

**AC 25.1302 INSTALLED SYSTEMS AND EQUIPMENT FOR USE BY THE FLIGHTCREW**

**Final Public Comment Log with Dispositions for Issuance 3/1/2013**

**Comments and Dispositions reviewed May 1, 2012**

**Michael Menkin, ANM-113, Transport Airplane Directorate, Standards Division, FAA, 1601 Lind Ave. SW, Renton, WA 98057**

	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
	<b>Commenter and paragraph number:</b>		
1.	Cessna/General	There is a significant concern in the area of who can make the compliance findings associated with 25.1302. This finding has historically been made by the FAA or Designee Flight Test Pilot. Cessna is concerned that there does not appear to be a clear plan of how the FAA intends for compliance findings to be made or who will accomplish them for 25.1302.	Ideally findings of compliance would involve a team including flight test and human factors specialists. <i>The FAA is currently working on an order for human factor roles and responsibilities within the FAA that will also cover findings.</i>  No change.
2.	ALPA/ General	There is a lack of guidance for if/when additional functionality is implemented for a system after completion of the certification process. Would this require re-certification to ensure that all the requirements outlined in the NPRM and AC for each function are met? To address this issue we recommend that draft AC 25.1302-X be amended to provide guidance on adding additional functions to systems and equipment already certified in accordance with the AC, or an alternate means, and 14 CFR 25.1302 for other functions.	This is normally handled by our STC process and subject to the changed product rule 14 CFR Part 21.101. Whether the proposed 14 CFR Part will be applied in the STC process depends on the guidance and policy from 14 CFR Part 21.101. <i>Recommendations for updating the 14 CFR Part 21.101 may be considered.</i>  No change.
3.	ALPA/General	There are requirements and guidance in the NPRM and AC respectively for	While it is desirable for the flightcrew to have interaction with some of the systems as proposed

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		<p>systems and equipment to provide sufficient information to the flightcrew to determine what their inputs will result in, manage any errors, provide information on the status of the system and note changing situations so that they can operate the system safely.</p> <p>Although the AC and NPRM refer to the importance of flightcrew awareness of system status, they appear to remain generally neutral on whether flightcrew interaction with the system performing its function(s) helps with flightcrew awareness and ultimately increases safety. The final rule should require that future aircraft designs keep the flightcrew actively involved in the process of controlling all aircraft systems, equipment, and the aircraft itself. The AC hints at the importance of flightcrew involvement when it states “the flightcrew’s interaction with the system enables them to understand the situation, and enables timely detection of failures and flightcrew intervention when appropriate.”</p> <p>It is ALPA’s position that rather than designing the flightcrew/human out of the system and delegating them to the</p>	<p>in the comment, it is not always appropriate to require it for all systems and may even impose a significant workload burden on the pilot.</p> <p>No Changes made.</p>

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		<p>status of system monitors, keeping the flightcrew actively involved is an important design concept to improve safety. This is so even if it means that the crewmember simply approves or rejects the proposed system's new course of action or continued course of action. Monitoring tasks in general are problematic, especially when performed over long periods of time (Sarter, Mumaw, and Wickens, 2007<sup>1</sup>). This is so because if the system only provides information but does not require pilot action or at least some limited interaction, it is human nature to start to rely on and trust the system and not stay engaged.</p> <p>To mitigate this, these tasks should require active participation as opposed to passive involvement. (See attached ALPA position paper titled "Human Factors in Aviation Automation" for additional information.)</p> <p>Therefore, we propose the following amendments:</p> <p>a. Amend NPRM 25.1302 (a) as follows to keep the flightcrew actively engaged</p>	

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		<p>(new text in italics and original text to be removed crossed out):</p> <p>(a) “<i>Installed Flight deck controls systems and equipment</i> must be installed to allow accomplishment of all the tasks required to safely perform the equipment’s intended function(s) including providing information to the flightcrew <i>and requiring appropriate levels of flightcrew interaction</i> that is <i>as necessary to accomplish the defined task.</i>”</p> <p>b. Amend AC 25.1302-X to provide guidance to 14 CFR Part 25.1302(a). This will require adjustment to language throughout the AC. One example would be to change paragraph 5-6, (6), (a) to add an additional sentence in italics at the beginning so that it reads “<i>System and equipment design should include an adequate level of flightcrew interaction to keep them actively involved and aware of the status of the system. However, some ‘automated systems may perform various tasks with minimal flightcrew interventions, but under supervision of the flightcrew.</i>”</p>	

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4.	ALPA/General	<p>Flightcrews should be provided adequate information by the flight deck equipment as needed to comprehend when there is a partial failure, or when the intended piece of equipment is not functioning within the system, or with other installed equipment.</p> <p>The AC should address partial system and equipment failures. To address this issue, we recommend that AC 25.1302-X be amended to provide guidance on system and equipment requirements for feedback to the flightcrew on partial failures.</p>	<p>The determination of what is alerted is based on other rules and a § 25.1309 systems safety analysis. How it is alerted (information presented to the flightcrew) is based on the § 25.1322 (flightcrew alerting) requirements and advisory material.</p> <p>Partial failures in the proposed AC 25.1302 are not broken out separately but are included under non-normal conditions. This subject (non-normal conditions) is covered in the preamble and the advisory material</p> <p>Quote from the proposed AC 25.1302 showing one example of non-normal conditions is shown below.</p> <p><i>“Covered Equipment.</i></p> <p><b>a.</b> This material applies to flightcrew interfaces and system behavior for all installed systems and equipment used by the flightcrew on the flightdeck while operating the airplane in both normal and non-normal conditions. It applies to those airplane and equipment design considerations within the scope of part 25 for type certificate (TC) and supplemental type certificate (STC)</p>

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			<p>projects. It does not apply to training, qualification, or licensing requirements for flightcrews. Similarly, it does not apply to procedures for flightcrews, except as required within part 25. “</p> <p>No change.</p>
5.	ALPA/General	<p>The AC points out that applicants can gain significant benefits by involving the FAA ACO in the earliest possible phases of application and design. ALPA agrees and believes that equally important is getting active line pilot involvement early in the design stage to reduce the potential for design-related human factors issues.</p>	<p>Generally we agree.</p> <p>No change.</p>
6.	ALPA/General	<p>The AC points out that in the past, design characteristics known to contribute to flightcrew error were accepted, with the rationale that training or procedures would mitigate any associated risk. The AC goes on to state it is known such an approach is inappropriate. ALPA strongly supports the inclusion of both statements in the final AC. It is ineffective to try to train around a design feature that is recognized will likely lead to errors. The</p>	<p>We agree</p> <p>No Change</p>

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		AC provides a good example of this when it says “applicants must not design a display so that the symbology it provides is either inconsistent with or conflicts with the same or similar symbology displayed on other installed equipment.	
7.	ALPA/General	ALPA believes it is important that the AC points out, in reference to the NPRM’s introductory paragraph, that “...the provisions of this paragraph apply to each item of installed equipment”... “intended for the flightcrew’s use in operating the airplane from their normally seated positions on the flightdeck.	We agree  No Change.
8.	ALPA/General	The NPRM and AC both point out that installed equipment “individually and in combination with other such systems and equipment” must be designed so that qualified flightcrew members who are trained and checked in its use can safely perform all their tasks associated with the intended function of the installed equipment and systems. ALPA strongly supports the concept that during the design of new equipment it be required to assess its operation not only	We agree. No change.

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		in isolation, but also in combination with existing equipment and show that it doesn't contribute to flightcrew error.	
9.	ALPA/General	The provisions contained in the <b>NPRM</b> and AC should apply to both normal and nonnormal operations. These provisions call for equipment to be designed so that the flightcrew can safely perform the tasks associated with the equipment's intended function in both normal and non-normal operations. The AC includes this provision but the <b>NPRM</b> does not. Therefore, we propose that the following italicized text be added to 14 CFR 25.1302's introductory paragraph: "The applicant must show that these systems and installed equipment, individually and in combination with other such systems and equipment, are designed so that qualified flightcrew members trained in their use can safely perform all of the tasks associated with the systems' and equipment's intended function <i>'during normal and non-normal conditions.</i> "	The proposed text is included in the applicability and scope section of the final rule. We believe this covers this comment. Please view the following quote from the NPRM:  "The FAA envisions for the proposed requirement that equipment be designed so the flightcrew can safely perform tasks associated with the equipment's intended function. This requirement would apply for operations in both normal and non-normal conditions. Tasks intended for performance under non-normal conditions are generally those prescribed by non-normal (including emergency) flightcrew procedures in the airplane flight manual."  No change
10.	ALPA/General	ALPA believes that the following system and equipment characteristics as described in the NPRM and AC are very	Generally we agree.  AC language was modified to indicate that the

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		<p>important to reduce design-induced errors.</p> <p>a. Controls and information must be provided in a clear and unambiguous manner at a resolution and precision appropriate to the task.</p> <p>b. Controls and information must be accessible and usable by the flightcrew in a manner consistent with the urgency, frequency, and duration of their tasks.</p> <p>i. That controls or tasks used more frequently or are more urgent should require fewer steps or fewer actions to complete the task.</p> <p>ii. To the extent possible, the installed equipment should not significantly increase the crew workload when managing errors, or interacting with the equipment during normal and non-normal operations.</p> <p>c. Systems and equipment need to provide the flightcrew with feedback information about the effects of their actions on the airplane so that they can remain aware of the system and aircraft status and to recognize and correct errors.</p> <p>i. The flightcrew should always know what their action, or a changing</p>	<p>current mode should remain identified/displayed at all times.</p>

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		<p>situation, will cause the system to do under foreseeable circumstances so that they can operate the system safely. There should be no ambiguity of the result of a flightcrew selection. The design should enable the flightcrew to determine a need for, choose, and take appropriate action, or to change or alter an input to the system, in a manner appropriate to the task, and to monitor the system and airplane response to the action.</p> <p>ii. The AC appropriately states “Mode annunciation should be clear and unambiguous.” “Additionally, any change in the mode as a result of the aircraft’s changing from one operational mode (for instance, on an approach) to another should be clearly and unambiguously annunciated and fed back to the flightcrew.” This type of information is important for the flightcrew, so that as mentioned in the AC, they know what the system/aircraft is doing, what it is trying to do, and what it is going to do next.</p> <p>1. In addition, the AC should also state “The current mode should remain identified/displayed at all times.”</p>	

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11.	ALPA/General	<p>ALPA strongly supports the NPRM requirement and AC language elaborating on the need for equipment behavior to be predictable and unambiguous, and designed to enable the flightcrew to intervene in a manner appropriate to the intended function.</p> <p>a. For automated systems particularly it is important that the system provide the flightcrew with sufficient information so they understand and expect mode transitions as they occur. As pointed out in the AC, the lack of such information can confuse the flightcrew and has been determined to contribute to incidents and accidents.</p> <p>b. When the system detects a problem, it is important that the feedback by the system be sufficient for the flightcrew to determine the appropriate corrective action. In that regard, ALPA supports the statement in the AC which states, "The FAA considers an alert about a system state for which a flightcrew error is only one of several possible causes does not provide by itself sufficient information about the error.</p>	<p>We agree.</p> <p>No change.</p>
12.	ALPA/General	<p>ALPA believes it is appropriate that the AC points out that equipment designs</p>	<p>No change.</p>

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		are not a substitute for, nor should they be required to compensate for, deficiencies in flightcrew training or experience.	We agree.
13.	ALPA/General	ALPA strongly supports the NPRM requirement and AC elaboration on the design of systems and equipment incorporating means for errors by the flightcrew to be made evident to them so they can be detected and managed by the aircrew. This requirement is based on errors that can “reasonably be expected in service” from the flightcrew interactions with the equipment and that while intentional are not intended to have unsafe consequences. We agree that while this has the same intent provided in the EASA rule that allows applicants to assume “pilots are acting in good faith,” it is an important distinction and important safety objective.	No change.  We agree.
14.	ALPA/General	ALPA is in strong support of the AC’s guidance on the use of color on the flight deck. The AC states, “For visual alerts on multicolor displays, the colors red, amber, and yellow should be used	No change.  Thank you.  We agree.

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		<p>consistently throughout the flight deck to maintain the effectiveness of an alert. The applicant must limit the use of red, yellow, and amber for functions other than flightcrew alerting, so that misuse does not adversely affect flightcrew alerting.” (See attached ALPA position paper titled “The Use of Color in Aircraft Flight Deck Displays” for more information.</p>	
15.	ALPA/General	<p>The AC discusses the need for the system and equipment displays to be visible in all lighting conditions. ALPA supports this and recommends this requirement be added to 14 CFR 25.1302(b)(1) with the following italicized text to read, “Be provided in a clear and unambiguous manner at a resolution and precision appropriate to the task <i>in all lighting conditions and in all phases of flight.</i>”</p>	<p>We appreciate the comment and believe the rule already provides the intent of this requirement, however after review of 14 CFR rules and guidance material it was determined that this AC should be more explicit.</p> <p>Other rules and guidance on lighting: AC 25-11A on lighting conditions. The following quote is from AC 25-11A and also provides a rule basis for “plainly visible” as it pertains to instruments.</p> <p>“Each flight, navigation, and powerplant instrument for use by any pilot must be plainly visible to him from his station with the minimum practicable deviation from his normal position and line of vision when he is looking forward along the flight path (§ 25.1321(a)).”</p>

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			<p>Reference to § 25.1321(a) was added to 6-4. c.7 on page 50 in the AC.</p> <p>In addition it must meet the requirements for intended function in 14 CFR Part 25.1301(a).</p> <p>25.773 does not mention lighting. 25.1321 mentions lighting but only as it pertains to malfunctions. Other policy basically talks about lighting from an evaluation point of view.</p> <p>Additional references to AC 25-11A are added.</p>
16.	Dr. Khatwa/Honeywell -General	<p>We agree that the applicant’s Human Factors (HF) Certification Plan is usually the agreement for compliance findings, but further guidance material is recommended with respect to the following:</p> <p>The amount of initial training/familiarization required on the system prior to in-flight evaluations and certification flight tests for the FAA certification team.</p> <p>Observance of pilot performance by those trained to evaluate pilot judgement and performance (pilots trained in flight</p>	<p>We believe this detailed information does not belong in the proposed AC 25.1302 however it should be part of the discussion in the certification plan.</p> <p>The proposed AC 25.1302 does require that assumptions (including training) be documented so discrepancies can be detected. See the following language from the Sections of AC below:</p> <p>“(d) Evaluations, demonstrations, and tests (subchapter 6-4): For compliance purposes, evaluations are intended to identify error possibilities that may be considered for mitigation in design or training. In any case, scenario objectives and assumptions should be</p>

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		<p>standards e.g. check airmen). We recommend that guidance be included on defining the type of scenario tasks to be performed for system evaluation and level of pilot performance expected.</p>	<p>clearly stated before running the evaluations, demonstrations, or tests. In that way, any discrepancy in those expectations can be discussed and explained in the analysis of the results.</p> <p>As discussed further in Chapter 6, these evaluations, demonstrations, or tests should use appropriate scenarios that reflect intended function and tasks, including use of the equipment in both normal and non-normal conditions. Scenarios should consider flightcrew errors. The use of inappropriate scenarios can result in incorrect conclusions. If no errors occur during an evaluation, it may only mean the scenarios are too simple, incomplete, or not fully representative. On the other hand, if some errors do occur, it may mean any of the following:</p> <ul style="list-style-type: none"> <li>(a) The design, procedures or training should be modified;</li> <li>(b) The scenarios are unrealistically challenging; or</li> <li>(c) Not enough training occurred prior to the evaluation.</li> </ul>

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			OEMs provide training  No Change.
17.	Dr. Khatwa/Honeywell -General	The document provides very little guidance on the HF metrics or exit criteria that, when met, provide validation of the HF aspects of the design. Guidance on measurable standards and criteria for expected level of performance should be added to the document.	Chapter four of the proposed AC 25.1302 provides information on certification planning. Figure 1 shows a methodical approach to planning certification for design-related human performance issues. The certification plan should provide the proposed HF metrics and exit criteria.  Chapter six discusses the selection and application of a means of compliance in addressing human performance issues. These means of compliance are generic and have been used in certification programs. The applicant should develop and propose a means of compliance acceptable to the FAA.  No change.
18.	Dr. Khatwa/Honeywell -General	The Safety Assessment Process in CFR 25.1309 was not linked to the evaluation of Human Factors – we recommend this should be more explicit. We recommend the link to “ <i>SAE ARP-4754A Guidelines for Development of Civil Aircraft and Systems</i> ” be identified in the document. The assessment of errors and error effects is something that can be	The harmonization working group does not agree that the assessment of errors and error effects is something that could be assessed or addressed using the safety assessment methods outlined in 25.1309.  See language in AC 25.1302 paragraph 5-7a.(3)  No change.

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		addressed using safety assessment methods, yet these are not covered in the document. Likewise, we recommend any tie-in to the Functional Hazard Assessment (FHA) should be explicit.	
19.	Dr. Khatwa/Honeywell -General	The document explicitly states that it applies to all installed systems and equipment used by the flight crew. Since it is guidance, we recommended that a statement indicating its applicability to non-installed equipment as well, e.g., Class 1 EFBs, hand-held devices, etc. Even though the regulations for those types of systems may be less stringent, it may be advantageous to remind manufacturers that adequately addressing HF issues applies to all flight deck systems.	While we agree with the concern these are considered portable electronic devices. This advisory circular (AC) provides guidance for the design and methods of compliance for installed equipment on transport airplanes intended for use by the flightcrew. AC 120-76A contains information on human factor guidance for Class 1 and 2 EFBs.  No change.
20.	Dr. Khatwa/Honeywell -General	Some guidelines make a subtle change from design to pilot state – for example, Section 5-6, page 35, paragraph (7)(c), states “the automated system must support flight crew coordination and cooperation by ensuring shared awareness ...” – the design can’t ensure shared awareness, it can ensure the presentation of information that supports	The comment is understood. The intent is to go beyond just presentation of information but also the management of errors. The requirement is to make sure that the presentation is not simply presented but is also effective and provides necessary feedback to manage errors resulting from the kinds of flightcrew interactions with the equipment that can be reasonably expected in service.

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		shared awareness. This is subtle, but several items like this in the document should be re-worded to be technically correct.	No change.
21.	<p>Garmin/Page 3, Section 2-1 Human Error, Paragraph a.:</p> <p>Human error is generally characterized as a deviation from what is considered correct in some context, especially in the hindsight of analysis of accidents, incidents, or other events of interest. Some types of human error can be the following: an inappropriate action, a difference from what is expected in a procedure, a mistaken decision, an incorrect keystroke, or an omission of some kind. Many other situations can also illustrate what we mean by the term “human error.”</p> <p>Garmin presumes all references to ‘error’ throughout the AC always refer to human error as defined in this paragraph.</p>	Request the FAA clarify usage of the word ‘error’ as it applies throughout the document (i.e. system errors, human errors, etc).	<p>The word flightcrew was inserted in several places within the chapter to clarify flightcrew error.</p> <p>We agree.</p>
22.	<p><b>Airbus</b></p> <p>Chapter 3. Scope and Assumptions. 3-4. Exceptions.</p>	Remove § 25.1549 Powerplant and auxiliary power unit instruments.	Table was removed from para 3-4 (exceptions) and placed under para 3-1 since the table provides recommendations rather than

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	Table 1. Requirements Related to this AC. Comment: Airbus notices that § 25.1549 Powerplant and auxiliary power unit instruments has been added in this table of requirements,		exceptions.
23.	Cessna/Section 3-2.a	The first sentence states "...for all installed systems and equipment..." Is this intended to exclude use of other equipment (such as an Electronic Flight Bag [EFB]) in the cockpit? An EFB may or may not be installed equipment, depending on the particular application. The aircraft OEM typically does not have control over the design or function of an EFB carried on the airplane by the flightcrew, and thus cannot exercise any certification control over the device.	Yes, it does exclude equipment that is not installed.  25.1302 only applies to installed equipment. If the EFB is not installed, it does not apply.  No Change
24.	Cessna/Section 3-2.a	This section indicates it will be applied to STC applicants as well as those applying for a TC. It is not clear how the criteria contained in the AC would (or could) be applied to an airplane certified with the regulations in effect prior to the existence of 25.1302. There is at least the appearance that such a requirement would render update of avionics or cockpit displays via the STC process extremely onerous if even possible.	This is normally handled by our STC process and subject to the changed product rule 21.101. Whether 25.1302 will be applied in the STC process depends on the guidance and policy from rule 21.101.  No Change.
25.	Garmin/Page 4, Section 3-2 Covered	Throughout the AC, Garmin requests the	This is normally handled by our STC process and

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	<p>Equipment, subparagraph a.: [the proposed rule and AC] applies to those airplane and equipment design considerations within the scope of part 25 for type certificate (TC) and supplemental type certificate (STC) projects.</p> <p>Garmin notes the applicability of the rule to STC design changes. Throughout the guidance, it is unclear to what extent and by what methods STC applicants will be required to show compliance.</p>	<p>FAA clarify differences in applicability between ‘clean sheet’ type design (e.g. TC) projects and post-production alterations (STC), as it may not be appropriate to apply identical processes or means of compliance to both.</p>	<p>subject to the changed product rule 21.101. Whether 25.1302 will be applied in the STC process depends on the guidance and policy from 21.101.</p> <p>No change.</p>
26.	<p>Cessna/Section 3-3</p>	<p>What level of proficiency is being associated with the ability to “assume a qualified flightcrew is trained and checked in the use of the installed equipment...?” A pilot can meet the minimal training for a type rating without being “proficient” in the use of all capabilities of a particular system (i.e., a flight management system (FMS)). FAA ACO test pilots are frequently not “trained” or “qualified” in a particular aircraft design at the earliest stages of design/development for the cockpit. This knowledge is essential to effective evaluation of any particular integration. Cessna agrees that general knowledge in a similar aircraft is applicable, however this would not meet the “trained and checked” guidance of the AC.</p>	<p>As stated in chapter 3, paragraph 3.3: “Flightcrew Capabilities.</p> <p>In showing compliance with the requirements referenced by this AC, the applicant may assume a qualified flightcrew is trained and checked in the use of the installed equipment. This compliance refers to a flightcrew allowed to fly the airplane because the flightcrew meets the requirements of the operating rules for transport category airplanes.”</p> <p>In showing compliance this assumption would</p>

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	Comment	Requested Change	Disposition
			<p>also apply to the airworthiness authority. This training assumption could be part of the certification plan to be discussed with the FAA.</p> <p>From the ACO perspective:</p> <p>In showing compliance with the requirements referenced by this AC, the applicant may assume a qualified flightcrew is trained and checked in the use of the installed equipment by the requirements generated by flight standards during the FOEB (Flight Operations Evaluation Board) near the completion of the certification program. This compliance refers to a flightcrew allowed to fly the airplane because the flightcrew meets the requirements of the operating rules for transport category airplanes.</p> <p>In showing compliance to the rule the flight crews (ACO Flight Test) who conduct the engineering evaluations during the flight test program are trained to apply their experience and techniques in the aircraft development. These flightcrew members have far greater knowledge of the aircraft and its systems than that required for an operational pilot. During the development phase operational pilots are integrated into the</p>

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	Comment	Requested Change	Disposition
			<p>team to add their expertise to the mission requirements. These assumptions of the test team could be part of the certification plan to be discussed with the FAA.</p> <p>No Change.</p>
27.	Cessna/Section 4-1(b)	<p>Cessna agrees that early involvement of FAA ACO personnel is beneficial; however the application of “sequencing” by the FAA tends to preclude this arrangement. The design of cockpit layout is done early in the program, typically while a program has been “deferred” by the FAA, and FAA personnel are not available to participate in early activities.</p>	<p>No change.</p> <p>FAA personnel are able to participate in POC (Proof of Concept) ideas prior to official start of a program. Cockpit layouts, display contents, or other integration issues are typical items that can be discussed early on. These items will, however, have to be revisited during the certification program.</p> <p>Available ACO Manpower will always be of a concern at any given time.</p>
28.	Dr. Khatwa/Honeywell -Page 9, Sect 4.2	<p>Some guidelines make a subtle change from design to pilot state – for example, Section 5-6, page 36, paragraph (7)(c), states “the automated system must support flight crew coordination and cooperation by ensuring shared awareness ...” – the design can’t ensure shared awareness, it can ensure the presentation of information that supports shared awareness. This is subtle, but several items like this in the document</p>	<p>Duplicate from comment 22.</p> <p>No change.</p>

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
		should be re-worded to be technically correct.	
29.	Dr. Khatwa/Honeywell -Page 9, Sect 4-2	should reference FAA PS-ANM111-1999-99-2	The reference is added in appendix A.
30.	Mitsubishi/Page 10, Section 4-2, para 3E  <i>How much experience does the applicant have with the features of the Design?</i>	Delete whole sentence.  We understand that scrutiny should be emphasized if applicants have less experience with the features of the design. However, we suggest that this factor should not be appropriate for identifying the degree of design novelty, because this sentence may easily give a misleading impression, such as "experienced applicants can avoid scrutiny."	Section was re-written.
31.	Dr. Khatwa/Honeywell -Page 11, Sect 4-5, para b	we recommend one other item be added:  Description of the intended function.	We added the description of intended function to the list in sect 4-5.b.
32.	Garmin/Page 12, Section 5-1 Overview, Paragraph c.:  To comply with requirements of part 25, the design of flightdeck systems must appropriately address...	There is an extra space between 'must' and 'appropriately':  To comply with requirements of part 25, the design of flightdeck systems must appropriately address...	No space problem seen.  No change.

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
33.	<p><b>Airbus</b> 5-2. Applicability of Material to § 25.1302. c. (2) Section 25.1302(a) requires the applicant to install appropriate controls and provide necessary information for any flightdeck equipment identified in the first paragraph of § 25.1302. Controls and information displays must be sufficient to allow the flightcrew to safely accomplish all of their tasks. To show compliance, the applicant must identify the tasks associated with each piece of installed equipment, and show the controls for the equipment, and the information provided for operation of the equipment, are adequate to enable the flightcrew members to perform the identified tasks, per §§ 25.1301, 25.1303, 25.1305, 25.1307, and 25.1309.</p> <p><b>Comment:</b> Airbus considers that the applicant should propose the level of task description, which is not necessarily associated to each piece of installed equipment.</p>	Delete the 3rd sentence (marked in red).	Deleted reference to rules and added reference to Part 5-3c.
34.	Boeing/Page 15, Paragraph 5-2. (2) c <b>Applicability of Material to § 25.1302</b>	Delete the word “ <i>must</i> ,” or change it to “ <i><u>should</u></i> .”	We agree with the first part of the comment and changed the “must” to “should.”

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
	<p>The proposed text states:  <i>“(2) ... To show compliance, the applicant must identify the tasks associated with each piece of installed equipment, and show the controls for the equipment, and the information provided for operation of the equipment, are adequate to enable the flightcrew members to perform the identified tasks, per §§ 25.1301, 25.1303, 25.1305, 25.1307, and 25.1309.”</i></p>	<p>There are two issues with this text that is in addition to the EASA AMC.</p> <p>One issue is that it points to several other general system regulations, but it is unclear how this AC is to be formally tied to demonstration of compliance with those other rules. If the intent is to define pilot tasks from the output of the compliance demonstrations to other rules such as §25.1309, the methodology for extracting pilot tasks from other compliance demonstrations is not mature; so “must” should be changed to a “should.”</p> <p>The second issue is that it adds a requirement for some type of task assessment. This is covered more specifically and more clearly in paragraph 5-3.c., where it states:  <i>“An applicant must describe intended functions and associated tasks for equipment. This type of information is of the level typically provided in a pilot handbook or an operations manual. It would describe indications, controls, and flightcrew procedures.”</i></p>	<p>We also revised the text to reference Par 5-3c since that is the section on intended function and associated tasks.</p>

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
35.	<p>Garmin/Page 15, Section 5-2 Applicability of Material to § 25.1302, Paragraph (2) c. To show compliance, the applicant must identify the tasks associated with each piece of installed equipment, and show the controls for the equipment, and the information provided for operation of the equipment, are adequate to enable the flightcrew members to perform the identified tasks, per §§ 25.1301, 25.1303, 25.1305, 25.1307, and 25.1309.</p> <p>Garmin appreciates the process the FAA describes in showing compliance and recognizes the system design must meet the certification standards set forth in the regulations, which are minimum standards. Assessing a system as ‘adequate’ in support of a function or task is very often a subjective determination made by a qualified evaluator or panel of evaluators (i.e. MPSUE style evaluations). This assessment does not imply a lack of potential for further design refinement, but instead indicates that the system</p>	<p>Garmin requests the FAA clarify guidance regarding the methods and processes to be used to determine equipment and controls are adequate (reference draft AC Section 3-2 Covered Equipment).</p>	<p>See chapters 5 and 6 are for clarification. These two chapters are to be used together to result in an agreement between the applicant and the authority to determine methods and process to be used for assessing equipment.</p> <p>In addition, the cited paragraph states that the intent is to show that the controls and information “are adequate.” There is no implied intent to conduct evaluations whose purpose is to “perfect or improve” systems that have already been shown to be adequate.</p> <p>No change.</p>

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
	<p>performs sufficiently to meet the minimum certification standards. A general concern is that applicants may be required to undergo extensive and drawn out evaluation and test campaigns in the spirit of ‘human factors testing’ to perfect or improve systems which otherwise may have already been shown to adequately support the related tasks and intended functions. This would negatively impact industry and delay potentially safety enhancing products from becoming operational.</p>		
36.	<p>Cessna/Section 5-2.c(1)(c) - “The applicant should initiate proposals for flightcrew qualification criteria (minimum training, checking and currency) through the FAA Flight Standardization Board (FSB) process, specified in AC 120-53A, Guidance for Conducting and Use of Flight Standardization Board Evaluations, in conjunction with their application for a type certificate or supplemental type certificate.”</p>	<p>It is assumed that “in conjunction with” means “at the same time as” because it is already inherently clear in the certification process that the Flight Standardization Board (FSB) application is required in addition to the aircraft TC application. These two things do not happen at the same time in our current certification process. The FSB application is submitted later in the program, near the time at which the simulator/training program are complete, whereas the TC application occurs very early in the aircraft design process. Much of the information regarding the training program is just not known earlier in order to submit the FSB application at an earlier time.</p>	<p>Changed wording in paragraph 5-2.c(1)(d)</p>

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37.	<p>Embraer/Page 16, Sect 5-2, para c (4) (c)</p> <p>"The general intent is to foster the design of equipment controls whose operation is intuitive ..." The AC by deleting this statement limited the means the manufacturer can provide "clear and unambiguous form" for controls presentation to those listed.</p>	<p>Recommendation is to add the statement as it is presented in the AMC.</p> <p>Wording from AMC 25.1302:</p> <p>For controls, the requirement for "clear and unambiguous" presentation means that the crew must be able to use them appropriately to achieve the intended function of the equipment. The general intent is to foster design of equipment controls whose operation is intuitive, consistent with the effects on the parameters or states they affect, and compatible with operation of other controls on the flight deck.</p>	<p>The suggestions does not provide a method of compliance. The word "intuitive" is open to interpretation.</p> <p>No Change.</p>
38.	<p>Dr. Khatwa/Honeywell -Page 16, Sect 5-2, para (4) c</p>	<p>the statement "<i>means that the flight crew must be able to correctly and reliably identify the control by using control distinctiveness such as shape, color, and location</i>" may be too restrictive of integrated touch or cursor controllers. A more general wording that would cover those new type of controllers is more appropriate.</p>	<p>Shape, color and location were used as examples and are not intended to be a comprehensive list. .</p>
39.	<p>Cessna/Section 5-2c (4)(c)</p>	<p>The proposed criteria that the flightcrew must be able to correctly and reliably identify the control by using control</p>	<p>AC 5.2c(4)c changed to and/or</p> <p>In addition, since the "controls" on a touch screen</p>

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	Comment	Requested Change	Disposition
		distinctiveness such as control shape, color, and location would appear to preclude use of touchscreen technology for control or crew interface, since there is no “control shape” associated with this type of interface. If the criteria is established as “and/or” instead of “and” this would accommodate such design technologies. Section 5-4 uses “and/or” in this context.	are displayed by the system, they could have many possible shapes (e.g. rectangles, circles, triangles). Se we believe that shape coding does apply to touchscreens.
40.	Dr. Khatwa/Honeywell -Page 16, Sect 5-2, para d	is confusing – it should be stated more clearly and concisely.	Paragraph (d) is rewritten.  Section 25.1302(b)(1) also requires that the information or control be provided, or that it operate at a level of detail and accuracy which is appropriate to accomplishing the task. If the resolution or precision of the control is insufficient, the flightcrew cannot perform their task adequately. Conversely, if information has excessive resolution, the task could be too difficult because of poor readability. Excessive resolution of control may imply that the task requires more precision than it needs.
41.	Embraer/Page 16, Section 5-2, para 5  The example mentioned does not clearly explain the relationship of § 25.1302(b) (2) with § 25.779(a) and (b). It is not	Recommendation is to better clarify the relationship between the two requirements.	Agree with the comment.  Removed phrase as stated in 25.779 a and b in the example. The reference to 779 is in para 5-4.  Reference to 25.771, 25.777 and 25.1523 is

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
	clear how readily accessible controls are related to the movement and actuation of controls defined in 25.779(a) and (b).		similar to the AMC version.
42.	Cessna/Section 5-2.c(6)(d) - "Section 25.1523 and part 25 Appendix D have a different context and purpose (determining minimum flightcrew), so they do not address these requirements in a sufficiently general way"	The exact same testing will be used for both 25.1523 and 25.1302 however, both looking at the pilot error analysis, one with the emphasis on pilot work load and the later with an emphasis on error itself.	The applicant can use dual purpose testing.  No change.
43.	Cessna/Section 5-2c (7)a	Same comments on "predictable and unambiguous" as stated for 5-2.c.(8). This quality can relate directly to the prior experience and perception on the part of any individual flightcrew member.	We agree, this quality can relate to prior experience and perception on the part of the flight crew which is the reason the FAA assumes that pilot's will be trained and qualified. If the applicant feels that training is needed to enable the pilot to understand what is predictable and unambiguous the training assumption should be documented by the applicant.  No change.
44.	Garmin Page 17, Section 5-2 Applicability of Material to § 25.1302, Paragraph c.(7)(b): ...behavior that is operationally relevant...	There is an extra space between 'behavior' and 'that': ...behavior that is operationally relevant...	Typo corrected.
45.	Cessna/5-2.c(8) - "Section 25.1302(c)(1) requires system behavior be such that a qualified flight crew can know what the system is doing and why. It requires	Whether the operation of a system is "predictable and unambiguous" is highly subjective and dependent on how well the pilot understands and accepts the	See disposition 45 above for Cessna.

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
	operationally relevant system behavior be ‘predictable and unambiguous.’ This means a flightcrew can retain enough information about what their action or a changing situation is so they will know what the system will do under foreseeable circumstances. This ‘predictable and unambiguous’ behavior enables the flightcrew to operate the system safely.”	fundamentals of a system’s operation. In other words, it may not appear predictable if you do not have a thorough understanding of how it works. This would appear to set a training standard that may be different from the minimum required for a type rating.	
46.	Embraer/ Page 18, Section 5-2.c.(10)(b)  The <b>AMC</b> also lists the same four means for "design which enable the flightcrew to manage errors" but it does not limit the means for managing errors as the <b>AC</b> does. The <b>AC</b> is more restricted by stating that "... the flightcrew members to manage errors by one or more of those means." This unnecessary input a limit to the manufacturer despite of stating that "to the extent practicable”	Recommendation is to remove the limitation to one or more of the design means.	Changed each “must” to “should” in (10)(a) pg 18. Remove the word “and” and replace it by the word “or” in (a)3.  Added reference to para 5-7.
47.	Boeing/Page 18, Section 5-2.c.(10)(b) [and referenced section 5-2.c.(10)(a)] Applicability of Material to § 25.1302 The proposed text states: <i>“(b) The list above identifies different means for managing errors. The intent is</i>	Delete this additional wording. In the referenced list [see 5-2.c.(10)(a)] replace the word “and” throughout the list with “ <u>or</u> ”  This text is in addition to the EASA	Refer to disposition 48 above.

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
	<i>for the installed equipment design to be such that it enables the flightcrew members to manage errors by one or more of those means. ‘To the extent practicable’ refers to the implementation of error management capability within the one or more of those means, as provided within the equipment design.”</i>	AMC and also replaces the “or” with “and” in the list of error management means. While multiple means of error management is desirable and may be achievable, the term “to the extent practicable” is a judgment that is above and beyond determination of airworthiness.	
48.	Mitsubishi/Page 19, Section 5-2, para. C (10) (e)  <i>" An example of such an intentional, good faith error would be a situation in which an alert occurs, but the flightcrew does not perform the associated procedure because they believe it to be a nuisance alert. In this situation, § 25.1302(d) requires the applicant to show that this error can be detected and managed by the flightcrew."</i>	We would like FAA to add acceptable Means of Compliance to show that this error can be detected and managed by the flightcrew.  This type of error is not described in EASA CS25.1302, we would like to clarify FAA proposed specific Means of Compliance to manage this error.	We added a sentence to refer to para 5-7b.(1) which provides information on showing compliance to 25.1302(d). “Applicants should design equipment to provide information so the flightcrew can become aware of an error or a system/airplane state resulting from a system action.”
49.	Cessna/Section 5-3.c.	A Pilot’s Guide containing detailed information on all functions associated with a particular piece of equipment is typically not available until late in a program, once all design considerations have been finalized. While this level of documentation is available prior to certification, it is typically not available in this form at a very early	The description of intended function needs to be detailed enough to describe the pilot tasks associated with it. This does not imply that the pilot guide needs to be completed.  No change.

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	Comment	Requested Change	Disposition
		<p>stage of development, when changes are expected prior to final design. It would impose a significant economic burden on the avionics OEM, for example, to develop a pilot's guide during the preliminary design phase of a program, and then do the same again once the design is complete. The operational concept and function for a system or equipment device can be described in sufficient detail to support early design efforts, however a detailed document describing all functions and associated tasks for a particular system would not normally be available early in a design program. It should be possible to conduct early evaluations and assessments using appropriate descriptive material (i.e., system design specifications) that exist at that time rather than a pilot handbook or operations manual. It is anticipated that for systems with a high level of capability, this document may be a large and potentially multi-volume manual, especially in the case of an FMS or similar system.</p>	
50.	<p><b>Airbus</b> 5-4. Controls. c. Clear and Unambiguous Presentation of Control-Related Information (§ 25.1302(b)). (2) Labeling - §§ 25.1301(a)(2),</p>	<p>Add EASA AMC 25.1302 5.3.3 b language: "However, such hidden functions may be acceptable if adequate alternate means are available for accessing the function. The design should still be evaluated for ease of crew and crew understanding."</p>	<p>The FAA believes that hidden functions should be avoided.</p> <p>No change.</p>

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
	<p>25.1543(b), and 25.1555(a).                      (c) The labeling design should avoid hidden functions such as clicking on empty space on a display to make something happen.  <b>Comment:</b>                      The following text has been removed compared to EASA AMC 25.1302 5.3.3 b.: “However, such hidden functions may be acceptable if adequate alternate means are available for accessing the function. The design should still be evaluated for ease of use and crew understanding”.                      Airbus wonders whether this language could not be kept, as it could avoid further additional IP, such as the A350 Issue Paper F-2 Control Labeling part relate.</p>		
51.	<p>Garmin/Page 23, Section 5-4 Controls, Paragraph c.(2)(a):                      Labels should be readable from the flightcrew’s normally seated position...</p>		Change made.
52.	<p>Dr. Khatwa/Honeywell -Page 24, Sect 5-4, c(2)(b)</p>	<p><i>SAE ARP 4105B Abbreviations and Acronyms for Use on the Flight Deck</i> is an appropriate basis for compliance and should be referenced.</p>	Added reference SAE ARP 4105B to 5-4 c.(2)(b).

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
53.	Dr. Khatwa/Honeywell -Page 23, Sect 5-4,c(1)(c)	we recommend making a list of how to make controls distinguishable (form, color, location) as explicit examples – otherwise it could be interpreted as a comprehensive list.	Agree with recommendation. Added 5-4.c.(1)(c), list of examples.
54.	Embraer/Page 23, Section 5-4 e.2.(b) (page 26).  The <b>AMC</b> states that "However, controls on the bezel of multifunction displays have been found to be acceptable." Since the <b>AC</b> does not mention anything related to this, could be understood that such design is not accepted. But use of controls on the bezel of multifunction displays is in worldwide use today in Electronic Flight Bags and with a long time application in military systems.	Recommendation is for adding to the <b>AC</b> the phrase as it is in the <b>AMC</b> .	No change.  It depends on where the controls are on the bezel. We don't want to have a blanket statement saying it's okay.  See paragraph in para 5-4e.2.b (page 26).
55.	Garmin/Page 24, Section 5-4 Control, Paragraph d.(3): The layering of information, as with menus or multiple displays, should not hinder...	A space needs to be added between 'should' and 'not': The layering of information, as with menus or multiple displays, should not hinder...	Agree – typo corrected.
56.	Garmin/Page 24, Section 5-4 Controls, Paragraph d.(3): Location and accessibility are not only the physical location of the control function, as they are on a	Recommend the FAA revise the sentence structure.	Sentence changed to: Location and accessibility considers more than just the physical aspects of the control function.

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
	display device, or any multifunction control, such as a cursor control device that is used to access them. This sentence is poorly worded and difficult to understand. The use of ‘not only’ seems to require a ‘but’ or ‘but also’ somewhere in the sentence.		
57.	Garmin/Page 24, Section 5-4 Controls, Paragraph d.(3): Accessibility should be shown in conditions of system failures, including flightcrew incapacitation, and minimum equipment list dispatch. The sentence structure implies that flightcrew incapacitation is an example of a system failure by the use of the word ‘including’.	Recommend the FAA revise the sentence to remove the word ‘including’: Accessibility should be shown in conditions of system failures, <del>including</del> flightcrew incapacitation, and minimum equipment list dispatch.	We Agree – wording changed.
58.	Dr. Khatwa/Honeywell -Page 26, Sect 5-4. para f.	(Adequacy of Feedback) – we recommend a sentence giving an example for speech recognition input, since it is mentioned as a control method earlier in the document.	No Change.  Since we have not yet approved any speech recognition controls but are just allowing for their possibility, we do not have any proven examples to cite.
59.	Garmin/Page 27, Section 5-4 Controls,	A space needs to be added between	Agree – typo corrected.

**AC 25.1302 INSTALLED SYSTEMS AND EQUIPMENT FOR USE BY THE FLIGHTCREW**

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	Comment	Requested Change	Disposition
	Paragraph f.(6): ...the applicant should show that all forms of feedback...	'should' and 'show': ...the applicant should show that all forms of feedback...	
60.	<p><b>Airbus</b> 5-5. Presentation of Information. b. Clear and Unambiguous Presentation of Information. (3) Color - § 25.1302.</p> <p>(b) For visual alerts on multicolor displays, the colors red, amber, and yellow should be used consistently throughout the flight deck to maintain the effectiveness of an alert. The applicant must limit the use of red, yellow, and amber for functions other than flightcrew alerting, so that misuse does not adversely affect flightcrew alerting per § 25.1322(f). Extensive use of red, yellow, and amber diminishes the attention-getting characteristics of warnings and cautions. This includes alert color consistency among propulsion, flight, navigation, and other displays and indications used on the flight deck.</p> <p>Comment: Airbus concurs as far as the text is consistent with AC 25-11A, Electronic</p>		No change requested.

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
	Flight Control Displays.		
61.	Embraer/Page 27, Section 5-5 a(1)  The statement "The proposed means should be ..." contains a typographical error.	Embraer recommends FAA should revise it to say "The proposed means should be.. ."	Agree – typo corrected.
62.	Garmin/Page 27, Section 5-5 Presentation of Information, Paragraph a.(1): The proposed means should be of sufficient detail...	A space needs to be added between 'should' and 'be': The proposed means should be of sufficient detail...	Agree – typo corrected.
63.	Garmin/Page 29, Section 5-5 Presentation of Information, b.(3)(e): To meet the requirements in § 25.1302(b) applicants should show that...	A space needs to be added between 'should' and 'show': To meet the requirements in § 25.1302(b) applicants should show that...	Agree – typo corrected.
64.	Garmin/Page 30, Section 5-5 Presentation of Information, b.(4)(e): The applicant should show display text...	A space needs to be added between 'should' and 'show': The applicant should show display text...	Agree – typo corrected.
65.	Garmin/Page 30, Section 5-5 Presentation of Information, Paragraph c.(1)(a) The applicant should show any information required...	A space needs to be added between 'should' and 'show': The applicant should show any information required...	Agree – typo corrected.
66.	Embraer/ Page 30, Section 5-5 Presentation of Information, Paragraph	Embraer recommends FAA should revise it to say "The applicant should	Agree – typo corrected.

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
	c.(1)(a)  The statement "The applicant should show ..." contains a typographical error.	show...".	
67.	Garmin/Page 31, Section 5-5 Presentation of Information, Paragraph c.(2)(d): Higher priority information should be available, readily detectable, easily distinguishable, and usable § 25.1302(b).	Suggest the FAA add a 'per' or 'in accordance with' to the sentence: Higher priority information should be available, readily detectable, easily distinguishable, and usable <i>per</i> § 25.1302(b).	Agree with comment and text changed.
68.	Garmin/Page 31, Section 5-6 System Behavior, Paragraph a.(2) This means a flightcrew should have enough...	A space needs to be added between 'should' and 'have': This means a flightcrew should have enough...	Agree – Typo corrected.
69.	<b>Boeing</b> Page 33, Paragraph 5-5.c.(3)(a) <b>System Behavior</b> The proposed text states: <i>“(a) ... To meet the requirements of § 25.1302(c)(1), applicants should propose the means they will use to show the system or system mode behavior in their proposed design is predictable and unambiguous to the flightcrew.”</i>	Delete this text  This text is additional to the EASA AMC. It is unclear what the intent of this additional text is and, as written, does not add to the understanding of means of compliance to the rule.	Agree – text removed. The applicant will have to meet the requirement anyway and we want to reduce any potential for confusion.
70.	Garmin/Page 34, Section 5-6 System Behavior, Paragraph c.(3)(c):	Request the FAA substitute the word 'display' with 'map depiction', to better	Agree – 5-6.c.(3)(c) now reads: A map depiction can be in “north up” mode or “track up” mode,

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
	<p>Formal descriptions of modes typically define them as mutually exclusive, so that a system cannot be in more than one mode at a time. A display can be in “north up” mode or “track up” mode, but not in both modes at the same time.</p> <p>Garmin disagrees with this example of mutually exclusive modes. Some ‘displays’ are intentionally designed with segmented windows that have the capability to show two map depictions of differing orientations (e.g. a track-up moving map alongside a north-up electronic approach chart, on the same display). Despite being shown on a single unit, these pages are regarded as separate displays.</p>	<p>illustrate the concept of mutually exclusive modes:</p> <p><i>A map depiction</i> can be in “north up” mode or “track up” mode, but not in both modes at the same time.</p>	<p>but not in both modes at the same time.</p>
71.	<p>Garmin/Page 34, Section 5-6 System Behavior, Paragraph c.(4)(b):</p> <p>If the means of showing compliance is by analysis, the thoroughness of the analysis should be established by defining both the depth and breadth of its criteria.</p> <p>The sentence wording is cumbersome to read.</p>	<p>Garmin suggests the sentence be changed to:</p> <p>If the means of showing compliance is by analysis, the applicant should define its scope and criteria.</p>	<p>Partially accepted.</p> <p>Sentence changed to:</p> <p>If the means of showing compliance is by analysis, the applicant should describe it thoroughly.</p>
72.	<p>Garmin/Page 34, Section 5-6 System</p>	<p>A space needs to be added between</p>	<p>Agree: Typo corrected.</p>

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
	Behavior, Paragraph c.(5)(a): The design of such “automation specific” controls per§ 25.1302, should enable the flightcrew to...	‘should’ and ‘enable’: The design of such “automation specific” controls per§ 25.1302, should enable the flightcrew to do the following:	
73.	Embraer/ Page 34, Section 5-6 System Behavior, Paragraph c.(5)(a)1  The statement "Preparation of a new task (for example, new flight trajectory) shouldn't. .." contains a typographical error	Embraer recommends FAA should revise it to say "Preparation of a new task (for example, new flight trajectory) should not.. .".	Agree: Typo corrected.
74.	Garmin/Page 34, Section 5-6 System Behavior, Paragraph c.(5)(a)1: Preparation of a new task (for example, new flight trajectory)should not interfere with...	A space needs to be added between ‘)should’ and ‘should’ and ‘not’: Preparation of a new task (for example, new flight trajectory) should not interfere with...	Agree: Typo corrected.
75.	Dr. Khatwa/Honeywell -Section 5-7	This section discusses a flight crew error management scheme that includes error detection, error recovery, and error effects (where error tolerance is really the focus). This is followed by a subsection at the end (page 41) on precluding errors. We suggest a more logical and complete discussion of error management would be four sub-topics in the following order: (a) error prevention,	No change.  Error tolerance is not described due to the differences in what we think it means. This suggested change would also introduce differences from the harmonized EASA version. A, b, and c of the rule is about error prevention through design attributes that avoid error.

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
		(b) error detection, (c) error correction or recovery, and (d) error tolerance.	
76.	Boeing/Page 36, Paragraph 5-7.a.(2) Flightcrew Error Management The proposed text states: “(2) To comply with the § 25.1302(d) requirement that a design enables the flightcrew to “manage errors,” the installed equipment design must meet the following criteria to the extent practicable.	Revise this text to read as follows: “(2) To comply with the § 25.1302(d) requirement that a design enables the flightcrew to “manage errors,” the installed equipment design must meet <b><u>at least one of the following criteria.</u></b> ” In the list following [(2)(a) – (d)], replace “and” with “ <b><u>or</u></b> ”  This text is in addition to the EASA AMC and also replaces the “or” with “and” in the list of criteria. While multiple means of error management is desirable and may be achievable, the term “to the extent practicable” is a judgment that is above and beyond determination of airworthiness.	No Change.  Same disposition as 77 above.  Error tolerance is not described due to the differences in what we think it means. This suggested change would also introduce differences from the harmonized EASA version. A, b, and c of the rule is about error prevention through design attributes that avoid error.  The term “to the extent practicable” is used in FAA guidance to recognize that there can be practical limitations in designs that should be weighed against the potential safety benefits.
77.	Garmin/Page 36, Section 5-7 Flightcrew Error Management, Paragraph a.(3)(b): call for means of compliance that are methodical and complementary to, and separate and distinct from, airplane system analysis methods such as system safety assessments.	Garmin requests clarification as to when this form of compliance would become necessary, especially with respect to STC design changes (reference draft AC Section 3-2 Covered Equipment), in lieu of other traditional and perhaps more preferable compliance methods such as	No change.  Other methods maybe less burdensome, more effective and more desirable for many applicants as suggested. The applicant may show compliance by following the means of compliance provided in chapter six. If there are

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
	Garmin is concerned with the proposal calling for ‘means of compliance that are methodical and complementary to’ the SSA process. Given the lack of specific guidance, it is likely there will be widely varying interpretations as to what is required, up to and including a very elaborate analytical process to document the subject of flightcrew error. Other methods to show compliance may be less burdensome, more effective, and thus, more desirable for many applicants.	company human factors evaluations (simulations, flight evaluations), FAA MPSUE-style pilot evaluations, and TIA flight tests.	specific processes that applicant should suggest that process. To be clear the primary analysis here regards the analysis associated with error management.
78.	Dr. Khatwa/Honeywell -Page 36, Sect 5-7. a.(2)	Several guidelines use the word “must” and the phrase “to the extent practicable” in the same sentence – this is inconsistent. We suggest use of “to the extent practicable.	Reworded to clarify.
79.	Dr. Khatwa/Honeywell -Page 36, Sect 5-7.b.	we suggest adding another subparagraph to cover automated error checking and filters that prevent entry of unallowable or illogical entries.	Agree  5-7.b(1)(b) <u>4</u> If the system can detect pilot error, the system could be designed to prevent pilot error. For example, if the system can detect an incorrect frequency entry by the pilot, then the system should be able to disallow that entry and provide appropriate feedback to the pilot. Examples are automated error checking and filters that prevent entry of unallowable or illogical entries.

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
80.	Embraer/ Page 37, Section 5-7 Flightcrew Error Management, Paragraph a.(7)(c)  The statement "The applicant should understand.. ." contains a typographical error.	Embraer recommends FAA should revise it to say "The applicant should understand..."	Agree. Typo corrected.
81.	Garmin/Page 37, Section 5-7 Flightcrew Error Management, Paragraph a.(7)(c): The applicant should understand what potential errors...	A space needs to be added between 'should' and 'understand': The applicant should understand what potential errors...	Agree: typo corrected.
82.	Dr. Khatwa/Honeywell -Page 39, Sect 5-7 b.2(b)	discusses alerting if pilot error is detectable by the system. We recommend including a sentence suggesting that if system can detect pilot error, the system could be designed to prevent the pilot error, e.g., if the system can detect incorrect frequency entry by the pilot, why not disallow that entry and provide appropriate feedback?	Agree:  Added 5-7b.2(b) <u>4</u> If the system can detect pilot error, the system could be designed to prevent pilot error. For example, if the system can detect an incorrect frequency entry by the pilot, then the system should be able to disallow that entry and provide appropriate feedback to the pilot.
83.	Embraer/ Page 39, Sect 5-7, b(1) The text mentions the terminology "system errors" that it is not present in any other place on the document. The definition for a system error it is not presented neither is clearly understood by someone using the AC. The meaning	Recommendation is to use the text as in the AMC or clarify what is meant by system error or how a system can make mistakes.	Agree: return to the wording in the AMC 5.6.2.  5-7.b.(1) Applicants should design equipment to provide information so the flightcrew can become aware of an error or a system/airplane state resulting from a system action.

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
	is also not in line with the AMC which states as "...error or a system <i>I</i> aeroplane state resulting from a system action."		
84.	Dr. Khatwa/Honeywell -Page 41, Sect 5-7.c.(2)	a sentence describes a concept that removes symbology if the data driving the symbology is invalid – we suggest adding feedback to the flight crew for the reason that the symbol is removed.	No change.  In many cases it is not practicable or desirable to provide that feedback.
85.	Garmin/Page 44, Section 5-8 Integration, Paragraph e.(2): Applicants should show the integrated design...	A space needs to be added between ‘should’ and ‘show’: Applicants should show the integrated design...	Agree. Typo corrected.
86.	Dr. Khatwa/Honeywell -Page 45, Sect 5-8, para e.(4)(b).	a practical example would be helpful for context.	Agree. For example baro altimeter set wrong.
87.	Boeing/Page 47, Paragraph 6-4.a.(5) <b>Description of Means of Compliance</b> In describing Statement of Similarity, the proposed text states: “(5) ... <i>Substantiation of the adequacy of the design includes sufficient operational data for the FAA to make the determination of the design robustness</i>	Please clarify what is meant by “ <i>sufficient operational data</i> ”  It is unclear how much and what type of operational data would be considered “sufficient.” Clarification should be provided to ensure understanding and appropriate compliance.	Changed last sentence on 6-4.a.(5)  The applicant should reach agreement with the FAA as to the type of operational data that would be considered “sufficient”. This can be included in the certification plan.
88.	Embraer/ Page 47, Paragraph 6-4.a.(5)  Currently, there is no process which requires the operators to report to the manufacturer operational errors that	Recommendation is to delete the requirement for "sufficient operational data" or to better clarify the statement.	We agree. Requirement for sufficient operational data is deleted.

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
	could be related to the design, such as required for system failures. The request to require "sufficient operational data for the FAA to make the determination of the design robustness." inputs a burden in the use of statement of similarity beyond what it is done currently. There are several human-machine interface designs in worldwide use today that can provide acceptable levels of error tolerance which, if used, will unnecessary require a larger and costly evaluation.		
89.	Dr. Khatwa/Honeywell -Page 48, Sect 6-4	Paragraphs c, d, & e on pages 48 and 49 should be sub-sections to paragraph b on page 48.	Agree. paragraphs changed.
90.	Dr. Khatwa/Honeywell - Page 51, Sect 6-4. d.(12)	the wording " <i>traditionally, these types of activities have been used as part of the design process without formal certification credit</i> " is likely to discourage applicants from using in-flight evaluations to collect HF data for certification credit. Our experience suggests that the use of in-flight evaluations as a means of compliance is extremely useful and should not be discouraged. We recommend removal of this statement or rewording to positively	Agreed - rewritten  6-4.d.(12) Those evaluation activities result in better designs that are more likely to comply with the applicable requirements.

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
		encourage use of in-flight evaluations to gain certification credit.	
91.	Robert Joplin AIR 100 COSTA-para 6-4.d.(7) Description of Means of Compliance-page 51	Change the example for demonstrating that controls are arranged so flightcrew members from 5'2" to 6'3" in height can reach all the controls. Justification: Stature is not the most relevant body measurement to determine functional reach.	Change 6-4.d.(7) Example of a mock-up evaluation: one example might be an analysis to demonstrate that controls are arranged so flightcrew members from 1.58 m (5 ft., 2 inches) to 1.91 m (6 ft., 3 inches) in height can reach all the controls. This analysis should also consider differences in anatomy, such as functional arm reach, leg length, and other relevant body measurements. It may use computer generated data based on engineering drawings. The applicant may demonstrate results of the analysis in the actual aircraft.
92.	Mitsubishi/Page A-1, Section A-2  a. Policy Memo ANM-99-2, Guidance for Reviewing Certification Plans to Address Human Factors for Certification of Transport Airplane Flight decks,	We would like FAA to add FAA position on applicability of these documents, if they are still effective in parallel with this AC, or are replaced by this AC.	Agree. Policy memos were added to appendix 1.  In addition it is recommended that Part 21.101 be examined for possible update.

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
	<p>dated 09/29/1999.                      b. Policy Memo PS-ANM100-01-03A, Factors to Consider When Reviewing an Applicant's Proposed Human Factors Methods of Compliance for Flightdeck Certification, dated 02/07/2003.</p>	<p>Policy Memo ANM100-01-03A describes "If these ARC Harmonization our Working Groups develop or modify regulatory or advisory material relevant to human factors issues, the FAA will review this policy statement and update it as necessary to maintain consistency" in paragraph "Objectives of The Policy Statement". From the view of this sentence, we would like FAA to clarify the position of these Policy Memos. Our understanding is that they are still effective in parallel with this AC as mentioned below.                      - Policy Memos cover Human Factors MOCK which is included in existing regulation.                      - AC25.1302-X covers Human Factors MOCK which is not included in existing regulation.</p>	
93.	Dr. Khatwa/Honeywell Page A-2, Sect A-4	references c(2) and d(1) are identical. c(2) is an CIAO document and should be cited as such.	Agree. removed A-4 c (2).
94.	From FAA (Kathy, Loran, Guy)	<p>EASA wording</p> <p>(a) Flight deck controls must be installed to allow accomplishment of these tasks and information</p>	<p>Wording was added to the final decision document for 25.1302 that included the recommended rule language</p> <p>(a) Flight deck controls must be installed to allow accomplishment of all the tasks required to</p>

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	<b>Comment</b>	<b>Requested Change</b>	<b>Disposition</b>
		<p>necessary to accomplish these tasks must be provided.</p> <p>FAA NPRM wording</p> <p>(a) Flight deck controls must be installed to allow accomplishment of all the tasks required to safely perform the equipment's intended function including providing information to the flightcrew that is necessary to accomplish the defined tasks.</p>	<p>safely perform the equipment's intended function and information must be provided to the flightcrew that is necessary to accomplish the defined tasks.</p>