

Field Document Review Comment Matrix

| TSO-C201 AHRS, Attitude Heading Reference System | | | | | | |
|--|-------------------------------|--------------------------|---|---|---|--|
| # | Commenter | Page, Section, Paragraph | Comment | Rationale for Comment | Recommendation | Resolution |
| 1 | ANM-160S, Robert Stoney | Pg 2, para 3(2)c | There is very little in this document about the human factors of how AHRS data might be displayed. At first, I thought that this was because this TSO dealt ONLY with the AHRS itself (i.e., gyros spinning, providing data but NO DISPLAY). But, the referenced paragraph says “If the AHRS includes a display, demonstrate the required functional performance of the display under the test conditions specified in RTCA/DO-3XX, Section 2.6.” (there is also a brief mention of “display” of information in paragraph a). I’m not familiar with DO-3XX and, perhaps, my concerns would be allayed if I read that. But, I’m concerned that AHRS displayed data might “pass” the TSO process (i.e., get a TSOA) but have a negative, human factors–related problem. | There have been enough safety issues related to unusual attitude awareness, etc. that we should guard against skipping past the issue and waiting for it to be covered in the type certification process. | <p>I don’t have the best picture of all TSOs involved, but I recommend either (a) removing the allowance/applicability of this TSO to ANY displayed information or (b) make sure any displayed information is thoroughly evaluated, from a human factors perspective, prior to TSOA. In my experience (working with TSO applicants who know the right/best way to consider HF and those who don’t), this will also benefit the TSO applicants.</p> <p>Consider reference to “early FAA human factors involvement in the evaluation of the display of AHRS information.”</p> <p>Consider referencing AC25.11A “Flight Deck Displays.”</p> <p>Please call me if I can</p> | <p>Not Accepted. The display requirements for RTCA DO-334 are derived from the display requirements for the original gimbaled attitude, heading, turn, and slip instruments (TSO-C3, C4, and C6). No new requirements were included.</p> <p>Section 2.5 of RTCA DO-334 provides this information by stating, “These requirements are derived from the historically accepted marking requirements of the applicable TSOs for pitch, roll, direction, turn and slip. Compatibility with emerging cockpit display technology may require characteristics differing from those specified herein. In these cases an alternate means of compliance will be acceptable upon the approval of the certification authority.”</p> <p>If the display requirements were not ported into DO-334/TSO-C201, manufacturers would have been forced to get incomplete system TSO authorizations for the</p> |

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| | | | | | provide any more information or insight. | old gimbaled systems for their displays. |
| 2 | ANM-100D | P. 2 ¶3.(2) c. P. 2 ¶3.(2) d. | Multiple references to DO-3xx | DO-3XX includes numerous documents, most of which do not address AHRS. | Replace DO-3XX with DO-334. | Accepted. Changes made. |
| 3 | ANM-100L | Page 2, Para. 3.2(d) | The TSO-C201 and the MOPS DO-334 called out environmental qualification of DO-160G. | So many times the applicants request to use a latter DO-160 revision(s) than the one that called out in the TSO. The affected ACO will have to issue a standard approval which does not contribute to safety. | Provide a provision that allows using a later DO-160 revision(s). | Not Accepted. We do provide provisions for later revisions without formal review and acknowledgement of future versions of DO-160. The FAA environmental qualification policy, which is reflected in this TSO, is that any suitable environmental standard is acceptable. The only caveat is that older versions of DO-160 (D Change 2 and earlier) require substantiation via deviation.) |
| 4 | ANM-100L | Page 2, Para.3.2 (e) | The TSO-C201 called out the software DO-178B | DO-178C will be invoked by the FAA soon. | Provide a provision that allows using the later DO-178 revision(s). | Not Accepted. The FAA is currently reviewing DO-178C for inclusion in TSO policy. AIR-120 will provide guidance on the use of DO-178C in an advisory circular. |
| 5 | ANM-100D | P. 6 ¶8.b. | Wrong URL used. | 1. The website has changed and the instructions are | 1. Replace “You can also order copies online ...” | Not Accepted. This TSO was drafted in accordance |

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| | | | | no longer valid. 2. The www.access.gpo.gov portal is difficult to navigate & is not the most direct access to the Bookstore. 3. P. 6 ¶ 8. a. & c. do not provide navigation on the referenced web pages. | with “You can also order copies online from www.bookstore.gpo.gov .” 2. Delete the last two sentences (on page navigation). | with the TSO boilerplate in Order 8150.1C. |
| 6 | ANM-100L | General | Throughout the document, RTCA/Do-3XXs listed. | List the MOPS document number. | Revise it to RTCA/DO-334 as applicable. | Accepted. Changes made. |
| 7 | ACE-114, Gunnar Berg | Throughout | Need to correct references. | Some references to DO-3XX | Correct reference to DO-334. | Accepted. Changes made. |
| 8 | ACE-114, Gunnar Berg | Page 1 Paragraphs 3.(1) & 3(2) | The format of the subparagraphs’ numbering is not consistent with that of the rest of this document (i.e., number.letter.(number).(letter)). | Consistency. | Correctly re-number/letter this section. | Accepted. Changes made. |
| 9 | ACE-114, Gunnar Berg | Page 1 Paragraph 3.(2).a (based on current incorrect | Present wording of the paragraph is inaccurate (e.g., it refers to the parameters of “...heading, turn, slip” as “functions”, whereas in actuality a function would be any/all of the “sensing, calculation, | For accuracy and completeness of the paragraph; the proposed new wording changes are in bold italicized text. | Change to: “ a. Functionality. This TSO applies to <i>solid state</i> strap-down AHRS (intended to output pitch and roll attitude (pitch and roll) that <i>do</i> not use | Partially Accepted. The duplicative use of “non-gimbale” has been resolved. The remainder of the paragraph accurately reflects the functionality of the AHRS. |

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| | | numbering) | indication or display” of these parameters). It also could be more clear in its exclusion of gimballed sensors by explicitly saying it applies to solid state AHRS. | | gimballed sensors. It also addresses the optional <i>instrument indication</i> functions for of heading, turn, slip and the display of information provided by an AHRS.” | |
| 10 | ACE-114, Gunnar Berg | Page 2 Paragraph 3.(2).e (based on current incorrect numbering) | Present wording of the paragraph is inaccurate (e.g., DO-178B does not use the term “design assurance level” but instead uses “software level”). Also, the present wording of the Note for this paragraph does not link it to DO-178B and implies that the FAA has no authority for other than the review of data. | For accuracy and completeness of the paragraph; the deleted and proposed new wording changes are in strike-out and bold italicized text, respectively. | Change to: “e. <u>Software Qualification</u> . If the article includes software, develop the software according to RTCA, Inc. document RTCA/DO-178B, <i>Software Considerations in Airborne Systems and Equipment Certification</i> , dated December 1, 1992 to the design assurance <i>software</i> level consistent with the failure condition classification defined in paragraph 3.b of this TSO. Note: The certification liaison process objectives of DO-178B will be considered satisfied after FAA review <i>and</i> | Partially accepted. The paragraph was changed to reflect software level in accordance with the Order 8150.1C. The Note was not changed as it is consistent with Order 8150.1C. |

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| | | | | | <i>acceptance</i> of the applicable life cycle data.” | |
| 11 | ACE-114, Gunnar Berg | Page 2 Paragraph 3.(2).f (based on current incorrect numbering) | Present wording of the Note for this paragraph does not link it to DO-254 and implies that the FAA has no authority for other than the review of data. | For accuracy and completeness of the paragraph; the proposed new wording changes are in bold italicized text. | Change to: “ Note: The certification liaison process objectives of DO-254 will be considered satisfied after FAA review <i>and acceptance</i> of the applicable life cycle data.” | Not Accepted. This TSO was drafted in accordance with the TSO boilerplate in Order 8150.1C. |
| 12 | ACE-114, Gunnar Berg | Page 4 Paragraph 5.c | Acronym PSAC is defined but never used again. | Reduction of unused acronyms. | Delete “(PSAC).” | Not Accepted. This TSO was drafted in accordance with the TSO boilerplate in Order 8150.1C. |
| 13 | ACE-114, Gunnar Berg | Page 4 Paragraph 5.d | Acronym PHAC is defined but never used again. | Reduction of unused acronyms. | Delete “(PHAC).” | Not Accepted. This TSO was drafted in accordance with the TSO boilerplate in Order 8150.1C. |
| 14 | ACE-114, Gunnar Berg | Page 6 Paragraph 7.a. | Last sentence reads: “Add any other data needed for the proper installation, certification, use, or for continued compliance with the TSO, of the AHRS.” | The FAA doesn’t certify appliances. | Reword the sentence to read: “Add any other data needed for the proper installation, approval, use, or for continued compliance with the TSO, of the AHRS.” | Not Accepted. This TSO was drafted in accordance with the TSO boilerplate in Order 8150.1C. |
| 15 | ANE-150, NRediess | Page 2, Para 3b | The TSO says “document the loss of function and malfunction failure condition classification for | Conflicting requirements. | Change to be consistent with DO-334 requirement. The installation manual should simply identify the | Not Accepted. The manufacturer must document the loss of function and malfunction classification for which the |

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| | | | which the equipment is designed.” DO-334 Section 2.1.7 says “The manufacturer shall declare in the installation manual the hardware and software design assurance levels of the equipment.” | | assurance levels that the equipment was designed to. Let the installer determine whether those are sufficient for the intended installation. | equipment was designed in accordance per the TSO and per the MOPS. If this information was not documented by the AHRS manufacturer, the installer would have no means to determine if the design of the TSO’d article is sufficient for the intended installation. |
| 16 | ANE-150, NRediess | Page 1, Section 3a | The TSO says that it applies to the optional function of the display of AHRS information. Yet the TSO does not point to the applicable requirements (those in DO-334 section 2.5 and 2.6) for the display function. | No reference to the applicable requirements for the display. | Expand the table in Section 3(2) to include the applicable requirements for the display function. | Accepted. Changes made. |
| 17 | ANE-150, NRediess | General | There should be a discussion about the applicability of this TSO versus TSOs-C3, C4, and C6. | Applicants should be provided with clear information on which TSOs are applicable to their equipment. This TSO (DO-334) seem much more appropriate for current generation PFDs with and without incorporated AHRS. | Provide instructions on which TSOs are best applicable to which type of equipment. | Not Accepted. TSO-C201 clearly states that this TSO is for solid state strap-down AHRS intended to output pitch and roll attitude that do not use gimbaled sensors. It also addresses the instrument indication functions of heading, turn, slip and the display of information provided by an AHRS. |

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| 18 | ANE-150, NRediess | Sections 3c, 3d, and 5k | Still reference "DO-3XX" | DO-334 is the correct reference | Change to DO-334. | Accepted. Changes made. |
| 19 | ASW-110 | Page 2, Para 3b | Expand the statement on documenting the failure classifications of the equipment to include using the ARPs 4754 and 4751 and declaring the loss and malfunction for each function provided by AHRS System being TSOD. | This TSO-C201 document clearly defies the process and standards used to develop the Software and AHE to the corresponding design assurance levels needed to support the system. However it's the failure classification of each function or combination of functions and their associated loss and/or malfunction contained in a properly documented FHA the drives these development process DAL requirements. Having the FHA done to the ARP standards assures that the follow installation certification effort will go smoothly as all parties will better understand the AHRS equipments capabilities and limitations. | The applicant will provide an FHA developed using the information provided in SAE ARP 4754 and \$761. In the FHA the applicant will document the failure classification for loss of and malfunction each function and/or probable combination of all functions for which the AHRS equipment is designed. | Not Accepted. This is a idea which we actually started incorporating, but then stopped. The rationale is the SAE ARPs are one acceptable way to accomplish a FHA, but not the only method. Also, it is possible that the AHRS manufacturer not need to do a FHA. If an airframe manufacturer comes to the AHRS vendor and says make me an AHRS with Class A software and Class A AEH, the article vendor doesn't really need to determine the appropriate design assurance, the airframe integrator has already determined. Of course, applicants utilization of the guidance in ARP 4754a and ARP 4761 is acceptable and encouraged. |
| 20 | ASW-170 | 1 and 3(1) | Format needs to be corrected, e.g. it shows 3.(1) and (2) | Correct Format | Change format to standard, e.g. 3.a(1) etc | Accepted. Changes made. |

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| 21 | ASW-170 | 2, 3.c, 3.d, 5.k | RTCA/DO-334 was stated in 3.(1) but not in 3(c), 3(d), or 5.(k) | Need to update the document to include the new RTCA/DO-334. | Change RTCA/DO-3XX to RTCA/DO-334. | Accepted. Changes made. |