

## DOCUMENT COMMENT LOG

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| <b>Originating Office:</b> | <b>Document Description:</b>           | <b>Project Lead:</b> | <b>Reviewing Office:</b> | <b>Date of Review:</b> |
| AIR-130                    | TSO-C196a Consolidated Public Comments | Kevin Bridges        |                          |                        |

| Comment Submitted By: | Page & Paragraph | Comment  | Rationale for Comment   | Recommendation  | Disposition      |
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| Garmin                | Page 1, par 3.   | <p>States:</p> <p>New models of TSO-C196a airborne GPS sensors using aircraft-based augmentation identified and manufactured on or after the effective date of this TSO must meet the MPS qualification and documentation requirements in RTCA, Inc. Document No. RTCA/DO-316, <i>“Minimum Operational Performance Standards for Global Positioning System/Aircraft Based Augmentation System Airborne Equipment,”</i> dated April 14, 2009, Section 2.</p> <p>Reference to the entire DO-316 section 2 as providing the intended functional and performance requirements leads to confusion because DO-316 section 2 also includes the environmental qualification and test conditions.</p> | <p>In a recent discussion on another TSO, FAA AIR-120 indicated that test sections are not part of the functional and performance requirements that the equipment must meet in order to provide the intended function defined in paragraph 3.a.(1) of this TSO. In other words, TSO deviations do not need to be obtained in cases where the tests are not conducted precisely in accordance with the procedures defined within the MPS test section although the intent of the test must be followed and any modifications to the test must be validated.</p> <p>Referencing the entire DO-316 section 2 leads to this confusion. Since DO-316 section 2.2 on environmental conditions and DO-316 section 2.3 on test conditions are already individually referenced in TSO paragraphs 3.d and 3.c respectively, it is sufficient to reference only DO-316 section 2.1 in paragraph 3.</p> | Suggest changing “Section 2” to “Section 2.1” in the quoted text. | <b>Accepted.</b> |

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| Garmin                | Page 2, par 3.b.(3) | <p>Includes the statement:</p> <p>Design the system to at least these failure condition classifications.</p> <p>Wording needs to change to allow failure condition to be determined at the aircraft level.</p> | <p>This statement implies the failure condition classification of an appliance is determined by the TSO regardless of mitigations employed to meet aircraft level safety requirements such as redundant appliances/systems. Unless the DAL cannot be affected by the installation, the aircraft System Safety Assessment should determine the failure classification and by extension, the design assurance level (DAL) requirement. The aircraft FHA/SSA ultimately determines the DAL requirement for a particular installation. Specifying the DAL at the appliance level without the benefit of the specific aircraft level FHA/SSA means that in some cases the DAL will undoubtedly be higher and more costly than necessary. This will have a chilling effect on the installation of new, safety enhancing technologies since the cost will be greater than necessary. It is possible to build and certify a TSOA appliance that cannot be approved for installation in 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. 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 3.b in this TSO to the general guidance in the Recommendation column. (Note that TSO-C112c is an example where a</p> | <p>Suggest changing to the following wording:</p> <p>Develop each system to at least the design assurance level required by the anticipated installation for the function defined in paragraph 3a.</p> | <p><b>Not Accepted.</b> This comment has been previously debated and the decision is that the wording in the template is correct.</p> <p>The unique failure modes for the GPS signal dictate the failure condition classification and design considerations for GPS equipment. This has been the case since TSO-C129 was first published in 1992. The failure condition classifications and resulting design assurance levels have remained the same since then and are no different than those published in this TSOs predecessor. An applicant whose equipment does not meet the stated failure condition DAL, or with a specific installation consideration, can always file a deviation request that provides mitigations and/or limitations that provide an equivalent level of safety.</p> |

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|                       |                        |  | classification/DAL may be appropriate as a transponder output is used by the national airspace system and the installation has no ability to mitigate the safety risk.)   |   |  |
| Garmin                | Page 3, par 4.b.(2)    | <p>Paragraph 4.b.(2) states:</p> <p>Each subassembly of the article that you determined may be interchangeable.</p> <p>This language is confusing.</p>   | 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. | <b>Not Accepted.</b> The applicant is charged with determining which interchangeable subassemblies require marking. This requirement is no different from TSO-C196 or previous TSOs.   |
| Garmin                | Page 4, par 5.a.(4)(d) | This paragraph requires listing the “failure condition classification” in the installation manual which can be misleading to the installer and is inconsistent with the process of determining failure condition classification at the aircraft level. | <p>Failure condition classification is determined by system safety assessment at the aircraft level and can vary based on installation. By providing a failure condition classification at the appliance level this creates an impression that the safety analysis for these functions is complete.</p> <p>Additionally, TSO paragraphs 5.a.(4)(a) and 5.a.(4)(b) already require the Manual(s) to contain the software and AEH design assurance levels that an installer needs to determine whether the equipment can support the aircraft level failure condition classification.</p> | Remove the requirement to list “failure condition classification” in the Manual(s).   | <b>Accepted.</b>   |
| Garmin                | Page 5, par 5.f        | TSO paragraph 5.f and its subparagraphs define required information to be supplied to the ACO for a non-TSO function. This guidance is inconsistent with Order 8110.4C CHG 4.  | 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)   | Reword to point to Order 8110.4C CHG 4 paragraph 6-9.b.(3).   | <b>Not Accepted.</b> This paragraph simply asks the applicant to declare non-TSO functions and show test results that the non-TSO functions do not interfere with the TSO functions. Simply stating a test doesn’t confirm the test results. |

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|                       |                  |   | <p>“Manufacturer Data Submittal” requirements. For example, TSO paragraphs 5.f.(5) and 5.f.(6) require submittal of “Results of test/analysis” while Order 8110.4C CHG 4 paragraph 6-9.b.(3) requires submittal of “proposed test procedures”; while both sets of guidance use the word “test”, otherwise there is no similarity.</p>   |   |  |
| Garmin                | Page 5, par 5.f  | <p>TSO paragraph 5.f and its subparagraphs include definition of non-TSO functions and the data to be submitted to the ACO for non-TSO functions. This guidance is inconsistent with Order 8110.4C CHG 4.</p> | <p>TSO paragraph 5.f states “Identify functionality or performance contained in the article not evaluated under paragraph 3 of this TSO (that is, non-TSO functions).” Use of the term “performance” in the definition of a non-TSO function is inconsistent with the Order 8110.4C CHG 4 paragraph 6-9.b.(1) and 6-9.b.(3)(a) guidance regarding how to define a non-TSO function. The issue is non-TSO should not be defined as “performance”. It will create difficulty if these criteria are used. For example, if a TSO requires a minimum 10 watt transmitter and a company makes equipment that is robust at 11 watts, the performance exceeding the TSO is not called out under the TSO; consequently, by the paragraph 5.f “performance” definition, the 11 watt transmitter has a non-TSO 1 watt capability. The distinction of a “function that can be accomplished outside the TSO box” as is specified in Order 8110.4C CHG 4 paragraph 6-9 is critical to making non-TSO function work long term.</p> | <p>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 function.</p> | <p><b>Not Accepted.</b> The example provided is an incorrect interpretation of a non-TSO function. The TSO defines the minimum performance, but applicants are free to exceed the minimum performance and still receive a TSOA without that performance being considered a non-TSO function.</p> <p>Documenting actual functionality not covered by TSO and the non-TSO function performance helps the applicant receive credit for those functions. Again, the main point of non-TSO function documentation is to ensure the non-TSO functions do not interfere with the TSO functions.</p> |

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| Garmin                | Page 6-7, par 7.a | <p>Includes the statement:</p> <p>Add any other data needed for the proper installation, certification, use, or for continued compliance with the TSO, of the Flight Management Systems Using Multi-Sensor Inputs.</p> | <p>It is unclear why there is an expectation that an installation which includes TSO-C196a equipment must be interfaced with equipment which has “the TSO, of the Flight Management Systems Using Multi-Sensor Inputs”.</p> <p>Furthermore, TSO-C196a paragraph 3.a.(1) acknowledges that the equipment may interface with “automatic dependent surveillance” equipment and the TSO-C196a equipment also may interface with moving maps and inertial systems, none of which are acknowledged by this statement.</p>  | <p>Remove the quoted statement as it should be understood that such information should be provided to the installer.</p> <p>If FAA feels it is not understood that such information should be provided, then suggest that a paragraph be added under 5.a along the lines of:</p> <p>Instructions on connection to other airborne equipment such as flight management systems, inertial reference systems, displays, and terrain warning systems with known compatibility.</p> <p>This is more consistent with existing guidance in AC 20-138B 2-2.a.(3).</p> | <p><b>Accepted.</b> This was an unintended error of omission. “Flight Management Systems Using Multi-Sensor Inputs” has been replaced with “GPS sensor” to make the sentence exactly as it was in TSO-C196.</p> |
| Garmin                | Page 7, par 7.b   | <p>TSO paragraph 7.b contains wording that is inconsistent with Order 8110.4C CHG 4.</p>   | <p>TSO paragraph 7.b includes additional guidance about what furnished data should be provided to an operator or repair station when the equipment includes a non-TSO function. The problematic guidance states “include one copy of the data in paragraphs 5.f.(1) through 5.f.(4).” This guidance is inconsistent with Order 8110.4C CHG 4. Order 8110.4C CHG 4 paragraph 6-9.b.(6) defines the FAA-industry agreed data that must be provided to an installer when equipment includes a non-TSO function and it would be better if the TSO simply pointed to Order 8110.4C CHG 4 paragraph 6-9.b.(6).</p> | <p>Reword to point to Order 8110.4C CHG 4 paragraph 6-9.b.(6).</p>   | <p><b>Not Accepted.</b> The items listed are the minimum necessary to evaluate non-TSO functions. These items properly define the non-TSO functions.</p>  |

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| Garmin                   | Page 7, par 8.b  | This paragraph describes how to “Order SAE documents”.      | There are no SAE documents referred to within this TSO. | Suggest removing this paragraph.              | <b>Accepted.</b>   |
| Filippo Tomasello (EASA) | Page 1, Par. 1   | It is understood that proposed TSO-C196a replaces TSO-C129a | TSO-C129a has already been cancelled                    | Make the replacement clear in par. 1 of C196a | <p><b>Not Accepted.</b> Normally, a direct replacement would have been a revision to TSO-C129a (that is, TSO-C129b). However, a TSO revision wasn’t done at the time TSO-C196 was published due to certain considerations which resulted in both TSO-C129a and TSO-C196 being available at the same time. This situation dictated the unusual statement in TSO-C196 that it wasn’t intended to replace TSO-C129a because both TSOs applied to unaugmented GNSS sensors.</p> <p>As noted, TSO-C129a has already been cancelled, so no new certifications are possible against TSO-C129a. That will leave TSO-C196a or TSO-C145c as the only possibilities for manufacturers desiring a TSOA for their GNSS sensor with TSO-C196a as the only one that does not require augmentation (there have not been any TSOAs granted against TSO-C196).</p> |

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|                        |                  |  |  |   | <p>The proposed recommendation is more appropriate to an advisory circular and is being addressed in a revision to AC 20-138B currently out for public review. AC 20-138C is scheduled for publication in March 2012, shortly after TSO-C196a will be published.</p>   |
| Friedhelm Runge (EASA) | Page 1, Par. 3   | <p>The called DO-316 limits the following DO-160 tests as applicable to the antenna only:<br/> 23 Lightning direct Effects<br/> 24 Icing</p> | <p>TSO-C196 had excluded Explosion (section 9) and fire (section 26) testing from the mandatory requirements.</p> <p>TSO-C196a has no exclusion provision.</p> | <p>I propose making testing to section<br/> 9 Explosion<br/> 26 Fire<br/> Optional in general and</p> <p>10 Waterproofness<br/> 11 Fluids<br/> 12 Sand and Dust<br/> 13 Fungus<br/> 14 Salt Spray<br/> Applicable only to parts to be mounted on the outside of the airframe (antenna) as well.</p> | <p><b>Not Accepted.</b> This TSO follows the new “standard” language regarding environmental qualification versus the old “standard” used in TSO-C196. The new “standard” language relies on the MOPS-defined environmental tests and conditions as appropriate for the airborne equipment rather than prescriptive TSO requirements that may not apply.</p> <p>It is incumbent upon the applicant to declare the appropriate environment during TSO application; provide the necessary test data; and, ensure the installation instructions provide enough detail for the installer to determine if the TSO article is compatible with the aircraft and all foreseen equipment and systems with which the article is intended to interface.</p> |

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| Boeing                | Page 2<br>Paragraph 3.b.1,<br><b>Failure Condition Classification</b> | We suggest that failure condition classifications should not be specified in the TSO.   | Failure classification cannot be done outside of the context of the airplane integration and intended operational use. Assignment of the failure classification as “major” is arbitrary and may be inappropriate (i.e., either too stringent or not stringent enough, depending on how the sensor is actually integrated and used).  | Remove paragraph 3.b.   | <b>Not Accepted.</b> The unique failure modes for the GPS signal dictate the failure condition classification and design considerations for GPS equipment. This has been the case since TSO-C129 was first published in 1992. The failure condition classifications have remained the same since then and are no different than those published in this TSOs predecessor. An applicant whose equipment does not meet the DAL associated with the stated failure condition, or with a specific installation consideration, can always file a deviation request that provides mitigations and/or limitations providing an equivalent level of safety. |
| Boeing                | Page 3<br>Paragraph 5.a.,<br><b>Application Data Requirements</b>     | The language in this section seems largely inappropriate as it addresses the operational use of the equipment rather than the performance or characteristics of the equipment itself. A TSO does not seem the appropriate place to assert an operational requirement for RAIM (Receiver Autonomous Integrity Monitoring); instead, an advisory circular (applicable to part 91 or 121) would be a more suitable location for that material. | The 3 stand-alone paragraphs under paragraph 5.a. are apparently included in the installation instruction to support the installation approval. However, all 3 paragraphs refer to operational requirements. The adequacy of the installation should not be contingent on things that the installation does not affect or control. Achieved performance may be a function of the proper installation; however, potential use or misuse of the equipment cannot | We recommend revising paragraph 5.a. as follows:<br><br>a. Operating instructions and equipment limitations in an installation/instruction manual (IM), sufficient to describe the equipment’s <b>operational functional</b> capability <b>and performance</b> . Describe any deviations in detail. If needed, identify equipment by part number, version, revision, criticality level of | <b>Partially Accepted.</b> The language in this section contains the new “standardized” language for avionics TSOs. The new language is essentially similar to the old “standard” language, but is broken out into more easily readable chunks with numbered paragraphs for reference. The new items are for clarification. For example, the non-TSO functions are added on required data to include for the non-TSO functions to help applicants meet  |

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|                       |                  |         | <p>be addressed by the installation. Those operational requirements should be in an operationally relevant advisory circular (AC). That operational AC could then appropriately reference the TSO as a statement of acceptable installed performance.</p> | <p>software/hardware, classification for use, and environmental categories. Specifically, the following limitations must be documented in the installation/instruction manual for inclusion as part of the installation approval:</p> <p><del>Pilots using</del> <b>Airplanes with installations of</b> the GPS capabilities of the &lt;insert equipment model&gt; navigation equipment <b>that are intended to be used for other than oceanic or remote operations</b> under Instrument Flight Rules must be equipped with an approved <del>and operational</del> alternate means of navigation appropriate to the <b>intended operations</b>. <del>flight with the exception of oceanic and remote operations.</del></p> <p><i>[Delete remainder of paragraph 5.a.]</i></p> | <p>their responsibilities for these capabilities.</p> <p>The specific GPS limitation to have other navigation equipment is the same limitation that has always existed for non-SBAS/GBAS GPS equipment; that is, all versions of TSO-C129 equipment and the previous TSO-C196 version. The benefit of TSO-C196 equipment over TSO-C129 equipment is the automatic qualification for oceanic/remote operations without further approval based on the equipment MOPS requirements.</p> <p>However, the exact limitation language from TSO-C196 was inserted for TSO-C196a</p> |