barometric altitude or GNSS altitude to be used.
Garmin	Page 15, Appendix 1, Paragraph 3.5.b	If a Class B TAWS installation has a radio altimeter input, must it substitute an actual height above terrain reading with an approximation based on aircraft altitude and runway elevation?	Unclear specification / document inconsistency	Change to a suggestion that if a radio altimeter input is unavailable, it *may* be substituted in the suggested manner.	Accepted. Language added to clarify that a radio altimeter input is acceptable for Class B TAWS

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		Would height above terrain as determined by aircraft altitude and terrain elevation be an acceptable substitution? Paragraphs 3.5.a and 3.5.c allow radio altitude to be used for excessive descent rates and voice callout alerting. Paragraph 3.5.c states: "Class A equipment has a radio altitude input, and therefore, the altitude callout can be referenced to the radio altimeter."		Consider whether height above terrain as determined by altitude and terrain elevation is an acceptable substitution, given that it is allowed for excessive descent rate alerting.	Mode 3 alerting.
Transport Canada	Page 15, Appendix 1, Paragraph 3.5.c	Per earlier comment, suggest that this be based solely on nearest runway elevation.			Partially Accepted The 500' call out for Class A and B equipment must now base the 500' call out on the altitude above the runway threshold elevation for landing. The Class B TAWS equipment must also provide a 500 foot voice call out above terrain when not landing. This 500 foot voice call out above terrain when not landing is an important CFIT

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					protection function.
Transport Canada	Page 15, Appendix 1, Paragraph 3.5.c	Per previous comment, the 500' callout should be based solely on the nearest runway elevation. If it is based on height above terrain, then when flying into a plateau airport such as Telluride (KTEX), the 500' callout would not be heard until very short final. Similarly, the callout would occur (much) later than expected when flying an approach to a runway that was higher than the terrain on its approach. The FLTA function should be relied on to provide alerts when not in the vicinity of the destination, but the 500' callout should be heard consistently at the same time during all approaches, regardless of the terrain surrounding the airport.			Partially Accepted. The 500' call out for Class A and B equipment must now base the 500' call out on the altitude above the runway threshold elevation for landing. The Class B TAWS equipment must also provide a 500 foot voice call out above terrain when not landing. This 500 foot voice call out above terrain when not landing is an important CFIT protection function.
Transport Canada	Page 15, Appendix 1, Paragraph 3.5.c	Without a radio altimeter, the TAWS would need to use its computed altitude (either GNSS geometric or barometric) AND an altitude from its database (either current terrain elevation or nearest runway elevation).			Accepted: Wording was added.
THALES	Page 15, Appendix 1, Paragraph 3.6.d	Clarification needed on the intent of that modification.	Variation in terrain elevation can be depicted with a part of anticipation to allow a better awareness of the pilot when a hazardous situation is growing,		Accepted: The added wording reduces the restriction and allow for the

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			before the alert. Initial TSO c151b statement allowed such improvement in awareness, why restricting it now?		anticipation of a hazardous situation.
ACSS	Page 15, Appendix 1, Paragraph 3.6.d	Disagree with "Variations in terrain elevation must be depicted relative to the airplane's elevation"	This statement does not match existing standards of showing variations relative to short term FPA projections. This predictive terrain depiction yields an image that can show a potential problem well ahead of alerting.	Change to with "Variations in terrain elevation must be depicted relative to the airplane's current or projected elevation"	Accepted. The added wording reduces the restriction and allow for the anticipation of a hazardous situation.
Transport Canada	Page 15, Appendix 1, Paragraph 3.6	The need to interface to a monochromatic display is not apparent, given that virtually all installations will interface to a color display. It is suggested to delete "or monochromatic" from the first sentence of this paragraph.			Partially Accepted: Language changed to require a color interface, but allow an optional monochromatic interface.
Honeywell	Page 15, Appendix 1, Paragraph 3.7	Change the first sentence back to previous version wording		Suggested change: Operators required to install Class B equipment are not required to include a terrain display."	Accepted.
Transport Canada	Page 16, Appendix 1, Paragraph 4.0	Throughout Table 3, it's stated that the visual alerts must be a "text message that is obvious, concise, and must be consistent with the aural message." In practice, external annunciators are often used to provide the visual alerts, particularly on retrofit			Acknowledged. Agree that EFIS Multi-function displays should have greater

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		installations. The amber alerts are typically labeled "TERRAIN", "TAWS "or "GPWS", whereas the red annunciators are invariably "PULL UP". Unfortunately, "TERRAIN", "TAWS" and "GPWS" are neither obvious, nor consistent, with the multitude of aural alerts which they accompany. While use of such labels is an acceptable compromise for discrete annunciators in retrofit installations, their use should not be allowed to continue on EFIS displays. For example, a visual annunciation of "GND PROX" on the PFD, is not consistent with an aural "GLIDES LOPE" alert, and is potentially confusing to the flight crew, especially considering that the same "GND PROX" visual alert could illuminate in combination with many other aural alerts, such as "CAUTION, TERRAIN", "SINKRATE", "TOO LOW GEAR", "TOO LOW FLAPS", etc. Such annunciations on an EFIS are also non-compliant with the draft FAR 25.1302.			fidelity in visual annunciations, however, because an EFIS is not a minimum requirement this type of requirement has not been added. TAWS intended for installation in Part 25 aircraft will have to address 14 CFR § 15.1302.
Transport Canada	Page 16, Appendix 1, Paragraph 4.0, Note 3	If the reference to monochromatic displays in Section 3.6 is deleted, then the reference to monochromatic displays in this section should also be deleted.			Not Accepted. Monochromatic displays are still a permissible option on TAWS equipment.
Transport Canada	Page 16, Appendix 1, Paragraph 4.0, Note 3	It should be stated that visual alerts of the appropriate color must be in the primary field of view of each required pilot. If the terrain situational awareness display is in the pilot's primary FOV, then additional			Not Accepted: Location of TAWS equipment in the aircraft is an installation

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		annunciators are not required. However, in most installations, either dedicated external annunciators will be required, or annunciation on the EFIS will be required. This is current industry practice.			requirement, versus an equipment requirement.
ATA	Page 15, Appendix 1, Paragraph 4.1.	Revise the sentence as recommended on the right.	Accuracy	The TAWS is required to provide aural and visual alerts for each of the functions described in **section** 3.0 of this appendix.	Partially Accepted: Use of the word section instead of paragraph in references to the TSO and its appendices have been updated.
ATA	Page 15, Appendix 1 Paragraph 4.2.	The first sentence, starting, "The required aural and visual alerts must initiate from the TAWS system …" is needlessly inconsistent with industry practices.	The TSO should be clear on the allowable role of other systems (eg, Airbus FWC, Boeing CAWS, or GPWS) in presenting these alerts. AFS has acknowledged that annunciation of aural alerts by other systems is acceptable	Modify the paragraph to state that the TAWS must "activate" the alert, and that the alert be must be presented or annunciated as described in the TSO, but the alert may be supplied by other power, hardware or display systems without need of a deviation approval.	Accepted: Wording added to allow for the alert to be initiated by the TAWS, but accomplished by other aircraft systems.
ATA	Page 15, Appendix 1, Paragraph 4.2.	A list of the types of allowable 'suppression' should be added at the end of the sentence.	We assume applicable types would include prioritization schemes, nuisance alert inhibitors, automatic inhibitors, and the selection feature introduced in paragraph 4.7. To avoid having to thumb through the document and to support better comprehension, they should be listed here.	Add a list of the types of allowable 'suppression' should be added at the end of the sentence.	Not Accepted. The intent of this paragraph is that visual and aural alerts must be accomplished in a manner that the crew associates them. The allowance for aural inhibiting with continued visual

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					alerting is clarified.
ATA	Page 16, Appendix 1, Paragraph 4.7.	Add after the sentence the text recommended on the right.	Add this internal reference to avoid readers taking the sentence out of context. Paragraph 9.1 indicates that for Class A TAWS, there could be only one "selectable" feature for alerts – a manual 'all on or all off' switch (only for FLTA and PDA alerts. Also, noted that altitude callouts would be selectable for Class C TAWS (See pgs 39-40).	**(See paragraph 9.1 of this appendix.)**	Not accepted: This statement in general is to discuss the arrangement of visual and aural alerts to reduce confusion amongst aircraft fleet types.
ACSS	Page 16, Appendix 1, Paragraph 4.8	Please clarify – no longer valid can be confusing.	We are assuming that a failure of telemetry is also couched under this paragraph's definition of "resolved". Obviously, if the system loses position inputs, it can no longer detect a situation that may or may not be resolved. A better wording might include an "or" between the original statement and the new one.	Change to "no longer valid or resolved:	Accepted.
THALES	Page 16, Appendix 1, Paragraph 4.9, Table 3	Simplify the table 3 by merging RTC and ITI alerts into FLTA alert	Rather than clarifying in App1 §4.9 in Note 2 that alerts related to "Reduced required terrain clearance" and "Imminent Impact with terrain" as part of the basic forward-looking functions, it would be better to combined the 2 corresponding lines in Table 3 in one single line dedicated to "FLTA alert"		Accepted.
ACSS	Page 16, Appendix 1,	Reduced Required Terrain Clearance and Imminent Terrain Impact have the exact	These two scenarios are both testing the single FLTA function.	Combine Reduced Required Terrain Clearance and	Accepted:

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	Paragraph 4.9, Table 3	same response and can be combined.	Therefore, the same response is expected. If left as is, the reader vainly tries to see the difference between the two entries.	Imminent Terrain Impact entries on this table.	
Garmin	Page 16, Appendix 1, Paragraph 4.9, Table 3, Mode 2B table entry	All of the alerts except for the Mode 2B warning require both a visual and aural alert. Mode 2b does not require a corresponding visual alert. Why?	Inconsistent function behavior.	Change the Mode 2B Visual Alert section from ***"None Required"*** to ***"Red text message that is obvious, concise, and must be consistent with the aural message."*** Or, add a note that explaining why it is not present in the table.	Accepted: Statement was added
Garmin	Page 16, Appendix 1, Paragraph 4.9, Table 3, Mode 3 table entry	With respect to the Mode 3 alerts, the aural alert definition was changed from ***"Don't Sink" and "Too Low-Terrain"*** To ***"Don't Sink" or "Too Low-Terrain".*** Why was the "and" changed to an "or"?	This change is not needed or desired.	Change the "or" back to an "and".	Partially Accepted: The language was changed to: "and/or" allowing either the "Don't Sink" or the "Too Low Terrain" while still allowing both the "Don't Sink Too Low Terrain" callout.
Garmin	Page 16, Appendix 1,	In the table for Mode 3, only the "Altitude Loss after Takeoff", or Mode 3B as defined	Missing "Mode 3A" alert	Change the existing "Mode 3" to "Mode 3B" and add a	Not Accepted. The aural and visual

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
	Paragraph 4.9, Mode 3 table entry	in RTCA/DO-161A, is called out. What about Mode 3A, or "Negative Climb Rate"?	definition.	new table entry for "Mode 3A".	annunciations for Mode 3A and 3B are the same.
Garmin	Page 18, Appendix 1, Paragraph 4.9, Note 2	Do not understand the necessity of this note. How does it help the definition? If we choose to keep it, then additional definitions should be added regarding "basic forward-looking functions".	Additional note unnecessary and potentially confusing.	Remove Note 2.	Accepted
Garmin	Page 18, Appendix 1, Paragraph 4.10.a	The first character in "table" should be capitalized since it starts a sentence ("table 4 includes an alert prioritization scheme.")	Grammatical error.	Capitalize the "t" in "table".	Accepted
ACSS	Page 19, 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 others are noted as being continuous. Then too, it appears that this comment is in regard to the aural message. Does a 7 s period indicate a time between each aural, as the alert itself is continuous (display, cockpit lamp) for the TAWS systems we know of.	Explain the comment column of this table.	Not Accepted: The comments column provides requirements for alert durations. Because of the self explanatory nature, no additional comments have been added.
ACSS	Page 19, Appendix 1, Paragraph 4.10, Table 4	It is confusing that RTC and FLTA are in this table, but Imminent Terrain Impact is not.	Aren't RTC and ITI just specific cases of the FLTA mode? Both are described in sub-sections of 3.1 FLTA. It doesn't make sense to have RTC Caution listed separately from FLTA Caution. (Note that ITI caution is not listed as a separate item.)	Combine RTC, ITI and FLTA in this table.	Accepted: RTC, ITI, and FLTA were combined within the table where it was deemed appropriate.

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ACSS	Page 19, Appendix 1, Paragraph 4.10, Table 4	Omission of Mode number in this table can create confusion.	Sink Rate is readily identified as a Mode 1 Caution. However, we see Sink Rate Pull-Up Warning. Isn't this better termed "Mode 1 Pull Up Warning".	Include either FLTA, PDA or the specific GPWS Mode along with the aurals on this table.	Accepted.
Garmin	Page 20, Appendix 1, Paragraph 4.10, Table 4	The new alert, "Glidepath", is missing from the table.	The "Glidepath" alert prioritization is unaccounted for.	Add the "Glidepath" alert to the prioritization table.	Accepted.
Garmin	Page 20, Appendix 1, Paragraph 4.10, Table 4	The table Caption callout "Table 4" is not with the actual table (it is currently on a separate page).	Readability problem.	Change the Caption callout style to "Keep with Next" so as to keep the table captions with the actual tables.	Accepted.
Garmin	Page 20, Appendix 1, Paragraph 4.10, Table 4	Mode 2 caution alerts are missing from the alert prioritization table. Why?	The Mode 2 caution alert prioritization is unaccounted for.	Specify the prioritization of Mode 2 caution alerts in Table 4. If they are not specified, indicate with a note why they are not specified so that a manufacturer understands how to prioritize appropriately.	Accepted: Mode 2 Caution alerts were specified in Table 4.
Transport Canada	Page 20, Appendix 1, Parapraph 5.0	The TAWS does not necessarily need a vertical rate source input, as vertical rate can be derived from vertical position.			Partially Accepted. Section 5 has been rewritten to accommodate a number of comments. The new language describes the types

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					of information the TAWS will need, and details the nuances between when the data source is internal to the TAWS, and included in the TSO application, or an external source with performance requirements outlined in the installation manual.
AIRBUS	Page 20, Appendix 1, Paragraph 5.0	TSO C151c requires to use GPS input as a primary horizontal source. Due to this requirement, the aircraft shall be equipped with a GPS. As a result, airlines without GPS-equipped aircraft would not be able to upgrade their TAWS. While FAA may have issued such requirement, EASA did not.			Accepted. The GPS requirement has been reworded to reflect the previous requirement in TSO-C151b. Aircraft operated in 14 CFR § 121 operations may continue to use a non-GNSS position source as their only horizontal position source.
THALES	Page 21, Appendix 1, Paragraph 5.1.	This new version of TSO should described the acceptable performance degradation (acceptable degraded nuisance alert rate,	This new TSO version (App.1 §5.1) require the sole use of position with GNSS accuracy for TAWS		Partially Accepted. The GPS

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		and acceptable degradation in miss-detection rate) when using a position source with alternate position means and/or with a non-GNSS accuracy.	However since CFIT results from both a) operational deviation of the expected flight path b) deviation of the expected flight path due to system positioning errors such requirement limits the protection provided by the TAWS to only the first case of operational deviations. But, as the effective goal of such a TAWS system is to cover deviations from the expected flight path not only operationally but also those resulting from system positioning errors, then, though GPS is the mandatory means which will allow to ensure the best performance in detecting hazardous situations while minimizing nuisance alerts, TAWS operation should be allowed with alternate position means (as recognized in App1 §5.1c) to ensure continuous aircraft protection, even with acceptable degraded performance (acceptable degraded nuisance alert rate, and acceptable degradation in miss-detection rate). If such operation is not allowed (i.e. requirement is to use TAWS only when aircraft system position has the best		requirement has been reworded to reflect the previous requirement in TSO-C151b. Aircraft operated in 14 CFR § 121 operations may continue to use a non-GNSS position source as their only horizontal position source. Use of alternate horizontal position sources is acceptable and recommended. Acceptable degraded mode nuisance alert rates and missed alert rates are not defined in the TSO consistent with the historical TAWS TSOs.

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			precision), TAWS will be deactivated as soon as system position is degraded, leaving the aircraft unprotected in case of system positioning errors. However, last sentence of App.1 §5.1 b is in fact opposite of the previous sentences in this paragraph containing a recognition of potential degradation in position accuracy. Additionally, this new version of TSO should clarified if it is allowed to use a non-GNSS position source as alternate with a position accuracy less than GNSS accuracy. If it is the case this new version of TSO should also described the acceptable performance degradation when using a position source with a non-GNSS accuracy.		
ATA	Page 21, Appendix 1, Paragraph 5.1.a.	Revise the sentence to read as recommended on the right.	Believe the recommended change clarifies the authors intent. Also, noted that unlike earlier versions, this TSO would require GPS or WAAS, and would not allow FMS or any other navigation source, indicating a need for rulemaking.	The TAWS must use a GNSS horizontal position source equipment **that meets** the requirements in TSO-C129 or TSO-C196 for GNSS, or TSO-C145/C146 for satellite-based augmentation systems (SBAS).	Accepted. The language in the TSO has changed to accommodate 14 CFR § 121 operations without a GPS, consistent with the previous versions of the TSO.

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Honeywell	Page 21, Appendix 1, Paragraph 5.1.a	The TAWS equipment has no capability for detecting whether a device that provides data to the TAWS equipment meets a TSO. The suitability of the interfacing devices, e.g., position source, must be assessed on an installation basis; not during TSO authorization. Therefore, we recommend wording changes in some of the paragraphs in section 5.		Suggested change: "The TAWS must be capable of using GNSS horizontal position source equipment meeting the requirements in TSO-C129 or TSO-C196 for GNSS, or TSO-C145/C146 for satellite-based augmentation systems (SBAS)." Suggested addition: a note that indicates that the qualifications for position sources must be listed in the TAWS installation information. The installation information is something that can be reviewed at TSO authorization time.	Accepted. The language in the TSO has been modified. Requirements for the internal and external sources are more clearly and accurately defined.
Garmin	Page 21, Appendix 1, Paragraph 5.1.a	With regard to the sentence *"The TAWS must use a GNSS horizontal position source equipment must meet the requirements in TSO C129 or TSO C196 for GNSS, or TSO C145/C146 for satellite-based augmentation systems (SBAS)."* (1) The sentence structure is not well constructed and needs to be revised.	See comment.	See comment.	Accepted. The language in the TSO is modified. Requirements for internal and external sources are more clearly and accurately defined.

Company & Group	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
		(2) The sentence implies that the TAWS equipment must comply with one or more of the TSOs. This would be possible only if the TAWS equipment has an internal GPS receiver. Isn't this more of an installation issue which has guidance provided by the ACs?			
Garmin	Page 21, Appendix 1, Paragraph 5.1.a	Should "TSO-C129**a**" be specified instead of "TSO-C129"?	Correct reference specification.	Change "TSO-C129" to "TSO-C129a".	Accepted: The reference to TSO-C129 has been changed to TSO-C129a (or later revision).
Garmin	Page 21, Appendix 1, Paragraph 5.1.a	Should "TSO-C145**c**" be specified instead of "TSO-C145"?	Correct reference specification.	Change "TSO-C145" to "TSO-C145c".	Accepted. The reference to TSO-C145 has been changed to imply that any revision of TSO-C145 is acceptable.
Garmin	Page 21, Appendix 1, Paragraph 5.1.a	Should "TSO-C146**a**" be specified instead of "TSO-C146"?	Correct reference specification.	Change "TSO-C146" to "TSO-C146a".	Accepted. The reference to TSO-C146 has been changed to imply that any revision of TSO-C146 is acceptable.
Garmin	Page 21, Appendix 1,	The term "GNSS" is used several times in	Undefined acronym.	Define "GNSS", "Global Navigation Satellite	Accepted: GNSS will be spelled out

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	Paragraph 5.1.a	this document but is not defined.		System", in Appendix 1, Paragraph 2.0.	but where it is initially used in the document, Appendix 1, Paragraph 1.3.e, Bullet 5.
Garmin	Page 21, Appendix 1, Paragraph 5.1.a	The term "GLS" is used several times in this document but is not defined in the Definitions section.	Undefined acronym.	Define "GLS", "GNSS (Global Navigation Satellite System) Landing System", in Appendix 1, Paragraph 2.0.	Accepted.
Transport Canada	Page 21, Appendix 1, Paragraph 5.1.a	This sentence is grammatically incorrect. It appears that "Equipment" should be replaced with "which".			Accepted.
ATA	Page 21, Appendix 1, Paragraph 5.1.b.	Add at the end of the paragraph the condition as recommended on the right.	Add to clarify the meaning of "GNSS accuracy".	**(See paragraph 5.1.a.)**	Partially Accepted. The use of the phraseology "GNSS accuracy" has been removed from the revised section 5. The accuracy of the position source needs to be sufficient for the TAWS to accomplish its intended function
ACSS	Page 21, Appendix 1, Paragraph 5.1b	'GNSS accuracy' is vague	If GNSS levels of accuracy are critical, should a numerical value be applied? Do we allow for systems which do not have Selected Availability Aware (SA Aware) algorithms and thus account for those systems which	Specify a GNSS reporting accuracy and allow for the potential for the TAWS to calculate this based on GPS telemetry.	Partially Accepted. The use of the phraseology "GNSS accuracy" has been removed from the revised section 5. The accuracy of

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			assume selected availability is on?		the position source needs to be sufficient for the TAWS to accomplish its intended function.
ATA	Page 21, Appendix 1, Paragraph 5.1.c.	The last sentence appears illogical	The last sentence would require any optional, non-GNSS / Alternate Horizontal Position Source "to meet all applicable requirements". If so, why would the TSO prohibit use of non-GNSS sources as primary sources? Non-sequitur.	Explain why non-GNSS sources could not be used as primary sources.	Partially accepted. Section 5 has been rewritten allowing 14 CFR § 121 operators to use non-GNSS position sources.
Transport Canada	Page 21, Appendix 1, Paragraph 5.1.c	Suggest adding "and desirable" - to the second sentence, i.e. "It is acceptable and desirable to incorporate a secondary, non GNSS position source, ... ".			Accepted.
Garmin	Page 21, Appendix 1, Paragraph 5.2.a	"The radio altitude may be augmented" was added, but it begs the question of *how* it may be augmented or *with what* it may be augmented. A manufacturer would likely read that statement and ignore it, or may choose a variety of means to "augment" an input.	Unqualified statement.	Clarify what is meant by "may be augmented" or remove.	Accepted. This terminology has been removed from the updated section 5.
THALES	Page 21, Appendix 1, Paragraph 5.2.b	Same comment as Page 13/ App 1 - 3.4.b Use of a different wording for Geometric altitude.			Not Accepted. This use of Geometric Altitude is consistent with industry and FAA terminology.
ACSS	Page 21, Appendix 1,	Radio altitude subtracted from terrain height is not advisable as being equivalent to	Radio altitude itself is height above terrain and need not be	Delete radio altimeter height.	Accepted.

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	Paragraph 5.2b	height above terrain.	altered, or mentioned here.		
Garmin	Page 21, Appendix 1, Paragraph 5.2.b	Placing "radio altimeter height" in the list of items that are compared to terrain height (barometric altitude, GNSS geometric altitude), implies that it is to be calculated by comparison to the terrain height, by being part of the adverbial clause.	Editorial comment, awkward wording.	Change the wording to "or derived from radio altimeter height" or similar.	Accepted.
Transport Canada	Page 21, Appendix 1, Paragraph 5.2.c	The wording in this section is not prescriptive. One of the greatest shortcomings of certain existing TAWS equipment is that it can be rendered ineffective by altimeter mis-sets, or by extremely cold temperatures. This was recognized by the FAA after TSO C 151 a was published, and was addressed for Class C equipment with the issuance of TSO C151b. But it is now time to incorporate such wording into the requirements for Class A & B TAWS. Transport Canada questions the justification of allowing Class A & B TAWS to meet a lower standard. Transport Canada suggests inclusion of the revised wording from Appendix 3, para 1.2 as written, with one minor change; rather than stating that the GSL altitude "should" be displayed on the terrain display, suggest that it "may" be displayed on the terrain display, for Class A & B TAWS. Thus, suggest replacing 5.2c. with: "A means must be provided to compute an actual MSL aircraft altitude value that is immune to temperature errors and manual correction mis-sets that would otherwise prevent the TAWS from performing its			1. Not Accepted. The FAA recommends cross check of the baro and geo altitude sources, but is not requiring use of geo altitude at this time. 2, Not Accepted. The FAA recommends that if GSL altitude is displayed on the TAWS display, that it be annotated as such to avoid confusion with the baro altitude display.

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		intended function. This type of altitude is derived primarily from geometric sources such as GPS, and referenced to MSL typically via a database correction. If the TAWS includes a terrain display, this reference altitude value used for the TAWS alerts ***may*** also be indicated to the pilot on the display. The altitude value should be labeled according to AC 20-163,Displaying Geometric Altitude Relative to Mean Sea Level, which recommends' GSL' ."			
Transport Canada	Page 21, Appendix 1, Paragraph 5.2.c	Suggest using a term other than "equivalent", since "barometric altitude" and "GNSS geometric altitude" certainly are not equivalent.			Accepted.
Honeywell	Page 21, Appendix 1, Paragraph 5.2.c	Radio Altitude should be explicitly allowed for FLTA and PDA.		Suggested change: "Height above terrain may be calculated by comparing the terrain height to the barometric altitude, GNSS geometric altitude, radio altitude, or other equivalent measurement."	Partially Accepted. The revised section 5 does not address this level of design consideration. Thus it is not required or disallowed.
Honeywell	Page 21, Appendix 1, Paragraph 5.3.a	The TAWS equipment has no capability for detecting whether a device that provides data to the TAWS equipment meets a TSO. The suitability of the interfacing devices, e.g., position source, must be assessed on an installation basis; not during TSO		Suggested changes: "Any internal barometric altitude source contained within the TAWS must meet the requirements of TSO-C10b, *Altimeter, Pressure*	Accepted. The language in the TSO is modified. Requirements for internal and external sources

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		authorization. Also, for Class B equipment, barometric sources meeting TSO-C88b or equivalent (blind encoders) should be accepted.		*Actuated, Sensitive Type,* TSO-C106, *Air Data Computer,* or equivalent. If the TAWS does not have an internal barometric altitude source, it must be capable of using an external barometric altitude source that meets the requirements of TSO-C10b, TSO-C106, or equivalent. For a Class B TAWS, an altitude source meeting the requirements of TSO-C88b, *Automatic Pressure Altitude Reporting Code-Generating Equipment,* is acceptable."	are more clearly and accurately defined.
ACSS	Page 21, Appendix 1, Paragraph 5.3b	Use of "same requirements as GNSS" can be misleading.	This could be perceived as requiring some 0.3 Nm of accuracy for example. As the vertical component is critical, perhaps the desired vertical accuracy should be made explicit. Do we allow for systems which do not have the SA Aware algorithms and thus account for those systems which assume selected availability is on?	Specify a GNSS reporting accuracy and allow for the potential for the TAWS to calculate this based on GPS telemetry.	Partially Accepted. The wording "same requirements as GNSS" have been removed.
Honeywell	Page 21,			Suggested change: "Any	Accepted. The

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	Appendix 1, Paragraph 5.3.c			internal radio altitude source within the TAWS that is used for Class A TAWS functionality must meet the requirements of TSO-C67, *Airborne Radar Altimeter Equipment-for Air Carrier Aircraft*, TSO-C87 *Airborne Low-Range Radio Altimeter*, ETSO-2C87, *Low Range Radio Altimeters,* or RTCA/DO-155, *Minimum Performance Standards Airborne Low-Range Radar Altimeters*. Class A TAWS equipment that does not have an internal radio altitude source must be able to use an external radio altitude source that meets the requirements of TSO-C67, TSO-C87, ETSO-2C87, or RTCA/DO-155."	language in the TSO has modified. Requirements for internal and external sources are more clearly and accurately defined.
Transport Canada	Page 22, Appendix 1, Paragraph 5.4	Word "meet" is missing, after "must".			Accepted.

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Garmin	Page 22, Appendix 1, Paragraph 5.4	With regard to the sentence *"When an internal or external vertical velocity source is necessary, it must the vertical velocity requirements in TSO-C106 or TSO-C8, Vertical Velocity Instruments."* The sentence structure is not well constructed and needs to be revised.	See comment.	See comment.	Accepted.
Honeywell	Page 21, Appendix 1, Paragraph 5.4	GPS vertical velocity is used in some applications (e.g., Class B). The GPS receivers used may not meet the referenced TSOs. This type of vertical velocity should be accepted under this TSO for Class B systems. Many current (Class A) applications use Inertial Vertical Speed (IVS) from an Inertial Reference System, which does not meet the referenced TSOs. IVS should be allowed by the final TSO-C151c.			Accepted. Section 5 has been revised stating that external sources must meet performance requirements defined by the TAWS manufacturer (as listed in the installation manual.) Internal sources must meet applicable TSOs. Thus vertical velocity from a GNSS meeting one of the GNSS TSOs is acceptable, assuming the GNSS vertical velocity is sufficient for the TAWS function. Because inertial reference systems

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					do not have applicable TSOs, the performance of the IRS must be sufficient to meet the TAWS performance requirements.
THALES	Page 22, Appendix 1, Paragraph 5.5	As recognized in App 1 §5.1 c that retaining TAWS functionality is a safety benefits, use of degraded position sources may be accepted as long as the TAWS is performing within acceptable degraded performance.	This new version of TSO prohibits the use of position sources (App1 §5.5) which does not meet their performance requirements and yet for many aircraft installations, this is all that is available.		Accepted. The language on alternate position sources has been updated. The overarching requirement is that the position source must provide the level of performance necessary for the TAWS to perform its intended function.
ACSS	Page 22, Appendix 1, Paragraph 5.5	Clarification/disagree - "provide indications, as appropriate" seems interpretive.	Some products do not provide an indication of a loss of GPS, considering it a distraction for a TAWS display to include this. If this GPS loss is coupled with loss of other backup sources to produce a loss of FLTA, then a cockpit indication does occur. But as this reads, in the same sentence as the alternate source,	Replace with ", and must provide indications, as appropriate, regarding loss of function associated…" and therefore remove the degradation indication requirement. Alternately, show the indication as an option.	Accepted. Language associated with indicating a degraded mode has been removed, because no degraded mode is defined in the TSO.

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			it appears that the author wishes for an indication of the loss of the first source, the GPS source.		
Honeywell	Page 21, Appendix 1, Paragraph 6	To make it easier for manufacturers to keep the Terrain and Airport information current, we recommend that a Terrain and Airport Database information update not constitute a design change under this TSO. We suggest adding a statement to the effect that simple data updates (e.g., runway length changes, terrain elevation data refinements) can be made without it being considered a design change under this TSO.			Language was added clarifying that database updates do not require a change to the TSO authorization.
Transport Canada	Page 22, Appendix 1, Paragraph 6.1	The TAWS should consider the length and surface of the runways at nearby airports, before using those airports in the determination of the TAWS Phase of Flight, as defined in Table 1, and section 1 0 below. For example, some existing TAWS will determine that an aircraft within 5 Nm of an airport is in its Approach phase, and will reduce the Required Terrain Clearance from 700' (for enroute) to100' (for approach), without consideration of the runways at the nearby airport. This is done automatically, and without annunciation to the pilot. Thus, a large jet transport making an unintentional descent within 5 Nm of a 2000' grass strip would see its RTC reduced from 700' to 100'. This issue has been observed in flight			Accepted. Section 10.5 added with the requested allowance.

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		with TSO C151b TAWS equipment. Some TAWS, however, allow the installer to specify a minimum runway length, and minimum surface (e.g. only hard surfaced runways) for the aircraft on which the TAWS is installed. Such features should be mandatory, at least for Class A TAWS.			
ATA	Page 23, Appendix 1, Paragraph 9.1.	Add at the end of the first sentence text as recommended on the right.	Add to clarify a changed requirement.	**The switch would not inhibit any of the alerts defined in section 1.3.e. (eg, altitude alerts).**	Accepted.
ACSS	Page 23, Appendix 1, Paragraph 9.1	Contradiction within requirement: "must ha a capability… to manually inhibit" and if "if manual inhibit capability is provided"		Strike "If manual inhibit capability is provided".	Accepted. Last sentence reworded to: Inhibit status must be annunciated to the flight crew.
ACSS	Page 23, Appendix 1, Paragraph 9.1	Human factors concern with displaying of terrain with no alerting capability.	Disagree - the early human factors feedback noted on our product indicated that a display of terrain implied alerting capability and therefore protection in the flight crew's mind. There is the potential for the TAWS system to lose ground speed, for example, and then have the flight crew observe the aircraft flying in the direction of red terrain cells (higher than ownship) with no alerting and thinking they are OK.	Strike "This alternate manual inhibit functionality will allow pilots to disable the TAWS alerting without removing the terrain display".	Not Accepted. Availability of the terrain display can be valuable when the alerting has been inhibited. Operating instructions should highlight the human factors concerns.
Transport	Page 23, Appendix 1,	TCCA strongly supports the change to this section that suggests the manual inhibit of			Not Accepted.

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Canada	Paragraph 9.1	the FL T A and PDA alerts does not need to suppress the terrain display. However, we do not feel that the change goes far enough. Selection of the manual inhibit must not remove the terrain display. The primary use for this switch is to inhibit the visual and aural alerts when intentionally operating close to terrain, for whatever reason, including landing at an airport which is not in the database. Those are the very circumstances under which pilots will most want the use of their terrain displays, and to remove them upon selection of the manual FLTA/PDA inhibit ist he worst possible thing to do. If there is a sensed failure, including a navigation failure, then as noted above, the aural and visual alerts, as well as the terrain display, when appropriate, should be inhibited. In the unlikely event that the pilot believes there is an un sensed TAWS failure, leading the pilot to manually inhibit the FLTA/PDA alerts because he/she considers the alerts unreliable or misleading, then the pilot could also de-select the terrain display, if required.			The overall inhibit requirements now allow for greater flexibility in alert inhibiting.
Transport Canada	Page 23, Appendix 1, Paragraph 9.1	The pop-up function should also be inhibited, for both manual and automatic inhibits, and that should be clarified in the TSO requirements.			Not Accepted. Agree that faulted or inhibited terrain should not initiate the pop up feature, however the TSO currently does not address pop up

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					requirements. Although the FAA is not incorporating new standards for pop up in this TAWS revision, we will support an industry sponsored effort to develop new standards for display pop up.
Transport Canada	Page 24, Appendix 1, Paragraph 10.2	Under the conditions specified in the last sentence of the Note (ie. distance to runway is increasing), the conditions for Approach phase would *not* be met. Suggest that "the conditions for the approach phase may be temporarily met" should be replaced by "the conditions for the *terminal* phase may temporarily *not* be met."			Accepted. The intent of the requirement is that the procedure turn be accomplished in the terminal mode. There are two instances where the procedure turn could initiate other modes. 1. Terminal Phase is not met when the aircraft is on the outbound portion of the procedure turn, because distance to the runway is increasing.

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					2. The approach mode requirements could be temporarily met if the aircraft makes a direct entry into the procedure turn, crosses the FAF during the course reversal (outbound turn) and unintentionally ends up in the approach mode instead of the terminal mode.
Garmin	Page 25, Appendix 1, Paragraph 11	Unnecessary comma after "Official".	Editorial comment	Remove comma.	Accepted.
ACSS	Page 25, Appendix 1, Paragraph 11, Table 7	Table entry of "FMS" doesn't agree with requirement for GPS in 5.1 and 5.2.		Strike "FMS or"	Accepted. The requirement for Part 121 operators to utilize GPS position for TAWS has reverted to the requirement in TSO-C151b, thus the FMS entry is appropriate.
Transport Canada	Page 25, Appendix 1, Paragraph 11,	With the other changes to this TSO that now mandate GPS (or GNSS) as a required TAWS sensor input, the inclusion of the			Not Accepted: Section 5 has been rewritten allowing

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	Table 7	column titled "FMSIRNA V or GPS" only serves to add confusion. Suggest that the column be deleted.			14 CFR § 121 operators to use non-GNSS position sources.
Garmin	Page 25, Appendix 1, Paragraph 11, Table 7	The text *Terrain/Airport Database*, *RNAV*, and *Paragraph* in the table wrap so that the words are broken apart.	Editorial comment	Adjust column widths and/or the text wrapping so the words are not broken apart.	Accepted
ACSS	Page 26, Appendix 2, Paragraph 1.2	L/O can be confusing	L/O is not a commonly known acronym.	Write out L/O as Level Off here and globally.	Not accepted: Although L/O is not a commonly known acronym it is defined in paragraph 1.2, it is used consistently throughout the document, and has been historically accepted with the TAWS TSO. Although not a great deal of work to change, we are concerned that the change would have an unintended inference by other users of the TSO.
Honeywell/ Garmin/ACSS/THALES	Page 30, Appendix 2, Paragraph 1.7, Table 13	The values in the "TEST RUN ALTITUDE (MSL)" column in the last 7 rows differ from the TSO-C151b document.	The values in the table are incorrect.	Correct the table values as per TSO-C151b.	Accepted: The values will be corrected.
ACSS	Page 30,	"MAY ALERT" cases seem unnecessary.	Not part of the change set of	Removed test cases 4, 5 and	Not Accepted: The

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	Appendix 2, Paragraph 1.7, Table 13		C151C, but the direction of "MAY ALERT" doesn't yield a useful test. Is there a need for these test cases? If not, let's delete them.	6 from this table.	requirement in the final approach case is to alert when the aircraft comes within 150 feet of terrain. The first three cases demonstrate that there should be no alert at 250 feet above terrain. The last four cases demonstrate that there must be an alert within 150 feet of the terrain. The three "may alert" cases at 200 feet above terrain provide flexibility in the design of the alerting.
THALES	Page 31, Appendix 2, Paragraph 2.2	Add a comment specifying that a successful run with –200ft is sufficient.	Version b of the TSO was considering –100ft OR –200ft, it is now turned into –100ft AND –200ft. Knowing that the worse case will be reached with –200ft altitude error, the single successful run with –200ft should be sufficient to demonstrate compliance.		Accepted.
ACSS	Page 31, Appendix 2, Paragraph 2.2	The application of the altitude errors can be unclear.	When applying an altitude error, the reference could be FTE (both physical aircraft and reported position are 200 feet lower than	Provide an example after this sentence. For a case of test run altitude of 9000 feet, place the physical	Not Accepted.

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			original table) or position error (physical aircraft is at the level indicated in the table, but reported altitude has placed the aircraft higher than the table indicates). In e-mail exchange with K. Baker in 2009, we confirmed that the latter case of a reported altitude was correct.	aircraft at 9000 feet where the reported position is 9200 feet.	
ACSS	Page 31, Appendix 2, Paragraph 2.2, Table 14	Is a one second delay appropriate for all flight phases? 3 seconds is used for Enroute Descent condition.	Why is it expected that the pilot will respond faster during the imminent terrain impact tests than she did in the enroute descent cases of Table 8?	Indicate response time differences for those first 5 entries found more than 15 Nm from the runway.	Not Accepted: Historically, the TAWS TSO test cases have assumed a 1.0 second pilot response in the terminal and approach environments, and 3.0 seconds in the enroute environment.
ACSS	Page 31, Appendix 2, Paragraph 2.2, Table 14	Multiple tests seem to provide no additional value.	Introducing a 100 foot error and then a 200 foot error seems redundant. Passing the 200 foot error is evidence enough of being capable of passing the 100 foot error case. For that matter, the non-error case seems redundant.	Delete the 100 foot error case. Consider deleting the "no error" condition also.	Partially Accepted: The wording was changed back to "or" which was stated in the 'B' revision, which will provide an option of choosing either altitude error.
ACSS	Page 32, Appendix 2, Paragraph 3.0, Table 15	Test run method not indicated, yet this seems important.	Section 3.2 makes a point of indicating that PDA includes both straight-in and circling approaches. Historically, most premature descent CFITs have	Add a requirement than PDA testing must be run with aircraft track and position aligned to the runway heading.	Not Accepted. The test run method is not specified for this test case. This test case may

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			occurred along the extended runway centerline so testing to ensure the TAWS alerts in this case is appropriate. Shouldn't these PDA tests then dictate that testing should take place with aircraft aligned with the runway?		be run for a straight-in or circling approach.
ACSS	Page 33, Appendix 2, Paragraph 5.1	Multiple test runs being requested are unclear.	This paragraph indicates the nuisance cases must be run twice. Then, there is discussion of (a) lateral FTE of 0.3 Nm (3 cases – left, center and right), (b) vertical error of reaching MDA (2 cases : 0 feet, -50 feet) and (c) vertical FTE of -100 feet (2 cases: 0 error and -100 feet). However, what might be sufficient is an FTE of -100 feet, reaching MDA – 50 feet combined with left, center and right = 3 cases.	Specify the test cases to be run.	Not Accepted: The ACSS approach of testing without horizontal error, horizontal error left, and horizontal error right combined with no vertical error, -50 feet vertical error, and -100 feet vertical error is appropriate. Because these tests are based on the historical TSOs, and changes to the language in the test case could cause other vendors to infer changes which were not intended, the language in Appendix 2, paragraph 5.1 is unchanged.

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ACSS	Page 34, Appendix 2, Paragraph 6.0	Volpe test cases require individual inquiries.	Requiring each TSO applicant to individually inquire with Volpe to obtain the test cases adds unnecessary work to Volpe. The FAA should obtain the test cases from Volpe and include the data as an appendix in the TSO. Then the data would be available for all future TSO C151 applicants and those applicants would not need to trouble Volpe for the data.	Include Volpe cases as an appendix.	Partially Accepted: Directions were provided on how to obtain the information from the FAA website.
Garmin	Page 34, Appendix 2, Paragraph 6.0	The contact information to obtain the known accident cases is somewhat lacking. Can the information be consolidated and provided in a better location that is more readily available to all? If not, provide more information on whom exactly to contact.	Lack of contact information.	Consolidate the known accident cases in a website location and put that link here. Then test the link/process to ensure it actually works (unlike the TSO-C151b version).	Partially Accepted: Directions were provided on how to obtain the information from the FAA website.
ACSS	Page 34, Appendix 2, Paragraph 6.1	Phrasing of "The test report should include as many of the following parameters used to recreate the events" seems to have two intents.		Rephrase to "Recreating the events should involve inclusion of as many as possible of the following parameters as are available. The test results should include each of them, along with (4) time from terrain at caution and warning alerts and (5) distance from terrain at caution and warning alerts." Then items 1-3 and 6-11 should be listed.	Partially Accepted" The paragraph was reworded to indicate that as many parameters as possible should be recorded.
ACSS	Page 34, Appendix 2,	Clearing of terrain cell in question seems too limited.	Accident cases are in areas of much high terrain, not just the	"clears all terrain in this region" is suggested	Accepted. Removed the word

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	Paragraph 6.3		location of the CFIT. All cells should be cleared, not just the CFIT location cell.	wording.	"cell" from the sentence.
Garmin	Page 34, Appendix 2, Paragraph 6.3, Table 17	Why are the headers of this table not shaded like all the other tables?	Document inconsistency.	Shade the table header row.	Concur: The table header will be shaded.
Garmin	Page 37, Appendix 2, Paragraph 6.3, Table 17	The aircraft registration number was changed for La Paz, Bolivia from "N819EA" to "N891EA". An internet search of "N819EA" brings up the accident case in Bolivia. "N891EA" brings up a an incident at Atlanta in 1990 and this draft TSO-C151c.	Typo.	Change "N891EA" back to "N819EA".	Concur: The change will be made.
Garmin	Page 36, Appendix 2, Paragraph 7.0	It is unclear whether the "height above terrain" must be substituted as stated. If a radio altimeter input is available to a Class B system, this would imply that an actual height above terrain reading would be required to be substituted with an approximation. Appendix 1, Paragraph 3.5.c states: "Class A equipment has a radio altitude input, and therefore, the altitude callout can be referenced to the radio altimeter." This indicates that for some GPWS alerting, Class B may use radio altimeter, but for others, it would appear that radio altitude	Unclear specification / document inconsistency	Change to a suggestion that if a radio altimeter input is unavailable, it *may* be substituted in the suggested manner.	Accepted.

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		must be substituted.			
Transport Canada	Page 36, Appendix 2, Paragraph 7	Per previous comment, "Suggest referring to the "alerts for excessive descent rates "as "Mode 1 alerts", in the heading of this section, per section 1.3(f)."			Accepted.
Transport Canada	Page 36, Appendix 2, Paragraph 7	Per previous comment, "The use of the expression "QNH barometric altitude (or equivalent)" has not changed from C151b, but perhaps it should. Barometric altitude is subject to errors such as altimeter mis-sets and cold temperature effects, which can be significant. It is thus, preferable, where possible, to use non-barometric sources of altitude for TAWS alerts. Basing Mode 1 alerts on a GPS-derived altitude would be preferable to basing them on QNH barometric altitude, but it is a stretch to say that a GPS-derived geometric altitude is "equivalent" to QNH barometric altitude."			Not Accepted. Barometric altitude or geometric altitude are both acceptable.
Garmin	Page 37, Appendix 2, Paragraph 7, Figure 1	The image used for the Excessive Descent Rate envelope is even less clear than the one found in TSO-C151b. The numbers on the axes are further blurred. Additionally, due to the size and thickness of the lines, and the small size of the graphic, a manufacturer must guess what values are to be used for implementation.	Readability problem.	Restore the version found in TSO-C151b, or even better would be a new graphic that provided clear values and intersection points for the envelopes, similar to the quality level found in RTCA/DO-161A where the knees in the curve have value labels, or provide a table of values.	Partially Concur: This is the same figure that is in TSO-C151b. There has been no changes to the figure. We will make the figure more clear for the reader.
Garmin	Page 37,	It is unclear whether the "height above	Unclear specification / document	Change to a suggestion that	Accepted.

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	Appendix 2, Paragraph 8.0	terrain" must be substituted as stated. It may not be desirable to do so in situations where the terrain elevation in the airport area differs from the runway elevation. If a radio altimeter input is available to a Class B system, this would imply that an actual height above terrain reading would be required to be substituted with an approximation. Is "height above terrain" as determined by aircraft altitude and terrain height an acceptable substitution for radio altimeter? Paragraph 7.0 for excessive descent rates allows this substitution. Appendix 1, Paragraph 3.5.c states: "Class A equipment has a radio altitude input, and therefore, the altitude callout can be referenced to the radio altimeter." This indicates that for some GPWS alerting, Class B may use radio altimeter, but for others, it would appear that radio altitude must be substituted.	inconsistency	if a radio altimeter input is unavailable, it *may* be substituted in the suggested manner. Consider whether height above terrain as determined by altitude and terrain elevation is an acceptable substitution, given that it is allowed for excessive descent rate alerting.	
ACSS	Page 36, Appendix 2, Paragraph 9.1	Four different vertical speeds seems excessive.	Running this test with 4 different vertical speeds seems redundant. If the altitude callout is heard adequately for the maximum vertical speed case, it stands to reason that the other cases would be as good as or better.	Include only the 1500 fpm case.	Accepted: A single test case is sufficient for this requirement. The 500, 750, and 1000 fpm descent rates have been removed

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					from the final TSO. Although the 1500 fpm test case is a higher descent rate than the normal approach path, it does represent the most demanding of the test cases proposed in the draft TSO.
ACSS	Page 36, Appendix 2, Paragraph 9.1	No tolerance on this test.	Without a tolerance, it is conceivable to have a design producing a 500 foot callout at 100 feet. Should there be a pass/fail criteria here?	Recommend a tolerance of occurring within a second after passing through the 500 foot level.	Accepted. Agree that a tolerance is appropriate, and that one second is reasonable. The language in the final TSO is changed to require the aural callout of "five hundred" within one second of the aircraft's descent through 500 feet
Transport Canada	Page 36, Appendix 2, Paragraph 9.1	The first sentence of this section does not have a verb. The word "the" before "test" seems extraneous, i.e. we believe the sentence should read "With the landing gear in landing configuration, test for ... ".			Concur: The change will be made.
Transport Canada	Page 36, Appendix 2,	Per earlier comment, suggest that for a fully functioning TAWS system, the 500'callout			Accepted.

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	Paragraph 9.1	should only be based on comparing the aircraft's barometric or geometric altitude against the database runway elevation. Otherwise, there could be significant variability in when the 500' callout would occur. The effect of descending terrain towards a runway, resulting in an early callout, might be minimal. However, the effect of rising terrain towards a runway on a plateau airport, such as at Telluride(KTEX), could delay a radar altimeter based callout until the aircraft was 100'above runway elevation. (Transport Canada can provide PFD video of such an approach, which shows 1100' radar altimeter when the aircraft is 140' above the TDZE, and then 4 seconds later, the radar altimeter shows 25'.)			
Garmin	Page 36, Appendix 2, Paragraph 9.1	This does not mention that the gear input should be considered, as it is specified in Appendix 1, Paragraph 3.3.c	Incomplete test specification	Add gear down.	Partially Accepted. The criteria in 3.3c specifying the gear position has been removed. (The requirement reverts to the TSO-C151b requirement).
ACSS	Page 36, Appendix 2, Paragraph 9.2	Callout is now defined as alert, which can be confusing.	All alerts, per 25.1322, are for non-normal situations. Passing through 500ft AGL doesn't seem non-normal, since it happens every flight (hopefully). We would suggest removing both the "advisory" and "alert" designations and call the altitude callouts	Replace alert with callout.	Accepted.

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			"informational".		
Garmin	Page 36, Appendix 2, Paragraph 9.2	The inputs in Appendix 1, Paragraph 3.5.c are radio altitude, aircraft altitude – runway elevation, and aircraft altitude – terrain elevation. The inputs in Appendix 2, Paragraph 9.2 are aircraft altitude – runway elevation. It is unclear whether the "height above terrain" must be substituted as stated. If a radio altimeter input is available to a Class B system, this would imply that an actual height above terrain reading would be required to be substituted with an approximation. Appendix 1, Paragraph 3.5.c states: "The equipment must meet the requirements specified in appendix **2**, paragraph **9.0**. Class A equipment has a radio altitude input, and therefore, the altitude callout can be referenced to the radio altimeter. Without the radio altimeter, Class B equipment must use barometric, GNSS geometric, an equivalent height above terrain or nearest runway elevation."	Unclear specification / document inconsistency	Change to a suggestion that if a radio altimeter input is unavailable, it *may* be substituted in the suggested manner.	Not Accepted. The 500' call out for Class A and B equipment must now base the 500' call out on the altitude above the runway threshold elevation, which is determined by comparing aircraft's barometric altitude or GNSS altitude against the runway threshold elevation. This clarification was made to ensure a consistent 500' call out on approach.
ATA	Page 36, Appendix 3, after Paragraph 2.0.	Revise the title to read as recommended on the right.	Clarity	MODIFICATIONS TO APPENDIX 1 **FOR CLASS C TAWS.**	Concur: The addition will be made.

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Garmin	Page 39, Appendix 3, Paragraph 3.1.1, Alternate Table 1	Feet/NM is inconsistent.	Other tables in the documents have been changed to use Feet/nautical mile (NM).	Make consistent – use Feet/NM or Feet/nautical mile (NM) throughout.	Not Accepted. The table in paragraph 3.1.1 is the first instance in the document where the abbreviation for nautical mile (NM) is utilized. We typically use the full text of the acronym or abbreviation the first time it occurs in the document, then only use the acronym or abbreviation throughout the remainder of the document.
Honeywell/ Garmin	Page 42, Appendix 3, Paragraph 1.2.c, Table 8	Vertical speed in row 2 changed to 100 FPM is incorrect.	TSO-C151b had 1000 fpm here. The calculations are correct with 1000 fpm and are not correct with 100 fpm.	Change back to 1000 fpm.	Accepted
Honeywell/ Garmin	Page 44, Appendix 3, Paragraph 1.6.c, Table 12	Vertical speed in row 3 changed to 100 FPM is incorrect.	TSO-C151b had 1000 fpm here. The calculations are correct with 1000 fpm and are not correct with 100 fpm.	Change back to 1000 fpm.	Accepted