Clearance Record
DOCUMENT COMMENT LOG

Originating Office:	Document Description:	Project Lead:	Reviewing Office:	Date of Review:
AIR-130	TSO-C146d/C205 Consolidated Public Comments	Kevin Bridges		

Comment Number	Page & Paragraph	Comment	Rationale for Comment	Recommendation	Disposition
1. Thales Avionics		We concur with this new approach of certifying sub assembly. Nevertheless as EU industrial, we are keen to have a harmonized approach between FAA and EASA on this topic in order to keep a level playing field.		FAA and EASA to harmonize their position on this subject.	**Accepted.** EASA is aware of these draft TSOs, but the FAA cannot guarantee EASA will adopt an ETSO version. However, the FAA did not receive an indication that EASA disagrees with the proposal. The FAA will continue discussions with EASA to resolve any harmonization issues.
2. Thales Avionics	TSO C205, §5	To be consistent with TSO C146d, paragraph 5.j (instead of 5.e) should be excluded from the data submitted to the civil aviation authority	-	Replace “5.e” by “5.j”	**Accepted.**
3. Thales Avionics	TSO C146d Appendix 1, page 3 §3.2.(c)	Remove ” described in paragraph 3.1.” at the end of the sentence. The pass/fail criteria for this test are not described in §3.1	-	Remove ” described in paragraph 3.1.”	**Partially Accepted.** The sentence was changed as follows to more accurately reference the appropriate paragraphs:

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					Section 2.5.2.4.2 defines the pass/fail criteria *for the test case described in paragraph 3.1(b)(3).*
4. Thales Avionics	TSO C146d Appendix 1, page 4 §4(a)	In the first sentence "class Beta tables" should be replaced by "class Delta 4 table". For clarity the table 2-20 from DO-229D Change 1 applicable to class Delta equipment should be referred.	-	Replace "class Beta tables" by "class Delta 4 table 2-20".	**Accepted.**
5. Thales Avionics	TSO C146d Appendix 1, page 3 §4(d)	Refer to DO-160G instead of DO-160E		Replace DO-160E by DO-160G	**Partially Accepted.** The TSO template language in paragraph 3.d allows applicants to use DO-160E as specified by the MOPS, or, to use another appropriate standard (such as a later revision). The appendix 1 paragraph includes a reference to paragraph 3.d as follows: RTCA/DO-160E section 16 relates to aircraft power supply *(refer to TSO paragraph 3.d for*

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					environmental qualification requirements).
6. CMC	C146 / Page 2 / Para. 3.	Reference to Sections 2.2 and 2.3 missing.	Class Gamma and Delta specific requirements are also in 2.2 and 2.3 respectively.	… dated February 1, 2013, Sections 2.1, 2.2, and 2.3.	**Partially Accepted.** TSO-C146c only referenced section 2 and DO-229D paragraph 1.4 to differentiate the section 2 requirements applicable to class Gamma and Delta-4 and the operational classes. In TSO-C205 it was less confusing to specify the specific requirements paragraphs because TSO-C205 is only for class Delta-4. The TSO now reflects this change to avoid confusion relative to the previous revision.
7. CMC	C146 / Page 2 / Para. 3.	First bullet in list of credit from TSO-C205 is incomplete.	TSO-C205 para. 3 requires compliance to Sections 2.1.1, 2.1.5, and 2.3.	Add Sections 2.1.1 and 2.1.5 to first bullet.	**Accepted.**

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8. CMC	C146 / Page 3 / Para. 3.e.(1)	Requires compliance to DO-178C. However using DO-178B per AC 20-155C, the software will be declared as DO-178B compliant not DO-178C. Such use of DO-178B must not require a deviation from the TSO.	Note 2 implies that software must meet DO-178C and be declared as such which is not the guidance of the AC.	Update Note 2: Applicants should refer to AC 20-115C for other acceptable means of software development using legacy software or software development methods.	**Partially Accepted.** The FAA is currently resolving the TSO template language for DO-178B versus revision 'C'. The current policy is to reference revision 'B' until the template language issue is settled. Note 2 was deleted and all references to DO-178C are changed to revision 'B'.
9. CMC	C146 / Page 5 / Para. 5	Incorrect reference to 5.j.	See text in 5.k.	Refer to 5.k.	**Accepted.**
10. CMC	C146 / Page 6 / Para. 5.a.(9)(b)	As written, a TSO-C144 active antenna appears excluded. Also use consistent wording with 5.a.(9)(a).	DO-229D Change 1 Section 2.1.1.10 Note 1 and AC 20-138C Table 2 allow such an active antenna for Class 1.	Include TSO-C144 active antenna in referenced TSO list. Replace "is installed" with "can satisfy the requirements of RTCA/DO-229D, Change 1".	**Not Accepted.** The language is the same as TSO-C146c except that the single paragraph is divided into two for easier reading. Nothing prevents an applicant from using a TSO-C144 active antenna as a manufacturer-specified antenna per 5.a(9)(a) and AC 20-138 (latest

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					revision).
11. CMC	C146 / Page 8 / Para. 7.a.	Incorrect references 5.f. to 5.i.	See C145d; inserting extra para. as 5.f. in C146d caused offset in references.	Refer to 5.g. to 5.j.	**Partially Accepted.** The correct reference is 5.g to 5.i. The second paragraph covers the furnished data requirements **if** non-TSO function(s) is/are incorporated.
12. CMC	C205 / Page 2 / Para. 3.e.	Requires compliance to DO-178C. However using DO-178B per AC 20-155C, the software will be declared as DO-178B compliant not DO-178C. Such use of DO-178B must not require a deviation from the TSO.	Note 2 implies that software must meet DO-178C and be declared as such which is not the guidance of the AC.	Update Note 2: Applicants should refer to AC 20-115C for other acceptable means of software development using legacy software or software development methods.	**Partially Accepted.** The FAA is currently resolving the TSO template language for DO-178B versus revision 'C'. The current policy is to reference revision 'B' until the template language issue is settled. Note 2 was deleted and all references to DO-178C are changed to revision 'B'
13. CMC	C205 / Page 2 / Para. 3.e	Sentence states "... according to either …" which implies an alternative when none is provided.	Implies alternative when none required; Note 2 covers the alternatives.	Delete "either".	**Accepted.**

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14. CMC	C205 / Page 3 / Para. 5	Incorrect reference to 5.e)	See text in 5.j.	Refer to 5.j.	**Accepted.**
15. CMC	C205 / Page 5 / Para. 5.i.(2), (3) and (4)	Incorrect reference to 5.h.(1)	Typo.	Change to 5.i.(1)	**Accepted.**
16. CMC	C205 / Page 6 / Para. 5.i.	Missing item 5.j.(6) of TSO-C146	Consistency with TSO-C146d and C204	Use equivalent text from TSO-C146d para. 5.j.(6) as C205 para. 5.i.(6).	**Accepted.**
17. CMC	C205 / Page 7 / Para. 7	Missing 5.h.	See TSO-C204.	Change text to "…paragraphs 5.a, 5.b and 5.f through 5.h of this TSO".	**Partially Accepted.** The correct reference is 5.f through 5.i.
18. Garmin	TSO-C146d Page 1, par 2.a	Section 2.a allows only 18 months after the effective date of this new TSO revision for all products in development against the previous revision to be completed and receive approval against the previous revision.	18 months is a relatively short grace period for products where development cycles can easily exceed 2 years.	Products being developed against the previous TSO revision should be allowed 24 months from the new TSO revision release to finish all qualification and approvals against the previous TSO revision the product was designed and	**Not Accepted.** This is the standard template language and time frame for TSOs.

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				developed against. Garmin appreciates the recent TSO template change to allow 18 months over the previous 6 months, but we believe 24 months is more in line with industry standard development cycles of 2 to 3 years.	
19. Garmin	TSO-C146d Page 2, par 3	The draft TSO-C146d only invokes DO-229D section 2.1 for class Gamma and Delta-4 equipment. TSO-C146c and earlier revisions invoke all of DO-229 section 2, as applicable to the equipment class.	DO-229D section 2.1 includes requirements applicable to all equipment classes (Beta, Gamma, Delta-4). DO-229D section 2.2 includes requirements for class Gamma equipment, and section 2.3 includes requirements for class Delta-4 equipment. Sections 2.2 and 2.3 must be referenced by TSO-C146d.	Modify text to either: a) Reference all of DO-229D section 2 as the source of requirements for the TSO, as was done in prior versions of TSO-C146; OR b) Specifically reference section 2.2 for Class Gamma equipment and section 2.3 for Class Delta-4 equipment.	**Partially Accepted.** TSO-C146c only referenced section 2 and DO-229D paragraph 1.4 to differentiate the section 2 requirements applicable to class Gamma and Delta-4 and the operational classes. In TSO-C205 it was less confusing to specify the specific requirements paragraphs because TSO-C205 is only for class Delta-4. The TSO now reflects this change to avoid confusion relative to the previous revision.

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20. Garmin	TSO-C146d Page 2, par 3	TSO-C146d allows Class Delta-4 applicants to take certification compliance credit for a TSO-C205 Delta-4 CCA. However, no such provision is made to allow Class Gamma equipment to take certification credit for a TSO-C204 CCA.	TSO-C146d class Gamma equipment must meet the requirements defined in sections 2.1 and 2.2 of DO-229D. TSO-C204 defines a CCA that meets the requirements defined in section 2.1. TSO-C204 is equally applicable to TSO-C145d (class Beta) equipment as it is for TSO-C146d class Gamma equipment.	Modify TSO-C146d to allow use of a TSO-C204 CCA as certification compliance credit for meeting the DO-229D section 2.1 requirements and the DO-229D section 2.5 performance testing appropriate to the section 2.1 functions.	**Not Accepted.** TSO-C204 is for a TSO-C145d sensor used in navigation or non-navigation equipment. It is possible to use a TSO-204 CCA for the TSO-C145 sensor portion used in Class Gamma navigation equipment. This is explained in AC 20-138D that will be published almost concurrently with these TSOs.
21. Garmin	TSO-C146d Page 2, par. 3.b	Includes the statement: **(1)** Failure of the function defined in paragraph **3.a** resulting in misleading information for en route, terminal, approach lateral navigation (LNAV), and approach LNAV/vertical navigation (VNAV) navigation data is a *Major* failure condition, **(2)** Failure of the function defined in paragraph **3.a** resulting in misleading information for localizer performance	It is reasonable to clarify the wording to ensure aircraft level analysis is the driver for determining failure classifications. EASA has recognized this using the following wording in ED Decision 2010/010/R 14/12/2010 Annex I Subpart A – General 2.4 Failure condition classification: "Develop the system to, at least, the design assurance level equal to the failure condition classifications provided in the ETSO.	We recommend that no failure classification/DAL requirement be included in the TSO as this requires an aircraft level system assessment. Or add the following general guidance: "The design assurance for the functions defined in paragraph 3.b of this TSO must be commensurate with the failure conditions listed even if the installation assesses the equipment failure to have a lesser safety effect."	**Not Accepted.** This is consistent with the TSO template language and all previous TSO-C146 revisions.

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		without vertical guidance (LP), and approach localizer performance with vertical guidance (LPV) navigation data is a *Hazardous* failure condition, and **(3)** Loss of the function defined in paragraph **3.a** for en route through LP/LPV navigation data is a *Major* failure condition. **(4)** Design the system to at least these failure condition classifications consistent with the operational capability. Wording needs to change to recognize the fact that failure condition classification is ultimately determined by aircraft level analysis.	Development to a lower Design Assurance Level may be justified for certain cases and accepted during the ETSO process but will lead to installation restrictions."		
22. Garmin	TSO-C146d Page 2, par 3.b.(2)	TSO paragraph 3.b.(2) states: "Failure of the function defined in paragraph **3.a** resulting in misleading information for localizer	LP is an approach operation and should be identified as such for consistency with LPV.	Suggest adding the word "approach" before the text "localizer performance without vertical guidance" in paragraph 3.b.(2).	**Accepted.**

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		performance without vertical guidance (LP), and approach localizer performance with vertical guidance (LPV) position data is a *Hazardous* failure condition, and" The LP operation is not identified as an approach operation.			
23. Garmin	TSO-C146d Page 3, par 3.e	Section 3.e "Software Qualification" requires compliance with DO-178C.	AC 20-115C allows DO-178B to be used to show compliance for the software aspects of airborne systems. The "Note 2" should be elevated to a requirement to explicitly allow DO-178B as allowed in AC 20-115C. Elevating this note to requirement would allow applicants to use standards other than DO-178C (as allowed by AC 20-115C) without the need to send deviations to the FAA. This change will reduce burden on both the FAA and the applicants in reviewing menial DO-178B deviations	An additional statement should be added to allow use of 178B or 178C as appropriate. Remove "Note 2", keep item (1) under 3.e as is, and add an item (2) under 3.e: "Applicants with legacy software may use RTCA/DO-178B rather than RTCA/DO-178C, if such use is in accordance with AC 20-115C ."	**Partially Accepted.** The FAA is currently resolving the TSO template language for DO-178B versus revision 'C'. The current policy is to reference revision 'B' until the template language issue is settled. Note 2 was deleted and all references to DO-178C are changed to revision 'B'.

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			as DO-178B could be used without need for a deviation, which aligns with the intent of "Note 2". This would be particularly relevant for equipment that has been granted TSOA to a previous revision of TSO-C146.		
24. Garmin	TSO-C146d Page 3, par 3.e.(2)	Paragraph 3.e.(2) states that applicants using a TSO-C205 Delta CCA functional sensor can use TSO-C205 as substantiation for the software qualification. The wording of this section should change to state that software resident in the appliance needs to be developed in accordance with RTCA/DO-178C or RTCA/DO-178B if it can potentially introduce failures or cause loss of function for any function defined in this TSO.	It is possible (perhaps likely) that the outputs from the TSO-C205 Delta CCA are processed by software resident in the appliance but external to the CCA. The current wording of the TSO paragraph does not appear to require software resident in the appliance but external to the TSO-C205 Delta CCA to be developed in accordance with RTCA/DO-178. If the appliance software can introduce failures or cause loss of function, then it also needs to be developed in accordance with RTCA/DO-178.	Clarify text of paragraph 3.e.(2) to require that any appliance software that can potentially introduce failures or cause loss of function for any function defined in this TSO be developed in accordance with RTCA/DO-178C or RTCA/DO-178B.	**Not Accepted.** There is no requirement to use a TSO-C205 CCA functional sensor. However, if an applicant does use one, then paragraph 3.e.(2) allows credit for the software development in the TSO-C205 sensor. The end-use applicant is responsible for all other aspects of the TSO-C146d application not covered by virtue of the C205 TSOA.

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26. Garmin	TSO-C146d Page 4, par 3. f	Section 3.f requires development according to DO-254 for all Design Assurance Levels.	AC 20-152 paragraph 1.b provides guidance that in all cases where the AEH DAL is Minor or lower DO-254 is not required.	Adjust the Electronic Hardware Qualification guidance as defined in AC 20-152 paragraph 1.b, which provides guidance that where the complex AEH DAL is Minor DO-254 compliance is not required.	**Not Accepted.** This is the standard template language and is consistent with previous TSO revisions. AC guidance can be applied as appropriate, but the lowest TSO-C146d failure condition per paragraph 3.b is major.
27. Garmin	TSO-C146d Page 4, par 3.f.(2)	Paragraph 3.f.(2) states that applicants using a TSO-C205 Delta CCA functional sensor can use TSO-C205 as substantiation for the complex custom airborne electronic hardware (AEH) qualification. The wording of this section should change to state that complex custom AEH resident in the appliance needs to be developed in accordance with RTCA/DO-254 if it can potentially introduce failures or cause loss of function for any function defined in this TSO.	It is possible (perhaps likely) that the outputs from the TSO-C205 Delta CCA are processed by complex custom AEH resident in the appliance but external to the CCA. The current wording of the TSO paragraph does not appear to require complex custom AEH resident in the appliance but external to the TSO-C205 Delta CCA to be developed in accordance with RTCA/DO-254. If the appliance complex custom AEH can introduce failures or cause loss of function, then it also needs to be developed in accordance	Clarify text of paragraph 3.f.(2) to require that any appliance complex custom AEH that can potentially introduce failures or cause loss of function for any function defined in this TSO be developed in accordance with RTCA/DO-254.	**Not Accepted.** There is no requirement to use a TSO-C205 CCA functional sensor. However, if an applicant does use one, then paragraph 3.e.(2) allows credit for the software development in the TSO-C205 sensor. The end-use applicant is responsible for all other aspects of the TSO-C146d application not covered by virtue of the C205 TSOA.

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			with RTCA/DO-254.		
28. Garmin	TSO-C146d Page 4, par 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.** This is the standard template language.
29. Garmin	TSO-C146d Page 4, par 4.e	Includes the statement: At least one major component must be permanently and legibly marked with the operational equipment class (for example, Class 2) as defined in RTCA/DO-229D, Change 1, Section 1.4.2. The Order 8150.1C TSO template does not include the "applicable equipment class(es)" phrase.	Garmin is routinely granted deviations from TSO requirements to mark the "applicable equipment class(es)" as the equipment does not have sufficient space to include this as well as all other required markings (e.g., multiple TSOs and SW level, etc. that appear in other TSOs). This deviation is granted through use of a marking similar to the example in Order 8150.1C par 7-4.e.(4).(b) "See Inst Mnl for Addtl TSO approvals and/or markings.").	Remove par 4.e from the TSO. Add a new paragraph under 5.a requiring the equipment class(es) to be included in the "Manual(s)".	**Not Accepted.** This language is carried forward from the previous TSO revision because it is still applicable. The equipment classes are a unique item to this TSO that was not anticipated by Order 8150.1C.

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30. Garmin	TSO-C146d Page 6, par 5.c.	A PSAC, SW configuration index (SCID), and SW accomplishment summary (SAS) should be required for any software resident in the appliance but external to the TSO-C205 Delta CCA that can potentially introduce failures or cause loss of function for any function defined in this TSO. Such software should be developed in accordance RTCA/DO-178C or RTCA/DO-178B.	As mentioned above, some software in the appliance but external to the TSO-C205 Delta CCA may be needed to meet the TSO requirements. This software must be developed in accordance with RTCA/DO-178C or RTCA/DO-178B and a PSAC, SCID, and SAS should be provided for these software items.	Add text to paragraph 5.c. stating that a PSAC, SCID, and SAS are required for any software items in the appliance that need to be developed in accordance with RTCA/DO-178C or RTCA/DO-178B.	**Not Accepted.** This paragraph is for the applicant that does not choose to use a TSO-C205 CCA. Applicants that don't use C205 must develop a PSAC just as they normally would when making application for a sensor under TSO-C146. Applicants choosing to use a C205 CCA sensor get full software credit by virtue of the C205 TSOA and only have to develop data not credited to C205 for their C146d application.
31. Garmin	TSO-C146d Page 6, par 5.d	A PHAC, hardware verification plan, top-level drawing, and hardware accomplishment summary should be required for any complex custom airborne electronic hardware (AEH) resident in the appliance but external to the TSO-C205 Delta CCA that can potentially introduce failures or cause loss of function for any function	As mentioned above, some complex custom AEH in the appliance but external to the TSO-C205 Delta CCA may be needed to meet the TSO requirements. This hardware must be developed in accordance with RTCA/DO-254 and a PHAC, hardware verification plan, top-level drawing, and hardware accomplishment summary should be provided for these	Add text to paragraph 5.d. stating that a PHAC, hardware verification plan, top-level drawing, and hardware accomplishment summary are required for any complex custom AEH in the appliance that needs to be developed in accordance with RTCA/DO-254.	**Not Accepted.** This paragraph is for the applicant that does not choose to use a TSO-C205 CCA. Applicants that don't use C205 must develop a PHAC just as they normally would when making application for a sensor under TSO-C146. Applicants choosing to use a C205 CCA sensor get full

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		defined in this TSO. Such complex custom AEH should be developed in accordance RTCA/DO-254.	software items.		hardware credit by virtue of the C205 TSOA and only have to develop data not credited to C205 for their C146d application.
32. Garmin	TSO-C146d Page 6, par 5.h.	This paragraph requires listing the "If the software qualification limits eligibility of the equipment to certain aircraft types, identify the qualification level, and that the equipment is not eligible for all aircraft types." in the installation manual which can be misleading to the installer and is inconsistent with the process of determining failure condition classification and requirements at the aircraft level.	Failure condition classification is determined by system safety assessment at the aircraft level and can vary based on installation. By providing a failure condition classification and limitations at the appliance level this creates an impression that the safety analysis for these functions is complete for an entire aircraft type. Additionally, TSO paragraphs 5.a.(6)(a) and 5.a.(6)(b) already require the Manual(s)to contain the software and AEH design assurance levels that an installer needs to determine whether the equipment can support the aircraft level failure condition classification.	Remove the requirement to list "software qualification limits" in the Manual(s).	**Not Accepted.** This is verbatim from paragraph 5.r in the previous revision. It applies <u>if</u> an applicant chooses to use the lower software DAL per the AC for Part 23 airplanes. Paragraph 5.g makes no statement about the installation manual. The applicant can choose to not use lower DAL in which case paragraph 5.h does not apply.

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33. Garmin	TSO-C146d Page 7, par 5.j	TSO paragraph 5.j and its subparagraphs define required information to be supplied to the ACO for a non-TSO function. This guidance is inconsistent with Order 8110.4C CHG 4.	TSO paragraph 5.j indicates that "you must … include the following information with your TSO application" but the TSO 5.j 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. For example, TSO paragraphs 5.j.(5) and 5.j.(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.	Adjust the wording in the TSO (template) to be consistent with the 8110.4C CHG 4 intent.	**Not Accepted.** This is the template language for non-TSO functions.
34. Garmin	TSO-C146d Page 7, par 5.j	TSO paragraph 5.j and its subparagraphs include definition of non-TSO functions. This guidance is inconsistent with Order 8110.4C CHG 4.	TSO paragraph 5.j states "Identify functionality or performance contained in the article not evaluated under paragraph 3 of this TSO (that is, non-TSO functions)." Use of the term	Adjust the wording in the TSO (template) to be consistent with the 8110.4C CHG 4 intent.	**Not Accepted.** This is the template language. We will explore better ways to explain the difference between performance better than

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			"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. For example, if a TSO requires a minimum 10 watt transmitter and a company makes equipment that is robust at 11 watts, the performance exceeding the TSO is not called out under the TSO; consequently, by the paragraph 5.j "performance" definition, the 11 watt transmitter has a non-TSO 1 watt capability. The distinction of a "function that can be accomplished outside the TSO box" as is specified in Order 8110.4C CHG 4 paragraph 6-9 is critical to making non-TSO function work long term.		what is required by the TSO, and a function completely unrelated to the TSO.

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35. Garmin	TSO-C146d Page 8, par 6.g	This requirement should also apply to software resident in the appliance but external to the TSO-C205 Delta CCA that can potentially introduce failures or cause loss of function for any function defined in this TSO.	As mentioned above, some software in the appliance but external to the TSO-C205 Delta CCA may be needed to meet the TSO requirements. This software must be developed in accordance with RTCA/DO-178C or RTCA/DO-178B and the appropriate documentation should be available for review by the responsible ACO.	Modify paragraph 6.g to state that the appropriate RTCA/DO-178C or RTCA/DO-178B documentation should be available for all software in the appliance that is not covered under TSO-C205.	**Not Accepted.** This paragraph is for the applicant that <u>does not</u> choose to use a TSO-C205 CCA. Applicants that don't use C205 must develop the software just as they normally would when making application for a sensor under TSO-C146. Applicants choosing to use a C205 CCA sensor get full software credit by virtue of the C205 TSOA and only have to develop data not credited to C205 for their C146d application.
36. Garmin	TSO-C146d Page 8, par 6.h	This requirement should also apply to complex custom airborne electronic hardware (AEH) resident in the appliance but external to the TSO-C205 Delta CCA that can potentially introduce failures or cause loss of function for any function defined in this TSO.	As mentioned above, some complex custom AEH in the appliance but external to the TSO-C205 Delta CCA may be needed to meet the TSO requirements. This complex custom AEH must be developed in accordance with RTCA/DO-254 and the appropriate documentation should be available for review by the responsible ACO.	Modify paragraph 6.h to state that the appropriate RTCA/DO-254 documentation should be available for all complex custom AEH in the appliance that is not covered under TSO-C205.	**Not Accepted.** This paragraph is for the applicant that <u>does not</u> choose to use a TSO-C205 CCA. Applicants that don't use C205 must develop the hardware just as they normally would when making application for a sensor under TSO-C146. Applicants choosing to use

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					a C205 CCA sensor get full hardware credit by virtue of the C205 TSOA and only have to develop data not credited to C205 for their C146d application.
37. Garmin	TSO-C146d Page 8, par 7.b	TSO paragraph 7.b contains wording that is inconsistent with Order 8110.4C CHG 4.	TSO paragraph 7.b includes additional guidance about what furnished data should be provided to an operator or repair station when the equipment includes a non-TSO function. The problematic guidance states "include one copy of the data in paragraphs 5.j.(1) through 5.j.(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.	Adjust the wording in the TSO (template) to be consistent with the 8110.4C CHG 4 intent.	**Not Accepted.** The additional items are necessary due to the unique nature of the TSO compared to what is generically envisioned by the template.
38. Garmin	TSO-C205 Page 2, par. 3.b	Includes the statement: **(1)** Failure of the function defined in paragraph **3.a** resulting in misleading information for	It is reasonable to clarify the wording to ensure aircraft level analysis is the driver for determining failure classifications. EASA has recognized this using the	We recommend that no failure classification/DAL requirement be included in the TSO as this requires an aircraft level system assessment. Or add the	**Not Accepted.** This is consistent with the TSO template language and TSO-C146d.

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		localizer performance without vertical guidance (LP), and approach localizer performance with vertical guidance (LPV) navigation data is a *Hazardous* failure condition, and **(2)** Loss of the function defined in paragraph **3.a** for LP/LPV navigation data is a *Major* failure condition. **(3)** Design the system to at least these failure condition classifications consistent with the operational capability. Wording needs to change to recognize the fact that failure condition classification is ultimately determined by aircraft level analysis.	following wording in ED Decision 2010/010/R 14/12/2010 Annex I Subpart A – General 2.4 Failure condition classification: "Develop the system to, at least, the design assurance level equal to the failure condition classifications provided in the ETSO. Development to a lower Design Assurance Level may be justified for certain cases and accepted during the ETSO process but will lead to installation restrictions."	following general guidance: "The design assurance for the functions defined in paragraph 3.b of this TSO must be commensurate with the failure conditions listed even if the installation assesses the equipment failure to have a lesser safety effect."	
39. Garmin	TSO-C205 Page 2, par 3.e	Section 3.e "Software Qualification" requires compliance with DO-178C.	AC 20-115C allows DO-178B to be used to show compliance for the software aspects of airborne systems. The "Note 2" should be elevated to a requirement to	An additional statement should be added to allow use of 178B or 178C as appropriate. Remove "Note 2", keep item (1) under 3.e as is, and	**Partially Accepted.** The FAA is currently resolving the TSO template language for DO-178B versus revision 'C'. The current policy is to reference revision 'B' until the

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			explicitly allow DO-178B as allowed in AC 20-115C. Elevating this note to requirement would allow applicants to use standards other than DO-178C (as allowed by AC 20-115C) without the need to send deviations to the FAA. This change will reduce burden on both the FAA and the applicants in reviewing menial DO-178B deviations as DO-178B could be used without need for a deviation, which aligns with the intent of "Note 2".	add an item (2) under 3.e: "Applicants with legacy software may use RTCA/DO-178B rather than RTCA/DO-178C, if such use is in accordance with AC 20-115C ."	template language issue is settled. Note 2 was deleted and all references to DO-178C are changed to revision 'B'.
40. Garmin	TSO-C205 Page 2, par 3. f	Section 3.f requires development according to DO-254 for all Design Assurance Levels.	AC 20-152 paragraph 1.b provides guidance that in all cases where the AEH DAL is Minor or lower DO-254 is not required.	Adjust the Electronic Hardware Qualification guidance as defined in AC 20-152 paragraph 1.b, which provides guidance that where the complex AEH DAL is Minor DO-254 compliance is not required.	**Not Accepted.** This is the standard template language and is consistent with previous TSO revisions. AC guidance can be applied as appropriate, but the lowest TSO-C146d failure condition per paragraph 3.b is major.

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41. Garmin	TSO-C205 Page 3, par 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.** This is the standard template language.
42. Garmin	TSO-C205 Page 5, par 5.g.	This paragraph requires listing the "If the software qualification limits eligibility of the equipment to certain aircraft types, identify the qualification level, and that the equipment is not eligible for all aircraft types." in the installation manual which can be misleading to the installer and is inconsistent with the process of determining failure condition classification and requirements at the aircraft level.	Failure condition classification is determined by system safety assessment at the aircraft level and can vary based on installation. By providing a failure condition classification and limitations at the appliance level this creates an impression that the safety analysis for these functions is complete for an entire aircraft type. Additionally, TSO paragraphs 5.a.(4)(a) and 5.a.(4)(b) already require the Manual(s)to contain the software and AEH design assurance levels that an installer needs to determine whether the equipment can support the aircraft level	Remove the requirement to list "software qualification limits" in the Manual(s).	**Not Accepted.** This is verbatim from paragraph 5.r in the previous TSO-C146 revision. It applies <u>if</u> an applicant chooses to use the lower software DAL per the AC for Part 23 airplanes. Paragraph 5.g makes no statement about the installation manual. The applicant can choose to not use lower DAL in which case paragraph 5.g

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			failure condition classification.		
43. Garmin	TSO-C205 Page 5, par 5.i(2),(3),(4)	TSO paragraph 5.i(2),(3),(4) intend to reference 5.i.(1) but erroneously reference 5.h.(1)	Reference error.	Adjust the bullets in 5.i.(2) and 5.i.(3) and 5.i.(4) to correctly reference 5.i.(1).	**Accepted.**
44. Garmin	TSO-C205 Page 5, par 5.i	TSO paragraph 5.i and its subparagraphs define required information to be supplied to the ACO for a non-TSO function. This guidance is inconsistent with Order 8110.4C CHG 4.	TSO paragraph 5.i indicates that "you must … include the following information with your TSO application" but the TSO 5.i 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. For example, TSO paragraph 5.i.(5) requires submittal of "Results of test/analysis" while Order 8110.4C CHG 4 paragraph 6-9.b.(3) requires submittal of "proposed test	Adjust the wording in the TSO (template) to be consistent with the 8110.4C CHG 4 intent.	**Not Accepted.** This is the template language for non-TSO functions.

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			procedures"; while both sets of guidance use the word "test", otherwise there is no similarity.		
45. Garmin	TSO-C205 Page 6, par 5.i	TSO-C205 paragraph 5.i excludes paragraph 5.f.(6) from the 8150.1C TSO template.	Excluding paragraph 5.f.(6) seems inconsistent with the need to verify the function and performance of the Non-TSO functions.	Add paragraph 5.f.(6) from the 8150.1C TSO template. However, adjust the wording in the TSO (template) to be consistent with the 8110.4C CHG 4 intent as noted in Garmin's other TSO-C205 par 5.i comments.	**Accepted.**
46. Garmin	TSO-C205 Page 5, par 5.i	TSO paragraph 5.i and its subparagraphs include definition of non-TSO functions. This guidance is inconsistent with Order 8110.4C CHG 4.	TSO paragraph 5.i states "Identify functionality or performance contained in the article not evaluated under paragraph 3 of this TSO (that is, non-TSO functions)." Use of the term "performance" in the definition of a non-TSO function is inconsistent with the Order 8110.4C CHG 4 paragraph 6-9.b.(1) and 6-9.b.(3)(a) guidance regarding how to define a non-TSO function. The issue is non-TSO should not be defined	Adjust the wording in the TSO (template) to be consistent with the 8110.4C CHG 4 intent.	**Not Accepted.** This is the template language. We will explore better ways to explain the difference between performance better than what is required by the TSO, and a function completely unrelated to the TSO.

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			as "performance". It will create difficulty if these criteria are used. For example, if a TSO requires a minimum 10 watt transmitter and a company makes equipment that is robust at 11 watts, the performance exceeding the TSO is not called out under the TSO; consequently, by the paragraph 5.j "performance" definition, the 11 watt transmitter has a non-TSO 1 watt capability. The distinction of a "function that can be accomplished outside the TSO box" as is specified in Order 8110.4C CHG 4 paragraph 6-9 is critical to making non-TSO function work long term.		
47. Garmin	TSO-C205 Page 7, par 7	TSO paragraph 7 requires furnishing data in paragraphs 5.a, 5.b and 5.f and 5.g to "one entity (such as an operator or repair station)". This is inconsistent with the intent of TSO-C205 as stated in paragraph 1.	TSO-C205 states in paragraph 1. "TSO-C205 is intended as a means for end-use equipment manufacturers incorporating the Delta-4 CCA to streamline their TSO-C146d application for a Class Delta-4 sensor by using the TSO'd Delta-4	Reword paragraph 7 to ensure consistency with the users identified in paragraph 1.	**Not Accepted.** This TSO is unique and all the items listed are necessary for the end-use manufacturer to apply for TSO-C146d.

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			CCA for partial certification credit." As this TSO is intended as a means for "end-use equipment manufacturers" there is no need to require sending the data identified in paragraph 7 to "one entity (such as an operator or repair station)".		
48. Garmin	TSO-C205 Page 7, par 7	TSO-C205 paragraph 7 excludes paragraph 7.b from the 8150.1C TSO template.	Excluding paragraph 7.b seems inconsistent with the need to submit the supporting Non-TSO data in paragraphs 5.i.(1) through 5.i.(4) to the FAA. If there are Non-TSO functions, it seems like the "end-use equipment manufacturers" should receive the supporting Non-TSO data.	Add paragraph 7.b from the 8150.1C TSO template if paragraph 7 is re-scoped to only require furnishing data to "end-use equipment manufacturers".	**Accepted.**