Certification Authorities for Large Transport Aircraft (CATA)

CATA Worklist Item (CWI) EASA-003 – 25.1302

Date Raised:	April 06/2018	Updated: N/A	Status:	**closed**
Date Revised	N/A			
Subject:	**Installed systems and equipment for use by the flight crew (25.1302)**			
Related Issue(s):	None			

Description of Issue(s):

Preliminary note: For the comfort of reading, the Authority-specific terminology (RBAC, CS, 14 CFR and AWM) will be removed from this document. Only "25.1302" and "25.1302 guidance" will be used.

25.1302 and 25.1302 guidance provide requirements for flight deck design with regard to human factors design criteria and management of flight crew errors.

Despite the fact that both requirements and guidance are harmonized, diverging interpretations and practices are observed at the project level

This topic was proposed to be added in the list of TOP 3 items [December 2019]

Background:

1. Intent of the rule

25.1302 was developed to provide a regulatory basis to address design-related aspects of avoidance and management of flight crew error.

- Requirements in sub-paragraphs (a) through (c) of 25.1302 are intended to reduce the design contribution to such errors by:
  - Ensuring information and controls needed by the flight crew to perform tasks associated with the intended function of installed equipment are provided,
  - Ensuring they are provided in a usable manner.
- 25.1302(d) addresses the fact that since flight crew errors will occur anyway, even with well-trained and proficient flight crews operating well-designed systems, the design must support management of those errors to avoid safety consequences.

2. Methodology to show compliance

In order to show compliance, the applicants are expected to follow the process described in the 25.1302 guidance.

3. Observed differences in practices and interpretations

In the frame of recent validation exercises diverging expectations were observed with regard to the implementation of the process described in the AMC/AC and therefore not consistently applied between FAA and EASA.

Proposed Prioritization:

(Per CATA Technical Issues List Prioritization schema, SME proposes along with authority CATA members)

Question	Answer
1. Is there an active working group related to this issue?	No
2. In which documents are there deviations amongst the authorities?	None
3. Was this issue raised by or at the CMT?	No
4. What is the level of impact on projects in the future (i.e. minor, major, critical)?	Major
5. How many authorities does the issue impact?	All
6. What is the approximate technical complexity of the issue (i.e. low, medium, high)?	Medium

Recommendation:

(Subject Matter Experts (SME) proposes expected resolution of the issue)

Establish a group of Subject Matter Experts with the aim of:

- Establishing a clear status of areas of diverging interpretations of 25.1302, including considerations related to the practical way of showing compliance with the rule.
- Harmonisation of the interpretations
- Define a set of adequate actions to implement the resulting conclusions

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CATA Decision
(Using CATA criteria for determination of technical issues)

In June 2018, CATA decision to action this issue. Authorities' SMEs consensus that topic deserved CATA attention.

CATA to establish a working group to develop harmonized paper.

SME Recommendation:
(Recommendations from SME Working Group; may contain links and/or embedded documents)

Ref. Annex 1 _ CATA Worklist Item EASA-003 – Installed systems and equipment for use by the flight crew (25.1302) _ Attachment to CWI EASA-003 – Guidance Paper

Final CATA Position:
(Explain agreement, dissent or conclusion on this paper)

The CATA accept the SME team's recommendation and proposed guidance paper. The guidance paper is appended directly to this CWI.

The CWI represents an agreement that the guidance paper is harmonized and accepted by all CMT authorities.

The CWI form, including the appended guidance, document a CMT member authority agreement that member authorities may reference when they are acting as the certificating authority (CA). Following CA endorsement for a particular project, the other CMT member authorities, when acting as validating authority, will accept the approach.

If any member-authority under CATA becomes aware of circumstances that make it apparent that following the guidance paper would not result in compliance with the member-authority's applicable airworthiness standards, then the use of this guidance paper is non-binding and the member-authority may require additional substantiation or design changes as a basis for finding compliance.

This CWI is closed.

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CATA Signatures:

CATA representative	Name	Signature	Date
ANAC	Daniel Pessoa Willian Tanji		Assinado de forma digital por Willian Tanji Dados: 2022.07.12 08:56:13 -03'00'
EASA	Colin Hancock Mathilde Labatut	Hancock Colin Labatut Mathilde	Digitally signed by Hancock Colin Date: 2022.06.14 16:40:37 +02'00' Digitally signed by Labatut Mathilde Date: 2022.06.14 13:16:28 +02'00'
FAA	Suzanne Masterson Hung Cao	 HUNG T CAO	Digitally signed by SUZANNE A MASTERSON Date: 2022.06.13 18:59:55 -07'00' Digitally signed by HUNG T CAO Date: 2022.06.14 05:43:38 -04'00'
TCCA	Canh Nham Andre Celere	Nham, Canh Celere, Andre	Digitally signed by Nham, Canh DN: C=CA, O=GC, OU=TC-TC, CN="Nham, Canh" Reason: I am approving this document Location: your signing location here Date: 2022.06.29 10:03:05-04'00' Foxit PDF Editor Version: 11.2.1 Digitally signed by Celere, Andre Date: 2022.06.28 10:40:13 -04'00'

Annex 1_ CATA Worklist Item EASA-003 – Installed systems and equipment for use by the flight crew (25.1302)

Attachment to CWI EASA-003 – Guidance Paper

1. SUBJECT

Installed systems and equipment for use by the flight crew (25.1302)

2. STATEMENT OF ISSUE

25.1302 was developed to provide a regulatory basis to address design-related aspects of avoidance and management of flight crew error.

- Requirements in sub-paragraphs (a) through (c) of 25.1302 are intended to reduce the design contribution to such errors by:
  - Ensuring information and controls needed by the flight crew to perform tasks associated with the intended function of installed equipment are provided,
  - Ensuring they are provided in a usable manner.

- 25.1302(d) addresses the fact that since flight crew errors will occur anyway, even with well-trained and proficient flight crews operating well-designed systems, the design must support management of those errors to avoid safety consequences.

In the frame of recent validation exercises diverging expectations were observed with regard to the implementation of the process described in the 25.1302 guidance and therefore not consistently applied between Authorities. The following differences were observed:

- A fundamental difference is the granting of early certification credits as a result of HF evaluation witnessing that occurs during the product development process, as recommended by the 25.1302 guidance. Some Authorities, despite their early involvement in the product development process, do not give “early certification credits” for non-conformed or partially conformed systems. Additionally, the FAA

prefer to reserve the right to do evaluations of the final versions of fully conformed systems, in the context of the aircraft and aircraft operations. In Europe most of the compliance demonstration is done during the development, which allows an in-depth coverage and assessment of all the pre-identified potential HF issues, using an iterative approach and with a de-risking objective. Some other authorities are reluctant to follow such an approach to give partial or preliminary "early certification credit" due to concerns and risks related to evaluating systems with hardware and/or software as well as engineering simulators that are not "final" versions or fully conformed. As a consequence, and in extreme situations, the showing of final compliance may be based on a single final HF evaluation, occurring at the end of the development process when the applicant is able to use the conformed simulator that will be used for training purpose, or the aircraft itself.

- It was observed and/or perceived that in order to demonstrate compliance with the 25.1302, some applicants still limit the investigations to the workload aspects, whereas EASA places an emphasis on usability matters. However, all authorities agree that it is not sufficient to only evaluate workload when showing compliance to 25.1302.

- EASA recently raised a CRI in order to recall some basic principles and methodological aspects in human factors for which diverging interpretation and/or practices were observed at project level. Those are typically provided with practical recommendations applicable to HF data gathering methods (questionnaires, interview techniques, observation techniques) and HF raw data analysis methods, including human error analyses. Experience of practical CS 25.1302 implementation in Europe showed that a few OEMs were still lacking knowledge and competence in that area. As such deficiencies can lead to experimental biases affecting the validity of compliance packages, it was deemed appropriate to make this CRI generally applicable by default, including for validation projects, due to the fact that those deficiencies were also observed out of Europe.

3. APPLICABILITY

- This document provides additional guidance on demonstrating compliance with the 25.1302.

- The content of this document does not change or create any additional regulatory requirements, nor does it authorize change in, or permit deviations from, regulatory requirements.

4. HARMONIZED PRACTISE, GUIDANCE TO DEMONSTRATE COMPLIANCE AND METHOD OF IMPLEMENTATION

I. Certification strategy

a. For the purpose of this document the following definition is proposed:

Assessment: The process of finding and interpreting evidence to be used by the applicant in order to establish compliance with a requirement. For the purpose of this AMC, the term 'assessment' can refer to both evaluations and tests. Evaluations are intended to be conducted using partially representative assessment means, whereas tests make use of conformed assessment means.

b. The HF assessment should follow an iterative process. Consequently, where appropriate, there may be several iterations of a same system-specific assessment allowing the applicant to reassess the system if the previous set of assessments resulted in design modifications.

c. An HF certification strategy based only on one test, is generally not acceptable (i.e. one final exercise proposed for compliance demonstration at the very end of the process).

d. There is an added value in having the authority involved during the development process as early as desirable through familiarisation sessions, regular witnessing of the HF evaluations at the system-level and aircraft-level assessments, and reviews of assessment plans and reports. Both parties may find an interest in this method, as the authority is continuously gaining experience and confidence in the HF process and the compliance of the flight deck design. The applicant may be granted partial early certification credit, leading to a proper mitigation of the certification risk. Additionally, potential issues may be identified early on by using this approach, thus reducing the risk of a late redesign of features that may not be acceptable to the authority.

e. The authorities agree that it is important to identify, document and track all human factors issues throughout Certification programs. However, as discussed in our meetings, not all issues are equally important, nor are all issues associated with finding compliance to the requirements/regulations. Emphasis should be

placed on issues that are related to non-compliance with the requirements/regulations or that may have safety consequences, those issues are required to be mitigated. It may be acceptable that some issues are kept with no specific mitigation, but in that case, it has to be properly justified, documented and duly assessed by the responsible authority.

f. In the early stages of system development, the systems or the assessment means may not be fully representative. However, the authority should still be involved, as long as the systems are representative enough that the data collected are valid.

The iterative nature of the process may require the applicant to perform assessments in the early stages of the project when the design is still likely to change. On the other hand, test articles that are not fully representative of the final design may be available later on during the certification process and may be the only available ones on which certain assessments may be performed (for example, a bench or a simulator may be the only means to assess the behaviour for failures that cannot be simulated in flight).

Therefore, the verification of the test article representativeness, with its deviations from the intended final design, is a step of paramount importance. These deviations should be evaluated and documented taking into account the objectives of the assessment.

For example:

- If a ground test is carried out to assess the controls reachability, specific attention should be paid at the flight deck geometry being representative of the design under certification while the conformity of the avionics is not required.
- If a simulator is used, the required functional and physical representativeness of the simulation (or degree of realism) will typically depend on the configurations, design items, and crew tasks to be assessed.

As a general principle, as long as the deviations from the intended final design are known, monitored and do not compromise the validity of the data to be collected, the lack of full representativeness should not prevent the use of a test article. In such cases, partial certification credits may still be granted, provided that the applicant can show that deviations do not affect the test results.

II. Principles applicable to the collection of HF related data

a. In order to substantiate the compliance with 25.1302, it is necessary to collect both objective and its related subjective data.

   i. **Objective data** on flight crew performance and behaviour should be collected by a trained observer, using the most appropriate means of data gathering. These means could include direct observation (paper/pencil) or other means such as response time measurements, eye tracking, video recording etc.
   The observables should not be limited to pilot errors, but should also include pilots' verbalizations in addition to behavioural indicators such as hesitation, inappropriate response time, suboptimal or unexpected strategies, catachresis that indicates misunderstanding or a usability concern, etc.

   ii. **Subjective data** should be collected during the debriefing by the observer through an interactive dialogue with the observed crew.
   The debriefing should be led by the observer, with a neutral and critical viewpoint.
   Subjective data are typically data that cannot be directly observed (e.g. pilot intention, pilot reasoning etc…) and they enable better interpretation of the observed objective data from (i).

b. Other tools such as questionnaires and rating scales could be used as complementary means of data-gathering. However, it is not adequate to rely purely on self-administrated questionnaires, due to the fact that flight crews are not necessarily aware of all their errors and deviations with respect to the intended use.

III. Workload considerations under 25.1302

a. The primary intent of the 25.1523 requirement is to evaluate the workload with the objective of demonstrating compliance with the minimum flight crew requirement.

b. The intent of the 25.1302 requirement is to identify design-related pilot performance issues.

c. Under the 25.1302 requirement, acceptability of workload levels is but one parameter among many to be investigated in order to highlight potential usability

issues. The 25.1302 evaluations should not be limited to considering workload only.
Workload ratings and other validated performance rating scales should be used in conjunction with other data, such as observation of flight crew behaviour.

d. The techniques used to collect data in the context of 25.1302 evaluations could make use of workload rating scales, but in that case no direct conclusion about compliance with 25.1302 should be made using only the results of workload rating scale.

IV. Use of debriefings

a. It is very important to conduct debriefings after formal, structured assessments of human factors aspects. The derbiefings allow the applicant's HF observers to gather the necessary data that will be used in the subsequent HF analyses.

b. Debriefings should be based on non-directive or semi directive interviewing techniques and should avoid the experimental biases that are well described in the literature in the field of social sciences (e.g. the expected answer contained in the question, non-neutral attitude of the interviewer, etc.).

V. Implementation of the scenario-based approach

The purpose of the following points is to provide guidelines on how to implement the scenario-based approach:

(a) The scenario-based approach is intended to substantiate the compliance of human–machine interfaces and system behavior. It is based on a methodology that involves a sample of various crews, who are representative of the future users, being exposed to realistic operational conditions in a test bench or a simulator, or in the aircraft. The scenarios are designed to show compliance with selected rules and to identify any potential deviations between the expected behaviour of the crew and the activities of the crew that are actually observed. The scenario-designers can make use of triggering events or conditions (e.g. a system failure, an ATC request, weather conditions, etc.) in order to build operational situations that are likely to trigger observable crew errors, difficulties or misunderstandings. The scenarios need to be finalized before the tests or evaluations begin. Dry-run sessions should be performed by the applicant before any HF campaign in order to validate the operational relevance of the scenarios. Authorities may require to participate or

witness these dry-run sessions. This approach should be used for both system- and aircraft-level assessments.

(b) System-level assessments focus on a specific design item and are intended for an in-depth assessment of the related functional and operational aspects, including all the operational procedures and environments. The representativeness of the test article is to be evaluated taking into account the scope of the assessment. Aircraft-level assessments consider the scope of the full flight deck and focus on integration and interdependence issues.

(c) The link between each scenario and the test objectives should be evident. This rationale should be described in the certification test plan or in any other relevant document and is subject to comments from the authority.

(d) The process and criteria used to select the crews involved in the HF assessments with certification credit should be presented to the authority for approval.

(e) Due to interindividual variability, HF scenario-based assessments performed with a single crew are not acceptable. The minimum accepted number of different crews used for a given set of assessments varies from three to five, including the authority crew, if applicable. A larger number of crews increases the reliability of analyses based on the data that are collected and also maximizes the likelihood of collecting a more comprehensive span of HF related findings. It is therefore recommended to use as many crews as practicable. In the case of a crew of two with HF objectives focused on the duties of only one of the crew members, it is fully acceptable for the applicant to use the same pilot flying or pilot monitoring (the one who is not expected to produce any HF data) throughout the campaign.
As an example, for a Crew Alerting System Campaign, five crews could be selected to perform the same scenarios. If the objective of the assessment is to only observe the Pilot Flying tasks, the applicant may elect to use the same Pilot Monitoring for all the occurrences of the assessment.

(f) The applicant is responsible for ensuring their design is evaluated and validated among a wide range of users who may pilot/interface with it. In order to be representative of the final users, a wide range of training and experience should be considered in the selection of test participants.

(g) An initial briefing should be given to the crew at the beginning of each session to present the following general information:

(1) Detailed schedule describing the type and duration of the activities (the duration of the session, the organisation of briefing and debriefings, breaks, etc.);

(2) What is expected from the crew: it must be made clear that the purpose of the assessment is to assess the design of the flight deck, not the performance of the pilot;

(3) The policy for simulator occupancy: how many people should be in the simulator versus the number of people in the control room, and what are the criteria for who should be included;

(4) The roles of the crews: if crews from the applicant participate in the assessment, they should be made aware that their role differs significantly from their classic expert pilot role in the development process. For the process to be valid without significant bias, they are expected to react and behave in the flight deck as standard operational pilots.

(5) The crew that participates in the assessment should **not** be:

(i) briefed in advance about the details of the failures and events to be simulated; this is to avoid an obvious risk of experimental bias; nor

(ii) asked before the assessment for their opinion about the scenarios to be flown.

(h) The crews need to be properly trained so that they are as representative as possible of type-rated pilots. This is required to be able, during the analysis, to exclude the "lack of training" factor to the maximum extent possible from the set of potential causes of any observed design-related human performance issue. Furthermore, for operational representativeness purposes, realistic crew task sharing, from normal to emergency workflows and checklists, should be respected during HFs assessments. The applicant should make available any draft or final aircraft flight manual (AFM), procedures and checklists sufficiently in advance for the crew to prepare.

(i) When using simulation, the characteristics of the experimental conditions should maximize the immersion feeling of crews in order to ensure the validity of the data. This generally leads to recommendations about a sterile environment (with no outside noise or visual perturbation), no intervention by observers, no interruptions

in the scenarios unless required by the nature of the objectives, realistic simulation of ATC communications, pilots wearing headsets, etc.

VI. Evaluation/Test objectives for 25.1302 compliance

The expected output is a document that links the design items to methods of compliance with the requirement/regulation. The following table provides one possible example of the formatting and the kind of information that is expected.

Function	Sub-Function	Crew Task	Potential Hazard or Error	Test or evaluation objective	Req	HF attribute (if applicable) §5 AMC 25.1302	MOC	Reference to related deliverable
Weather	Vertical Wx display on Vertical Display	Building of vertical Wx situation awareness	Range of detected Wx is not consistent on Navigation Display (300NM) as compared to Vertical Display (100NM). This lack of consistency may confuse the crew	To ensure correct interpretation of WX situation Assess potential degradation of rerouting planification due to Wx in case only the VD is used or available	25. 1302(b)	INFORMATION (§5.4) CONTROLS (§5.5) INTEGRATION (§5.7)	MOC 8 All HFs simulator evaluations	HF analysis §XXX HF Test Report §XXX

END