European Aviation Safety Agency

1 Dec 2010

COMMENT RESPONSE DOCUMENT (CRD) TO NOTICE OF PROPOSED AMENDMENT (NPA) 2008-22D

Draft Decision of the Executive Director of the European Aviation Safety Agency on

Certification Specifications for Aeroplane Flight Simulation Training Devices

"CS-FSTD(A)"

Explanatory Note

I. General

1. The purpose of the Notice of Proposed Amendment (NPA) 2008-22d, dated 30 October 2008 was to define the qualification code for aeroplane FSTDs based on JAA JAR-FSTD A and the JAA FSTD TGLs # 3, 8, 12, 13 and 14. JAA FSTD TGLs # 9, 10 and 11 are proposed as AMC and GM to Subpart ATO of Part-OR. For an overview of the migration of the JAA documents into EASA CS, see the cross-reference table provided in Appendix B to this CRD.

2. NPA 2008-22 was divided into six separate documents:
   - NPA 2008-22a contained the Explanatory Note and the regulatory impact assessment to the NPA, with detailed explanatory memorandums for both Part-AR and Part-OR, as well as cross-reference tables between JAR-FCL 1, 2 and 3, JAR-FSTD and the proposals presented in the NPA.
   - NPA 2008-22b contained draft proposals for Implementing Rules (IR) and related AMC and GM for authority requirements (Part-AR).
   - NPA 2008-22c contained draft proposals for IR and related AMC and GM for organisation requirements (Part-OR).
   - NPA 2008-22d contained draft proposals for CS for FSTD(A).
   - NPA 2008-22e contained draft proposals for CS for FSTD(H).
   - NPA 2008-22f Regulatory Impact Assessment for Part-FCL.

II. Consultation

3. NPA 2008-22d was published on the web site (http://www.easa.europa.eu) on 31 October 2008.

   The consultation period of the NPA was extended in accordance with article 6(6) of the Rulemaking Procedure[1], at the request of stakeholders, to ensure an overlap of the consultation periods of the first extension NPAs[2]. By the closing date of 28 May 2009 the European Aviation Safety Agency ("the Agency") had received 154 comments relevant to CS-FSTD(A) from 26 commentators, including National Aviation Authorities, professional organisations, private companies and individual persons.

III. Publication of the CRD

4. All comments received have been acknowledged and incorporated into this Comment Response Document (CRD) with the responses of the Agency. In reviewing and replying to the comments and making the necessary changes to the text of the NPA, the Agency was supported by a group of FSTD experts from industry, national authorities and the Agency, who had not been involved in the initial drafting phase.

5. In responding to comments, a standard terminology has been applied to attest the Agency's acceptance of the comment. This terminology is as follows:
   - **Accepted** – The comment is agreed by the Agency and any proposed amendment is wholly transferred to the revised text.

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1 EASA Management Board Decision 08-2007, amending and replacing the Rulemaking Procedure, adopted at the Management Board meeting 03-2007 of 13 June 2007 (http://www.easa.eu.int/ws_prod/g/management-board-decisions-and-minutes.php).

2 More specifically, NPA 2008-22, on Authority and Organisation Requirements, and NPA 2009-02, on Implementing Rules for Air Operations of EU Operators (http://www.easa.eu.int/ws_prod/r/r_archives.php).

- **Partially Accepted** – Either the comment is only agreed in part by the Agency, or the comment is agreed by the Agency but any proposed amendment is partially transferred to the revised text.
- **Noted** – The comment is acknowledged by the Agency but no change to the existing text is considered necessary.
- **Not Accepted** - The comment or proposed amendment is not shared by the Agency

The resulting text highlights the changes as compared to the current rule.

6. The Executive Director Decision on Certification Specifications for Aeroplane Flight Simulation Training Devices will be issued together with the Executive Director Decision on AMCs and GM to Part-OR, which is expected in April 2012.
7. Reactions should be received by the Agency not later than 11 February 2010 and should be submitted using the Comment-Response Tool at http://hub.easa.europa.eu/crt.

IV. Explanatory memorandum on the review of comments on NPA 2008-22d "CS-FSTD(A)"

A. Introduction

8. The Certification Specifications for aeroplane flight simulation training devices (FSTDs) describe the requirements an FSTD has to comply with in order to achieve a certain level of qualification (initial qualification) and to maintain this level of qualification (recurrent qualification). FSTDs are evaluated according to the qualification basis, which describes the performance, handling qualities and documentation requirements of the FSTD's compliance with the applicable processes for flight crew member training, testing and checking. The various types of FSTDs have to comply with different technical standards and should pass different validation tests as well as functions and subjective tests. These are listed and explained in this document.

   CS-FSTD(A) is based on JAR-FSTD A and JAR-FSTD temporary guidance leaflets (TGLs).

B. Comments

9. CS-FSTD(A) received a total of 154 comments. 55 of them are related to 'Book 1 – Qualification Code' and 99 to 'Book 2 – Acceptable Means of Compliance'. Comments were made by competent authorities, associations, FSTD operators, FSTD manufacturers, FSTD users and individuals.

C. Specific issues

10. Some comments claim that the Agency has introduced new requirements, thereby creating an additional burden. This was not the case, because the introduction of new requirements or major changes was beyond the scope of NPA 2008-22d. However, many commentators may not have been aware that changes had already been introduced when transferring the four JAR-STD documents into one JAR-FSTD document (in JAA NPA 11). JAR-FSTD A was the basis for the Agency's CS-FSTD(A). The justification given in the JAA NPA for many of the changes was a harmonisation of the four different documents for aeroplane FSTDs because:
    - they had been written at different times by separate groups, containing in some areas differences in the definitions, general requirements, flight conditions and tolerances;
    - there had been three updates of the requirements for FFS in the intervening period, while those for FTD, FNPT and BITD had remained unchanged since their original drafting (and were considered to be out-of-date).

- During this harmonisation JAR-STD 1A Amendment 3 was used as a master document, as this contained the most current requirements and was aligned with ICAO 9625, 2nd edition. With the alignment exercise for JAR-FSTD A, a common list of tests was used for all devices.

11. Comments on the apparent introduction of new tolerances should be seen in the context of the above. When merging the different documents there are validation tests requiring tolerances which are not different and not indicated separately for FFS and FNPT – the decision was made to align with the requirements given in the single STD documents. In those cases the lower (tighter) tolerance has been selected for both types of FSTDs to avoid an alleviation of requirements for FFSs. Concerns have been raised in the comments that FNPTs representing a class of aeroplanes cannot comply with this tighter ('FFS') tolerance for initial qualification. This is a misunderstanding of the requirements as, for the initial evaluation of an FNPT (and BITD), correct trend and magnitude (CT&M) should be used. The tolerances listed are for recurrent evaluations only. The alignment of tolerances has only been applied to validation tests where a deviation could only be caused by modifications in the software configuration or by replacing computer hardware. Therefore, when performing a recurrent evaluation, the FNPT is compared to itself and the tighter tolerance cannot be considered as an increase of regulatory burden. Additional explanation is given at the top of the 'Table of FSTD Validation Tests' in CS-FSTD(A).

12. NPA 2008-22 received a limited number of comments on the differences between STD/FSTD/CS-FSTD that had not been discussed and dealt with in NPA 11. These have been addressed in this CRD.

13. Some stakeholders commented that the Agency had intentionally introduced certain changes when, in fact, these were due to:

    - incorrect positioning of tick marks in the 'Table of FSTD Validation Tests' indicating which tests are required for each specific level of an FSTD; or
    - missing comments in the right column of that table.
    - The tick marks have been corrected. Comments in the comment column of the table that had been omitted unintentionally during the drafting process for JAR FSTD A have been reinstated.

    The introduction of major changes in the requirements (technical changes) was beyond the scope of this NPA.

14. Some commentators proposed the integration of the new ICAO Doc. 9625, 3rd edition '*Manual of Criteria for the Qualification of Flight Simulation Training Devices*'. This has to be postponed due to the following main reasons:

    - NPA 2008-22 has been drafted and published prior to the release of ICAO Doc. 9625, 3rd edition.
    - Only Volume I (Aeroplanes) of this new document has been published. Volume II (Rotary Wings) is still outstanding.
    - The new classification scheme for FSTDs used in Doc. 9625 (type I – VII) does not correspond directly to the previous scheme, thus the allocation of training, testing and checking credits would have to be reviewed and amended. This would have resulted in a significant delay to the publication of the CRDs to Part-FCL (NPA 2008-17) and Part-OPS (NPA 2009-02).
    - The integration of the new ICAO Doc. and the introduction of major changes to the requirements (technical changes) therefore require a level of consultation that can only be undertaken in a separate rulemaking task. The harmonisation of the layout of CS-FSTD(A) and CS-FSTD(H) would also be a future task.

D. Description of main changes

15. **CS-FSTD(A).200 "Terminology"**

Point (g) of the NPA defining the term *FSTD user approval* has been deleted as this approval no longer exists as a separate document. Instead, it becomes an attachment to the approved training organisation's certificate for the training course approval, and to the training manual of air operator certificate (AOC) holders. If differences have to be taken into account between the aircraft and the FSTD this should be reflected in the training approval (e.g. by special conditions, limitations).

A major reason for differences in the definitions is the editorial decision not to repeat definitions that are available in related rules. For instance, the term '*QTG*' is already explained in the Cover Regulation of Part-OR and is not transposed in CS-FSTD(A).

16. **CS-FSTD(A).300 "Qualification basis"**

Point (d) has been added to provide a link to the operational suitability data (OSD), being part of the type certification process under Part-21. The scope of the OSD encompasses that of the aircraft validation source data used to support the objective qualification of associated full flight simulators. The qualification of the first associated full flight simulator is used to validate and approve the process for releasing the aircraft validation source data.

17. **CS-FSTD(A).300 "Qualification basis"**

In point (d) the requirement has been reinstated to provide all documentation needed for the qualification of an FSTD in an acceptable format to allow an efficient review and evaluation. Practice shows that:

- in some cases validation data have been provided that do not clearly demonstrate the effect/behaviour to be evaluated even though they apparently comply with AMC No. 1 to CS-FSTD(A).300; and/or
- form and manner of documentation (scaling, explanatory notes, etc.) can sometimes make an evaluation difficult or impossible, or require further enquiries by the competent authority during the evaluation process.

18. **AMC1-CS-FSTD(A).300 "Qualification basis"**

The new point 1.6.3 provides the option to create an eQTG (electronic qualification test guide) since in practice this is becoming increasingly common. Submitting an eQTG instead of a paper version of the QTG should be agreed with the competent authority well in advance of the evaluation.

19. **AMC1-CS-FSTD(A).300 "Qualification Basis"**

Point 2.3 Table of FSTD Validation Tests has been modified since additional amendments and clarifications have to be made on the initial qualification of FNPTs and BITDs (see specific issues above):

- the 'initial' column for BITDs has been deleted because, for tests to be provided for BITDs (and FNPTs), correct trend and magnitude (CT&M) is always the requirement for the initial evaluation;
- accordingly 'CT&M' has been replaced by tick marks in the columns for FNPTs and BITDs.

Point 1.5.4, explaining the initial qualification for FNPTs and BITDs, has been amended by the "subjective assessment of a qualified pilot" as a major part of the evaluation process.

20. **AMC5-CS-FSTD(A).300 “Guidance on Evaluations of Electrical Motion Systems for FFS”**

The paragraph has been deleted in its entirety since electrical motion systems no longer belong to ‘new technologies’ and the requirements are the same as for hydraulic systems.

V. CRD table of comments, responses and resulting text

(General Comments) -

comment	*3* comment by: *Cirrus Design Corporation* Attachment #1
response	*Noted* Thank you for your comment. Your comment is not appropriate to this NPA2008-22 as credits associated with the different levels of FSTDs are covered under NPA2008-17.
comment	*11* comment by: *UK CAA* **Paragraph No: None (information in FSTDA not transferred to CS)** **Comment:** The requirement for the use of the device to be approved in JAR FSTD A (and H) has been omitted from the draft implementing rules. It is understood that FSTDs can only be operated under an approved ATO for training testing and checking. In industry there are many companies who lease out simulator time to customer airlines for recurrent training activities using the customer airline training personnel. This is not undertaken under the simulator operators TRTO, but under the terms of a user approval (reference FSTD-A and H .001). The following clarifications should be provided as a minimum.:- An airline with recurrent training needs (simulator based) does not currently need to hold a TRTO approval. Can they use a qualified FSTD in an independent ATO for recurrent training testing and checking under these implementing rules using their own instructors (as they currently do)? Do such airlines require their own ATO? If so, can an airline hold an ATO with the privilege to use FSTD without a CMS by using FSTD operated by another ATO having a CMS covering those devices? Can a simulator operator hold an ATO with no courses being approved but have the privilege to operate simulators (i.e. to allow the case of simulator operators whose business model is to lease out the FSTD but not deliver training specifically and do not currently hold a TRTO approval) **Justification:** Published clarification regarding the impact of the loss of user approval for industry is necessary. **Proposed Text (if applicable):** Some form of published guidance material is requested.
response	*Noted* The customer airline dry leasing a simulator from a simulator operator and using its own airline training personnel will describe the training in their OM Part D and the associated appendices (training syllabi) which include the use of the specific simulators. As the OM has to be approved the extent of use of the simulators will be approved concurrently.

The extent of use of FSTD(s) operated and/or used by an ATO will be described in the ATO Certificate itself.

Simulator operators only providing the devices in dry lease (and not providing any training) have to comply with specific requirements adapted to their organisation. An additional paragraph will be introduced in Part OR covering the requirements for those organisations (CMS etc.).

comment *13* comment by: *UK CAA*

Paragraph No: None (information in FSTD(A) not transferred to CS)

Comment:
The requirements in JAR-FSTD(A).030, paragraphs (d) and (e) have not been transferred into the draft Implementing Rules. These should be re-introduced.

Justification:
These requirements for the data and QTG presentation to be satisfactory and acceptable to the Authority allow the Authority to use it's knowledge and experience to ensure that the QTG validates the objective performance of the device to the standards defined in AMC No.1 to CS-FSTD(A).300, against valid data that clearly demonstrates beyond reasonable doubt that the standard has been achieved. Removing this requirement may result in acceptance of sub-standard validation data and/or QTG presentation.

Proposed Text (if applicable):
Re-introduce paragraphs (d) and (e) from JAR-FSTD(A).030, to CS-FSTD(A).300.

response *Partially accepted*

Paragraphs will be re-introduced as one paragraph (d) in a modified version.

comment *28* comment by: *UK CAA*

Paragraph No: None (information in JAR-STD 3A not transferred to CS)

Comment:
The standards required for FNPT have been reduced by removal of tests from those originally defined in JAR-STD 3A (during the transition from JAR-STD 3A to JAR-FSTD(A). JAR-STD 3A.030 AMC STD 3A.030, para 3.3, test 2b.(5) detail the test requirements for Gear and Flap/Slat Operating Times. (This is an anomaly introduced between JAR-STD 3A and JAR-FSTD(A) when JAR-FSTD(A) was published).

Justification:
JAR-FSTD(A) defines a standard that has been accepted by industry and regulators and is supposed to replicate the requirements of JAR-STD 1A, 2A, 3A and 4A. There is an anomaly between FSTD(A) and JAR-STD 3A that needs to be addressed in these final rules. JAR-STD forms the basis for JAR FSTD, which in turn forms the basis for these IRs and CS. The requirements of JAR-STD are known and accepted standards. The text as proposed would dilute the standards unnecessarily resulting in the potential for significant anomalies in cockpit cues for gear and flap movement which would have a direct effect on the training provided.

Proposed Text (if applicable):
Add paragraphs from JAR-STD 3A, AMC STD 3A.030, para 3.3, test 2b(5) to BOOK 2 SUBPART C: AMC No 1 to CS-FSTD(A). 300, Table 2.3. (Renumbering of the table will be required)

response *Not accepted*

The test has been taken out intentionally for all FSTDs. The more important effect for training is the change in aerodynamics which is considered by other tests like "Gear/Flap change dynamics" and "Gear/Flap change force". The dynamic tests are considered as being sufficient. Wrong travel times for gear and flaps would be stated and addressed already during customer acceptance tests.
Due to the simple software routine for switching
- gear lights

or
- flap/slat position indications

no deviation should occur after being subjectively (FNPT, BITD) checked during initial evaluation or during customer acceptance (FFS, FTD).

comment *30* comment by:*UK CAA*

Paragraph No: None (information in JAR-STD 2A not transferred to CS)

Comment:
The standards required for FTD have been diluted from those originally defined in JAR-STD 2A. JAR-STD 2A.030 AMC STD 2A.030, para 3.4, test 2c.(5) detail the test requirements for Gear and Flap/Slat Operating Times. (This is an anomaly introduced between JAR-STD 2A and JAR-FSTD(A) when JAR-FSTD(A) was published).

Justification:
JAR-FSTD(A) defines a standard that has been accepted by industry and regulators and is supposed to replicate the requirements of JAR-STD 1A, 2A, 3A and 4A. There is an anomaly between FSTD(A) and JAR-STD 3A that needs to be addressed in these final rules. JAR-STD forms the basis for JAR FSTD, which in turn forms the basis for these IRs and CS. The requirements of JAR-STD are known and accepted standards. The text as proposed would dilute the standards unnecessarily resulting in the potential for significant anomalies in cockpit cues for gear and flap movement which would have a direct effect on the training provided.

Proposed Text (if applicable):
Add paragraphs from JAR-STD 2A, AMC STD 2A.030, para 3.4, test 2c(5) to BOOK 2 SUBPART C: AMC No 1 to CS-FSTD(A). 300, Table 2.3. (Renumbering of the table will be required)

response *Noted*

See comment No. 28

comment *109* comment by:*ALSIM Simulateurs*

<u>Implementation of a Mutual acceptance process and/or a Type Qualification for lower level devices including FNPTs</u>

We believe, for the sake of common sense and to ensure simplification, that a type of a simulator, having already been qualified by one Authority, should

	give rise to implicit qualification for subsequent units, specially for lower level of devices. Then, We strongly suggest that a mutual acceptance and/or a Type Qualification be implemented for FNPTs, such as already exists for aircraft. In effect, when a simulator has already undergone one JAA-EASA qualification, its qualification procedure in another JAA-EASA counterpart should only involve a compliance check between the FNPT serial number and the Type Certification document. This provision exists in United States, without any adverse effect on the quality of training, for the Advanced Aviation Training Device (AATD=equivalent to FNPT in Europe) where qualifications are carried out by the "*General Aviation & Commercial Division*" under AC n°61-136 regulation. It is clearly stated that "*the approval will be valid for all serial numbers that are part of that configuration, provided there is no change in that configuration or in a value for a criterion in paragraph 8*" [AC 61-136 issued the 14th of July 2008, Appendix 2, paragraph 3]. While the EASA has the willing to harmonise the regulation, some National Aviation Authorities keep on claiming that they are required under local and European rules for FSTD qualification. They clearly want to take advantage of the lack of provision for approval of a type or for mutual acceptance in European regulatory process to reinforce their position. This is not acceptable for both operators and the industry world. **Then the provision in AMC to AR.ATO.210 for BITDs stating that "*the qualification should be valid for all serial numbers of this model without further technical evaluation*" should be extended to FNPT devices.**
response	*Not accepted* A (qualification) certificate shall be required in respect of <u>each</u> flight simulation training device used for the training of pilots (see Regulation (EC) No 1108/2009). The experience over the years has clearly shown that - for the time being - there is a necessity to evaluate and qualify each single FFS, FTD or FNPT. A 'type qualification' only applies to BITDs (according to AMC to AR.ATO.210). The qualification of an FSTD and its validity is also subject to the training organisation which has to comply with the applicable requirements for ATOs providing training in FSTD. The evaluation and qualification of a device cannot be seen as an independent process. The CMS of an ATO is a fundamental requirement to ensure that the devices remain in compliance with the technical standards of CS-FSTD(A) and CS-FSTD(H). This conjunction argues as well against a 'type qualification'.

comment	*110* comment by: *ALSIM Simulateurs* <u>Distinction between FSTD qualification and ATO qualification</u> The FSTD qualification should be issued independently of any management system approval. A double qualification should be given, one for the FSTD and another for the management system. This would avoid some confusion when it is not clear if revoking an FSTD qualification is due to FSTD non compliance or ATO non compliance. This confusing would not exist at any time if an FSTD Type Certification was possible (see remark about: "Implementation of a Mutual acceptance process and/or a Type Qualification for lower level devices including FNPTs").
response	*Not accepted*

There are qualifications for FSTDs and approvals for ATOs. But the qualification of an FSTD - as an integrated part of the entire system - is not independent of the ATO's management system.

comment	*111* comment by:*ALSIM Simulateurs* Distinction between higher level simulators and lower level devices A distinction between higher level simulators and lower level devices (FNPT & BITD) should be made in terms of requirements. In United States, the distinction is clearly made using two different regulations: the Full Flight Simulator qualifications are carried out by the "*National Simulator Program Staff*" under Part. 60 regulation whereas the Advanced Aviation Training Device (equivalent to FNPT) qualifications are carried out by the "*General Aviation & Commercial Division*" under AC n°61-136 regulation. Regarding the AATDs, the regulation is far less restrictive and far more pragmatic in terms of requirements. In the same way, we suggest that a distinctive approach be made in Europe between FFSs and FNPTs. This distinction may be similar to the one made between the commercial and general aviation regarding the aircraft maintenance (refer to the discussion process with the EASA MD032 working group).
response	*Not accepted* Regulation (EC) No 216/2008 has been developed to have common rules in the field of civil aviation in Europe. So FSTDs are considered in common as well, not divided by applying different regulations. The distinction is made by different requirements as laid down in the Certification Specifications. A further distinction has been made for those organisations operating FFS or FNPTs. Operators of FNPTs are often smaller organisations. This fact has been considered by diluted requirements for their management system and their CMS.

comment	*112* comment by:*ALSIM Simulateurs* Relaxing of Validation data and Validation Tests substantiation for FNPT & BITD The Validation Data and Validation Tests substantiation should be in a more relax form compared to what is required for bigger simulators. **Validation Data**: An acceptable mean to substantiate the objective tests would be to subjectively check the FNPT device with a qualified pilot, and determine whether or not the FNPT device is relevant of the aircraft or class of aircraft simulated. Hence subjective assessment from both the operator and the manufacturer could be accepted as Validation Data, as it is under FAA regulation for AATDs (see paragraph 1-2). **Validation Test**: The current regulation requires for FNPTs no more than 45 objective tests. It is huge compared to the FAA regulation for AATDs [AC 61-136 issued the 14th of July 2008], where no objective test at all is required for qualification process. We think that a compromise could be found between 0 and 45. For example, there are only 19 objective validation tests required for FNPTs under Canada regulation.
response	*Not accepted* A (M)QTG, accepted by the NAA or Agency respectively, demonstrates (initially) that the class of aeroplane/helicopter to be simulated has been met. The QTG should represent the designated aeroplane/helicopter configuration by a set of agreed validation data which could consist of

- flight test data
- data from AFM
- data from other sources

to be integrated into the aerodymanic model
plus

- subjective tuning
- subjective judgement

Once the set of validation data (for FNPTs described in the 'Engineering Report' of the QTG) is approved by the NAA or Agency the objective testing commences up to the accepted QTG.

In case of FNPTs the QTG is the basis to objectively indicate deviations from the initially qualified FNPT. Deviations may occur for instance due to a (wrong) implementation of new soft-/or hardware.

JAA NPA-STD 11 and 12 resulted in the JAA-wide agreed and accepted documents JAR-FSTD A and H. These JAA documents are the basis for NPA 2008-22 (d,e), where only structural changes have been made. It is outside the scope of this NPA to introduce technical changes. Technical changes will require a new rulemaking task including a new NPA.
Since all Implementing Rules and CSs, including those for FSTDs, will be kept updated on a regular basis, proposed changes will be considered within future rulemaking tasks, e.g. the alignment with the new ICAO doc. 9625, 3rd edition.

comment *113* comment by: *ALSIM Simulateurs*

Pragmatic approach

A strict application of the pragmatic approach of what a qualification process is (as specified in the current regulation) is urgently required: "*The Civil Aviation Authorities of certain European countries have agreed (…) aviation requirements (…) with a view to* ***minimizing Type Certification*** *problems or joint ventures,* ***to facilitate the export and import of aviation products*** *(…) in one European country to be accepted by the Civil Aviation Authority in another European country (…)*" [First paragraph of the foreword of the JAR-FSTD(A)].
The use of the phrase "*Unacceptable*" for serious defect, which holds up qualification and prevents operators from using their operational equipment, must be regarded as a serious issue and therefore used in a restrained and extremely well-targeted manner.

response *Noted*

When evaluating an FSTD the term "unacceptable" will be used whenever an item clearly fails to comply with the required standard.

A standardised use of the classification of discrepancies should be enforced through EASA's standardisation department.

comment *114* comment by: *ALSIM Simulateurs*

Creation of a supervisory Authority with appeal procedure

In cases where an Operator or a Manufacturer does not completely agree with some remarks, are the Manufacturer and/or the Operator allowed to put forward their point of view? If the answer is no, this would imply that they have no room for manoeuvre. Is this truly within the spirit of the regulations? Finally, in the event of any disagreement, which is the legitimate Authority capable of taking decisions in an objective manner?
If an identified serious defect is subject to be challenged, an appeal process should be possible with independent competent expert or third EASA member state Authority before downgrading or revoking the qualification level. In the interim, an FSTD temporary certificate shall be released unless a duly legitimate serious defect induces a clearly identified negative training.
We therefore request that a supervisory Authority be able to carry out the role of coordinator and moderator, in order to harmonise the rules and to defend the interests of Operators and Manufacturers objectively in the event of a disagreement with a NAA. We would like this role be provided during the interim phase between the dissolution of the JAAs and the actual publication of the new Part FSTD by the EASA in 2010.

response *Noted*

In the mentioned case, the appeal procedure of the NAA (competent authority) performing the evaluation and issuing the qualification certificate has to be followed. See AMC to AR.GEN.310 Para 3.
Appeals brought against decisions of the Agency will be processed according to Regulation (EC) No 216/2008 Article 40ff.

comment *115* comment by:*ALSIM Simulateurs*

Reformatting of the EASA part FSTD

The reformatting from JAR-FSTD(A) to EASA regulation has resulted in a too much voluminous document. It is quite difficult to link the parts AR and OR with the part CS-FSTD.

response *Noted*

comment *116* comment by:*ALSIM Simulateurs*

All our comments (both general and specific) are supported by a lot of Operators:

UCO AVIACION, Spain
STAPLEFORD FLIGHT CENTRE, UK
OATC, Portugal
AEROTEC ESCULA DE PILOTOS, Spain
SILVAIR, Poland
PROFESSIONAL AIR TRAINING, UK
DUTCHFLIGHTACADEMY, The Netherlands
AVIATOR FLIGHT CENTER, Cyprus
43 AIR SCHOOL, South Africa
AUNIS AIR EUROPE, France
MIDEAST AVIATION ACADEMY, Jordan
DONAU-AIR-SERVICE, Germany
AVIATION TRAINING & TRANSPORT CENTER, Germany
I.S.Aer.S., Italy
AERODYNAMICS, Spain
EGNATIA AVIATION, Greece

	MET-AIR, Turkey AYJET, Turkey MARTINAIRFLIGHTACADEMY, The Netherlands CRM EUROPE, UK TAYSIDE AVIATION, UK TURKISH AERONAUTICAL ASSOCIATION, Turkey AERO PYRENNEES, France ESMA AVIATION ACADEMY, France STELLA AVIATION, The Netherlands CABAIR, UK
response	*Noted*

comment *117* comment by: *Boeing*

GENERAL COMMENT:

The revised standards contained in the draft 3rd Edition of International Civil Aviation Organization (ICAO) Document 9625, "*Manual of Criteria for the Qualification of Flight Simulation Training Devices*," should be incorporated into CS-FSTD(A).

The proposed standards in CS-FSTD(A) are based on the 2nd edition of ICAO Document 9625. In 2006, the Royal Aeronautical Society established an International Working Group (IWG) to review the technical criteria contained within the 2nd Edition of ICAO 9625 Document. The IWG included members from the regulatory community (including members from the UK-CAA, French DGAC, and Swiss FOCA), pilot representative bodies, the airlines, and the training and flight simulation industry. It developed a unified set of technical criteria and training considerations. Since the new CS-FSTD(A) will be treated as regulatory, it presumably will be the only means of compliance for EASA qualification of flight training devices. Therefore, the data provider will be required to provide validation data for two sets of standards to satisfy both the EASA and the FAA. A similar burden will be placed on simulator manufacturers, who must support qualification by both the EASA and FAA for training devices for the same airplane model. In addition, simulator operators who provide training to flight crews under the jurisdiction of the European authorities and FAA would be required to provide validation material that must comply with both sets of standards. The FAA has publicly announced that they will be adopting the new ICAO standard and subsequently updating 14 CFR Part 60 to incorporate it. Other countries, including Canada who participated in the rewrite of ICAO Document 9625, have made similar commitments. Therefore, inclusion of a reference to the latest ICAO standard in proposed CS-FSTD(A) would be a valuable step towards our aim of standardizing international simulator regulations.

If EASA does not find it acceptable to incorporate the complete revised standards of the 3rd Edition of the ICAO Manual into the CS as we have recommended, then we request that EASA include a statement to allow the use of the ICAO 3rd Edition tests as an acceptable means of compliance until CS-FSTD(A) can be updated to include the revised ICAO standards. We suggest including the following text:

"The simulator qualification standards contained in ICAO document 9625, 3rd Edition, 'Manual of Criteria for the Qualification of Flight Simulation Training Devices,', following ICAO release, will be anan acceptable alternative means of compliance with CS-FSTD(A)."

	JUSTIFICATION: The 3rd Edition of ICAO Document 9625 contains significant changes from the previous edition. Unless, this latest version is acceptable for compliance with the proposed NPA, there will be an economic penalty for data providers, simulator manufacturers, and simulator operators if they are required satisfy two different EASA and FAA training device qualification standards.
response	*Noted* The new ICAO Document 9625 3rd edition Volume I (Aeroplanes) has been available since the beginning of August 2009. For helicopters the document still is in progress. NPA 22 started prior to the release of Doc 9625 3rd edition and could not consider this document within this process. Furtheron, the NPAs for EU-OPS 1 and FCL refer to the former and therefore different types of FSTD and should be adopted as well. Another point is that only Volume I of the ICAO document has been published and there would be different basic documents to be incorporated: ☐Doc 9625 3rd edition Volume I (Aeroplanes) and ☐FSTD (H). Since all implementing rules, including those for FSTDs, are kept updated on a regular basis, alignment with new ICAO documents for aeroplanes and helicopters will be considered within future rulemaking tasks and a new NPA process.

comment	*120* comment by: *FNAM (Fédération Nationale de l'Aviation Marchande)* Attachment #2 On one hand, FNAM fully recognizes the value added and quality of work delivered by EASA within the certification range (Article 5 of Basic Regulation 216/2008). FNAM will continue supporting the efforts of the Agency in this field. On the other hand, operational aspects are rather a different issue, though contributing to the same aim of safety enforcement. For years, thousands of flights are daily operated demonstrating the efficiency of the current regulations (JAR-OPS, OPS-1/3 and EU-OPS) applicable for flight safety. To that extend, FNAM highlights the issue raised by the Commission within COMMISSION OPINION on the final recommendations issued by the Management Board of the European Aviation Safety Agency following the external evaluation on the implementation of Regulation 216/2008, dated 05MAY09 (C2009-3220 final) "Having this in mind, the Commission is concerned by the potential consequences of the provisions of the "Notice of proposed amendments" on air operations (OPS) recently published by the Agency. The Commission believes that it is of a paramount importance to guarantee that the implementing rules to be adopted in this field reproduce the existing relevant legislation (EU-OPS Regulation 3922/91[1]). This will ensure continuity and coherence with such legislation and therefore more certainty for the industry. It will also allow the Agency to immediately start carrying out the related standardisation inspections. All efforts should be deployed to avoid any delay in the adoption of the implementing rules." FNAM performed a wide analysis of NPAs that EASA already published according to Basic Regulation 216/2008. First sights demonstrate that there

are many major changes, new concepts and questions that are worth additional work and consultation:

- Proposed regulation is widely different from EU-OPS. Its content is not a simple transfer of EU-OPS while Basic Regulation 216/2008 states that "with regards to commercial transportation by aeroplane, [measures shall be] developped initially on the basis of the common technical requirements and administrative procedure specified in Annex III to Reg EEC 3922/91"(Article 8 §6.);
- The structure forbids any comparison or cross-analysis with the currently applicable regulation;
- The legal structure of NPAs (GM/AMC/CS) seems confusing especially regarding implementation processes and legal certainty. Some key safety elements have still not been published or downgraded to soft-law which may be counter-productive.

To that extend, FNAM asked for "globally extending delays related to these NPAs until end of summer 2010, to successfully face this great change, jointly with EASA." This request was formally applied to M. Kneepkens through a letter dated 28APR2009, referenced 13198 (enclosed). At the time this comment his made, FNAM has not received any answer from EASA. Consequently, FNAM renews this official request through the CRT process and awaits a circumstanced answered from EASA, as some other third-parties are known to have express similar requests.

For all these reasons, FNAM considers that it is not possible to comment the proposed regulation in its current state.

Nevertheless, FNAM has proposed to EASA to "to settle a common and constructive approach between the Agency, the NAAs and the industry. Such an approach shall identify and discuss the issues of the proposed regulation. It appears as a timely and efficient way to cope with these topics, theme by theme, instead of dealing with various standalone but interconnected NPAs. FNAM aims to be an active actor of this work to support Agency's achievement."

The comments hereafter SHALL BE considered as :

A identification of some of the major issues FNAM asks EASA to discuss with third-parties before any publication of the proposed regulation, consistently with, and prior to, the above common and constructive approach.

In consequence, the comments hereafter SHALL NOT BE considered :

As a recognition of the third-parties consultation process carried out by EASA

As an acceptance or an acknowledgement of the proposed regulation, as a whole or of any part of it

As complete : the fact some articles refer to not yet-published (or even not yet-established) pieces of regulation or are not self-consistent prevented FNAM to understand and comment them

As exhaustive : the fact some articles (or any part of them) are not commented does not mean FNAM has (or may have) comments about them, neither FNAM accepts or acknowledges them

All the following comments are thus limited to our understanding of the effectively published proposed regulation, not withstanding their consistency with any other pieces of regulation, including with the Basic Regulation 216/200, giving mandate from the Commission and Parliament to EASA.

	[1] OJ L 373, 31.12.1991, p. 4.
response	*Noted* Thank you for this extensive comment. Unfortunately, your comments do not directly refer to NPA 2008-22. We would kindly ask you to readdress to EASA outside the scope of this particular NPA process.

comment	*131* comment by:*FCAA* Somewhere in the document it should clearly be stated that when such equipment that are not required are still installed (e.g. ATIS for an FNPT II device or icing feature for FNPT I), these extra feature equipment should be operative. Such requirement is needed, because if there are such selections on the IOS but they are not working (and/or even crash the simulation!), it leads to slower and uncertain training and to misled instructors and students. We did not find such presentation in the document. If such words are there already, please ignore this. If such presentation is not there, then the following presentation could be for example in the beginning part of Appendix 1 to CSFSTD(A).300: "Where nonrequired equipment or features are installed, these equipment should be maintained and kept operative according to same principles than all the required equipment and features."
response	*Noted* This point has already been addressed in "NPA 2008-22c, OR.ATO.320 Additional equipment"

resulting text	The experience over the years shows clearly that there is a necessity to perform an evaluation on each single device. So no type qualification is possible. Your proposal applies to BITDs only. Mutual acceptance means that a qualification (following an evaluation) of one state will be accepted by another state using the same **device** (not the same type) and that there is no need for this other state to check this specific device again. For the time being, there is a mutual acceptance for FFS, but not for FTDs and FNPTs

TITLE PAGE p. 1

comment	*133* comment by:*IACA International Air Carrier Association* IACA has no comments since IACA airlines do not operate FSTD(A).
response	*Noted*

B. Draft Rules - V. Draft Decision CS-FSTD(A) p. 4

comment	*6* comment by:*Pedro*

	Certification is a term generally used for aircraft and airborne equipment. This specification refers to Flight Simulation Training Devices "qualification" (it is the word used all along the document). Discussions arise in the simulation community to establish the difference between "certification" and "qualification". Suggest to use always the term "qualification" (even in the title page) when referring to the verification of requirements referring to flight simulators and other flight training equipment. **Qualification Specifications for Aeroplane** Flight Simulation Training Devices or **Requirement Specifications for Aeroplane Flight Simulation Training Devices Qualification**
response	*Partially accepted* The term 'qualification certificate' for FSTDs is used to describe a document which finalises the qualification process. We are not talking about a 'certification' of the FSTD, but of certification specifications. If the specifications are fulfilled (which will be evaluated during the qualification process) a qualification certificate will be issued. The term 'initial certification' in AMC No. 7 to CS-FSTD(A).300 will be replaced by 'initial qualification'.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 1 - Subpart A: Applicability - CS FSTD(A).001 Applicability p. 8

comment	*43* comment by: *ECA- European Cockpit Association* Add paragraph (c) as follows: **(c) FSTD users should also gain approval to use the FSTD as part of their approved training programmes despite the fact that the FSTD has been previously qualified.** Justification: The use of specific FSTDs needs to be approved for the training programmes. Otherwise FTO could almost use whatever FSTD they like.
response	*Noted* See response to GEN (11) UKCAA

comment	*123* comment by: *CAE* General 1,k,1 Compliance columns indicates reference to JAR-FSTD(A).300; should read CS-FSTD(A).300
response	*Accepted* JAR-FSTD(A).300 will be changed to CS-FSTD(A).300 in chapter 1.k.1 on page

1-A1-7.

comment | *124* comment by: *CAE*

Motion 2, b.1
Tick mark appears misplaced for first item, should appear beside b.1(1) for Level A

response | *Accepted*

The tick mark will be placed to the correct line.

comment | *125* comment by: *CAE*

Motion 2,c.1
Table separator line missing between sections b.1,c.1 and d.1.
Separator line should be added between sections b.1,c.1 and d.1

response | *Accepted*

Table separator lines will be added

comment | *141* comment by: *CAE*

Paragraph (b) refers to "version" , how will the revision of this document be controlled?

response | *Noted*

All implementing rules, including those for FSTDs, are kept updated on a regular basis. The revision of documents or parts of them will be done by NPAs. These are controlled processes so there will be a revision control.

resulting text | Table separator lines will be added

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 1 - Subpart B: Terminology - CS FSTD(A).200 Terminology p. 9

comment | *12* comment by: *UK CAA*

Page: 1-B-1

Paragraph No: BOOK 1 SUBPART B: CS-FSTD(A). 200, paragraphs (g) and (h)

Comment:
Paragraphs (g) and (h) provide the definitions of a 'Flight Simulation Training Device User Approval' and 'Flight Simulation Training Device User'. The proposed Implementing Rules do not make provision for a user of a specific FSTD and approval to do so; this is now defined under the rules for an Approved Training Organisation. These current definitions under the Terminology appear unnecessary. Propose deletion (but see CAA UK comment regarding the concept of the user approval).

Justification:

	Paragraphs (g) and (h) provide definitions of items not used in the regulation. **Proposed Text (if applicable):** Delete Item (g) and (h) and renumber remaining items.
response	*Partially accepted* Paragraphs (g) will be deleted in accordance with the response to comment 11 of General Comments (the content of the former user approval will now be part of the ATO Certificate and is part of the OM-D). Item (h) has to remain in this paragraph because the term FSTD User is used elsewhere in this document.

comment	*44* comment by:*ECA- European Cockpit Association* Change text as follows: (h) Flight Simulation Training Device User (FSTD User). The person, organisation**, operator** or enterprise requesting training, checking and testing credits through the use of an FSTD. Justification: Compliance with old JARs is important to specify who is responsible.
response	*Not accepted* "Operator" has not been included because it is ambiguous. (In conjunction with comment 12 above)

comment	*139* comment by:*AIRBUS* It is proposed to add the following definitions: "*MFTD (Mobile FTD).* An FTD Level1 designed to be easily relocated in differen training localities without any impact on its original qualification standard, basec on a software architecture and touchscreen cockpit replica technology. *MFTD Model*. A defined hardware and software combination, which has obtained a qualification. Each MFTD will be capable to replicate one or more specific models and be a serial numbered unit." Several FTD's are mainly based on software architecture and use touchscreen technology to replicate the cockpit panels instead of hardware parts. These devices have been initially designed to be moved in different training places easily. Today classified as FTD Level1, these devices lost their mobility capability and the requirements for their qualification evaluations are not adapted to their architecture benefits. To allow an easy relocation of such devices, a new classification should be created for the Mobile FTD's in order to officially identify the devices having this capability.
response	*Not accepted* Generally it is not within the scope of this NPA to create a new type or classification of training devices.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 1 - Subpart C: Aeroplane Flight Simulation Training Devices - CS FSTD(A).300 Qualification basis p. 10

comment	*9* comment by:*Marduc Aeronautical Consults* 3. Master Minimum Equipment List (representing the operation of the required

	training program) for the crediting of the applicable training and checking.
response	*Noted* The intent of the comment is not clear. Are you asking for an MMEL for FSTD? Justification missing.

comment	*45* comment by: *ECA- European Cockpit Association* Clarification needed: what happened with JAR-FSTD A.031 to A.050? Will they be definitely abolished or transition regulations will be published.
response	*Noted* JAR-FSTD A.040,045,050 have been transferred to OR.ATO.370,380,385 JAR-FSTD A.031 - 037 : These topics will be addressed in the Cover Regulation.

comment	*98* comment by: *ALackey - Frasca International, Inc.* Please define "submitted." Does the application for qualification need to be submitted by a particular date or the actual qualification have to occur by a particular date. The standard by which an FSTD to be qualified and evaluated needs to be very clear. A company may have their application received before CS-FSTD(A)/(H) is in effect. The engineering and manufacturing of such FSTD occurs sometime before the application is even created and sent. It is very important to know by which regulation the trainer will be qualified against. It would be courteous to inform the customer that in order to have the trainer built and engineered to CS-FSTD(A) your application must be received by ##/##/## or if the qualification must occur by ##/##/##. Our contracts are written to state which regulations will apply as well. A manufacturing company will have to fulfill their contractual obligations. It serves no purpose to sell a FSTD built to the requirements imposed by JAR-STD 4H and find out later that it will be qualified under CS-FSTD (A).
response	*Noted* The date is regulated by CS-FSTD(A).001 para (b) CS-FSTD(A).300 para (a) OR.ATO.360 and the decision will be left to the competent authority.

comment	*99* comment by: *Ryanair* **Comment** test **Proposal** test
response	*Noted*

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 1 - Appendices - Appendix 1 to CS FSTD(A).300 Flight Simulation Training Device Standards p. 11

comment	*126* comment by:*FCAA*
	Appendix 1 to CSFSTD(A).300 presents: "For MCC (Multi Crew Cooperation) minimum technical requirements are as for Level II, with the following additions or amendments:" The presentation is lacking the abbreviation FNPT before words "Level II". By adding the abbreviation FNPT, the presentation would be more unambiguous. The correct presentation should be: "For MCC (Multi Crew Cooperation) minimum technical requirements are as for FNPT II, with the following additions or amendments:"
response	*Accepted* The abbreviation FNPT will be added.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 1 - Appendices - Appendix 1 to CS FSTD(A).300 Flight Simulation Training Device Standards - 1. General p. 12-21

comment	*7* comment by:*Marduc Aeronautical Consults*
	The instructors station should be part of the Cockpit communication system (hot-mike)
response	*Noted* AMC to AR.ATO.200(a)(3) para 3. says that the IOS should provide adequate facilities for the task. It is understood that the IOS is part of the cockpit communication system via the intercom system where reasonable (depending on the type of FSTD)

comment	*8* comment by:*Marduc Aeronautical Consults*
	The instructors station shall be fitted with a suitable radio/intercom system to enable him/her to be part of a scenario based training environement
response	*Noted* See response to comment No. 7 above (same segment)

comment	*15* comment by:*UK CAA*
	Page: 1-A1-7 **Paragraph No: BOOK 1 SUBPART C: Appendix 1 to CS-FSTD(A). 300, paragraph k1** **Comment:** Incorrect references to JAR-FSTD(A) in the sections of CS-FSTD(A) in COMPLIANCE section of table. **Justification:**

	Reference to incorrect document. **Proposed Text (if applicable):** (Proposed amendments *italicised and underlined*) Replace reference to JAR-FSTD(A) with *CS-FSTD(A)* in the compliance column of para k.1
response	*Accepted* JAR-FSTD(A).300 will be changed to CS-FSTD(A).300 in chapter 1.k.1 on page 1-A1-7.

comment	*35* comment by:*FinnishAviationAcademy* paragraf s.1 Last sentence should be modified: manufacturer should not be the only source for flight test data Aerodynamic modelling shall be provided. This shall include, for aeroplanes issued an original type certificate after June 1980, low altitude level flight ground effect, Mach effect at high altitude, normal and reverse dynamic thrust effect on control surfaces, aeroelastic representation and representations of non-linearities due to sideslip based on aeroplane flight test data ~~provided by the manufacturer~~.
response	*Noted* See definition of 'Flight Test Data' (page 2-B-2) where it reads: *...by the aircraft manufacturer (or other supplier of acceptable data) during an aircraft flight test programme.* To obtain reliable data it should not be left open to 'anybody' to provide aeroplane flight test data. So it seems to be too vague just asking for aeroplane flight test data without further specification of the provider. (Same in JAR-STD 1A and JAR-FSTD A)

comment	*64* comment by:*FlightSafety International* **Comment** This section requires a Statement of Compliance that "A means for quickly and effectively conducting daily testing of FSTD programming and hardware shall be available." **Proposal** Change this requirement to be consistent with the requirements of CS-FSTD(H) Appendix 1 to CS FSTD(H).300 Page 1-A1-9 section s.1. Recommended wording is: "A means for quickly and effectively testing FSTD programming and hardware. This may include an automated system, which could be used for conducting at least a portion of the tests in the QTG. Selftesting for FSTD hardware and programming to determine compliance with the FSTD performance tests. Evidence of testing shall include FSTD number, date, time, conditions, tolerances, and the appropriate dependent variables portrayed in comparison with the aircraft standard." **Impact to FlightSafety** This requirement for a "means to quickly and effectively test the the FSTD programming and hardware" forces the FSTD manufacturer to develop and implement some sort of method to conduct these tests of programming and hardware. The FSTD is given a thorough preflight each day, which has always

	been the determining test to verify the FSTD is ready for training. There is no equivalent test required for aircraft. the development, implementation, and maintenance of these daily testing systems places a serious financial burden on FSTD manufactirers and provides no additional confidence in the device beyond that provided by the daily preflight.
response	*Partially accepted* It is correct that the tick marks for Aeroplane FSTDs are not consistent with those for Helicopter FSTDs. Tick marks will be added for aeroplane FFS Level A and B because at least some level B devices have a complexity and such an extent of training credits that it can not be justified why they don't need a daily testing like level C and D devices. At the same time the requirement will then be consistent with the requirement for helicopter FFS. Daily functional readiness tests can be done manually according to an established procedure (CMS). There is a mix up in the comment between QTG reruns and the daily readiness testing.

comment	*69* comment by: *Thales Training & Simulation* 1.General a.5 Compliance field : states "The use of electronically displayed images with physical overlay incorporating operable switches, knobs, buttons replicating aeroplane instruments panels may be acceptable." Although these words are used in JAR FSTD-A, and is not something introduced by EASA,the words "may be acceptable" are too vague. Acceptable to who? Competent authority? Pilot? User? Simulator manufacturer? Suggest changing the words to: "The use of electronically displayed images with physical overlay incorporating operable switches, knobs, buttons replicating aeroplane instruments panels may be acceptable to the authority."
response	*Partially accepted* The Agency follows your proposal by adding ...*may be acceptable <u>to the competent authority</u>.*

comment	*70* comment by: *Thales Training & Simulation* 1. General r.1 Transport Delay The pre-amble for the equivalent section in JAR FSTD-A has been removed with EASA text going straight tothe (1) Transport Delay text. With (1) Transport delay, the text has been rationalised (from the JAR text) to simply provide the requirement without the additional explanatory material. (2) Latency, additional explanatory text has been rationalised from the JAR text. Some important information such as the motion to visual relationship has disappeared as a requirement as a result of the rationalisation of the text when compared against JAR FSTD A. The original text should be restored.
response	*Noted*

comment	*127* comment by:*FCAA* On page 1-A1-2 in paragraph a.2 it says for FTD 2: "A cockpit/flight deck sufficiently enclosed to exclude distraction, which will replicate that of the aeroplane or class of aeroplane simulated." FTD 2 should be fully type specific, so to further improve clarity, the presentation should be: "A cockpit/flight deck sufficiently enclosed to exclude distraction, which for FTD level 2 will replicate that of the type specific aeroplane and for FNPT or BITD will be a generic replication of the class of aeroplane simulated."
response	*Partially accepted* To improve clarity the text will be changed as follows: A cockpit/flight deck sufficiently enclosed to exclude distraction, which for FTD level 2 will replicate that of the aeroplane and for FNPT or BITD will be a replication of the class of aeroplane simulated.

comment	*128* comment by:*FCAA* A minor comments to make the text on page 1-A1-4 paragraph e.3 even more unambiguous: The compliance column should present more clearly that the updates should consider changes in real world. A modified presentation could be: *For FTD 1 applies where navigation equipment is replicated.* *For all FFSs and FTDs 2 where used for area or airfield competence training or checking, navigation data should beupdated within 28 days <u>to consider navigation data changes in real world</u>.* *For FNPTs and BITDs complete navigational data for at least 5 different European airports with corresponding precision and nonprecisionapproach procedures including current updating within a period of 3 months <u>to consider navigation data changes in real world</u>.*
response	*Noted* Thank you for this comment but operators and users should know the reason for this requirement to update the navigational data base at regular intervals.

comment	*129* comment by:*FCAA* Page 1-A1-4 paragraph e.3 presents for FTDs level 1: "For FTD 1 applies where navigation equipment is replicated." Is the idea that if the FTD 1 device models naviation equipment, then the navigation data may be very old and expired? If not, then it should be presented that for these devices the updating period is e.g. 3 months (as for FNPTs).

response	*Noted* Since there are no credits given for navigation training/checks on FTD 1s there is no nav data base update necessary.

comment	*130*	comment by: *FCAA*
	On some pages from 1-A1-16 onward the compliance column often presents the words "Tests required" (see for example page 1-A1-16 paragraph j.1). Such presentation is not unambiguous. If tests are required, the text should clearly present what kind of tests (e.g. does it require flight test data, are the tests subjective or objective, are the tests manual or automatic, should there be QTG tests for these, etc.) are required. Most probably the words "tests required" means that there should be QTG tests for these issues. Therefore, we suggest that the words "tests required" are replaced with words "QTG tests are required."	
response	*Noted* Since different kinds of tests are possible (QTG, subjective, functional), which are specified in the other sections, the expression in the section for FSTD standards is a general one.	

comment	*156*	comment by: *CAE*
	'- CS-FSTD(H), i.1 and i.2 FSTD standards require 2 Additional seats for the instructor and observer (eg. check airman) for all FSTD levels (FFS, FTD, FNPT) - CS-FSTD(A), f.1 FSTD standard requires 3 additional seats for the instructor, delegated examiner and authority inspector for all FSTD levels (FFS, FTD, FNPT and BITD) and all seats seem to require adequate vision of the pilots' panel and forward windows. - Why are there differences between Airplanes and helicopters? Why does a third observer seat also require adequate view of the pilots' panels and forward windows? Note that: - ICAO 9625 edition 3 aeroplanes requires 3 additional seats as well for all FSTD types. - For reference, FAA 14 CFR PART 60 requires 2 additional seats for the instructor/check airman and authority inspector for all FSTD levels of airplanes and helicopters. CAE recommends harmonization, as required, within EASA and other NAAs such as the FAA. Consideration should also be given to the limitations associated with the dominant light helicopter cockpit configurations with limited viewing capability from the non-simulated area. Consideration should be given as to the necessity for the third observer to have adequate vision of the pilots' panel and forward windows. Attempting to find practical solutions for this requirement may turn out to be, possibly, unnecessarily complex and costly.	
response	*Noted* Thank you for your recommendation. The Agency will review its regulations within a new rulemaking task to assure alignment with the new ICAO document 9625, 3rd edition. Up to now Volume II (Rotary Wings) is not	

available to see if there is an amendment of the requirement for the number of additional seats in FSTD for helicopters.

comment | *157* comment by: *Czech Airlines*

We think, that some demands on the certification of the Visual Systems for Flight Simulator Training Devices according to these new rules should be specified more accurately for some parameters to avoid misunderstanding during the certification process itself.

1)

CS-FSTD (A) Book 1 – Appendix 1 to CS-FSTD (A).300
3. Visual System
Item m.3 on page 1-A1-15

There is not described in this document, what is the lowest, still acceptable, field (frame) update rate for the visual systems. **The requested sufficient system capacity (number of polygons and visible lights) can be fulfilled easily at the expense of reduced field update rate!**
Consequently, e.g. whenthe day field update rate decreases to 45 Hz during the system capacity test pattern check and to 40 Hz for twilight TOD, this field update rate reduction or decrement to **40 – 45 Hz results in flickering image which starts to be not acceptable for observation of the displayed image!**

response | *Noted*

Although you are right in principle, the Agency would leave the text unchanged. The standards should not be proposing the solutions. If a manufacturer could provide adequate performance to fulfil the training needs with different software execution rates that should be permitted providing the end result is acceptable.

1. Item m.3 on page 1-A1-15 describes the standard for FFS Level C and D. It is very unlikely that FFS Level C or D which will be initially qualified against CS-FSTD (A) will be equipped with visual systems not having sufficient system capacity. If the update rate has to be reduced to meet the requirements for the total scene content the image starts flickering, which will not be accepted, neither by the evaluation team nor by the pilots to be trained. It is improbable that such a system will be offered by any simulator manufacturer.
2. Older visual systems are allowed to display only part of the CS-FSTD (A) specified visual details for the scenes (see AMC No. 7 to CS-FSTD(A).300) This relates to older devices (grandfather rights) with grandfathered visual systems.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 1 - Appendices - Appendix 1 to CS FSTD(A).300 Flight Simulation Training Device Standards - 2. Motion system p. 21-23

comment | *4* comment by: *Christian Winkler*

"4. Additionally, the following persons should be present:
a. For FFS, FTD and FNPT a type or class rated instructor from the ATO operating A FSTD or main FSTD users."

In our opinion it should not be mandatory that this additional person is a instructor. In our ATO we have assesed and trained a special team of acceptance-pilots. This pilots are type rated and qualified to execute all the FSTD relevant issues between the authority inspections, like subjectiv, objectiv and functional tests and they know the simulator very well. But this so called acceptance-pilots are not instructors.
In our ATO this acceptance pilots are more suitable to assist on an evaluation instead of a instructor, which is maybe only once a year in exactly this simulator.

My request is to change the text as follows:
"4. Additionally, the following persons should be present:
a. For FFS, FTD and FNPT a type or class rated instructor or a type rated acceptance pilot from the ATO operating A FSTD or main FSTD users."

response *Not accepted*

The comment is misplaced here in this section. It refers to AMC4 to AR.ATO.200(a)(1).

comment *71* comment by: *Thales Training & Simulation*

2 Motion c.1 and d.1

Table formatting problem:

2.c.1 and 2.d.1 need to have their own horizontal separator lines in the table.

response *Accepted*

Table separator lines will be added.

comment *132* comment by: *FCAA*

On page 1-A1-12 paragraph b.1 the tick mark for FFS level A should be one row lower to match paragraph b.1.(1).

response *Accepted*

Tick mark will be moved one row lower to match paragraph b.1.(1)

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 1 - Appendices - Appendix 1 to CS FSTD(A).300 Flight Simulation Training Device Standards - 3. Visual System p. 23-26

comment *65* comment by: *FlightSafety International*

Comment
Section m.3 requires that the visual system have sufficient system capacity to display 16 simultaneously moving objects. The capacity to display 16 simulataneously moving objects has no training value.

Proposal
Change the requirement to state that the system have the capacity to display "multiple simulataneously moving objects."

Impact to Flight Safety
There are no approved training scenarios that require the use of 16 simulataeously moving objects. Requiring the development of that capability is extremely expensive, for no value added to the training delivered.

response *Not accepted*

This requirement is not a new one and is part of JAR-STD 1A, JAR-FSTD A and the new ICAO doc. 9625, 3rd edition (after a thorough review of the existing technical criteria by an international working group).
Changing to "multiple simultaneously moving objects" is too vague meaning that 2 objects could be already considered as "multiple".
In sense of a more realistic environment (ATC, moving objects (gnd, air)) by getting a similar stress level in the simulator it could be argued if there is no training value.

comment *72* comment by: *Thales Training & Simulation*

3.a.1 and 3.a.2 - Visual System

Applicability Applicability ticks have been removed from the JAR FSTD-A standard when implemented as an EASA standard for FTD Level 1 and 2. Why?

If an FTD has a visual system, the applicability needs to be clarified. The current EASA document has a note against visual standard 3.a.1. If this is a conceptual statement which imposes applicability for all of section 3 it should be positioned in the Compliance column at a higher level so that it encompasses all the applicable standards for that section rather than just 3.a.1.

Propose that the text in the compliance column for standard 3.a.1 which deals with FTDs and FNPTs be placed in its own compliance box after the "3. Visual system" but before "a.1". This will make the FTD and FNPT note applicable for the whole of section 3 and will remove the need for the ticks in some of the FTD and FNPT columns.

response *Noted*

- Comparing the tables for 'Flight Simulation Training Device Standards' in JAR-FSTD A and CS-FSTD (A) there have been no ticks removed in the Section 3 'Visual System'.
- Both documents don't have a paragraph 3.a.2 in this section.
- Thank-you for your proposal to reorganise Section 3, but the Agency is of the opinion that the structure of this section is unambiguous.

comment *73* comment by: *Thales Training & Simulation*

3.b.2 - Visual

EASA introduces "SOC is acceptable in place of this test."

This should say test required, as a test has been defined already and this statement in conflict with the need for a test. This standard had to be proven by test, and a SOC should not be sufficient for the initial qualification. Once the standard has been established by test, there may be a case for using the SOC approach for recurrent checks.

response	*Accepted* The paragraph addresses FFS Level C and D. The statement "SOC is acceptable in place of this test" will be deleted from paragraph 3.b.2. It only refers to 3.b.1. This mistake was made when transferring the JAR-STDs to JAR-FSTDs.

comment	*74* comment by: *Thales Training & Simulation* 3.b.3 Visual - EASA introduces "SOC is acceptable in place of this test." This should say test required, as a test has been defined already and this statement in conflict with the need for a test. This standard had to be proven by test, and a SOC should not be sufficient for the initial qualification. Once the standard has been established by test, there may be a case for using the SOC approach for recurrent checks.
response	*Not accepted* The paragraph addresses FNPT II, II MCC. An SOC is acceptable in this case. • FoV: should be like for Level A FFS (45 x 30). • Performance: the adequacy of the performance of the visual system will be determined by its ability to support the flying task. Certain visual system requirements shall be supported with an SOC which describes how the requirement is met.

comment	*75* comment by: *Thales Training & Simulation* 3.c.1 - Visual EASA removes need to measure visual response time for an FTD. No tick in FTD Level 2 column. Transport delay tests are needed for an FTD (if a visual is installed). Need to restore the ticks as in JAR FSTD A. alternatively, this could be catered for by the statement concerning FTDs at the start of section 3 Visual systems, see earlier comments on 3.a.1 and 3.b.1.
response	*Not accepted* The structure is the same as in JAR-FSTD A. EASA did not remove ticks. In ACJ No. 1 to JAR-FSTD A.030 there are ticks for the FTD transport delay test (if a visual system has been installed) as well as in CS-FSTD (A) 2.3 'Table of Validation Tests' page 2-C-42. There is no tick at this place because a visual system is not required for an FTD. Only in case of an installation of a visual system the requirements as mentioned in CS-FSTD(A) para 2.3 have to be met. It is obvious that then a means of recording the visual response time is necessary.

comment	*134* comment by: *FCAA* Attachment #3

On page 1-A1-14 paragraph e.1 ("Visual textural cues to assess sink rate and depth perception during takeoff and landing shall be provided.") there should be a tick mark for FNPT II also.

This is because of AMC STD 3A.030 paragraph 3.4 section m (see attached file) that presents for FNPT II:

"*Visual cues to assess sink rates during approach. Visual cueing sufficient to support changes in approach path by using runway perspective. Changes in visual cues during take-off and approach should not distract the pilot.*"

response *Noted*

AMC STD 3A.030 para 3.4, JAR-FSTD A and CS-FSTD(A) have in their **'Table of Functions and Subjective Tests'** a tick mark for FNPT II indicating that the following has to be checked when evaluating the device subjectively:

Visual cues to assess sink rates during approach. Visual cueing sufficient to support changes in approach path by using runway perspective.

There is a table **'Flight Simulation Training Device Standards'** in JAR-FSTD A and CS-FSTD(A) which cannot be found as such in JAR-STD 3A. The minimum standards in JAR-STD 3A are listed in JAR-STD 3A.030.
The table **'Flight Simulation Training Device Standards'** says that:

Visual textural cues to assess sink rate and depth perception during T/O and Landing should be provided.

There is no tick mark for FNPT II because the requirement to provide textural cues is beyond the requirement to use a change of runway perspective for visual cueing.

comment *135* comment by:*FCAA*

On page 1-A1-14 paragraph f.1 ("Horizon, and attitude shall correlate to the simulated attitude indicator") there should be a tickmark for FNPT II also.

This is because of AMC STD 3A.030 paragraph m.1 that presents a requirement for visual system of FNPT II: Accurate portrayal of environment relating to FNPT attitudes.

response *Noted*

Please see on page 1-A1-14 paragraph b.3:

The visual system...shall be capable of meeting the standards laid down in Part 2 and 3 (Validation, Functions and Subjective Tests - see AMC No.1 to CS-FSTD (A).300).

JAR-FSTD A and CS-FSTD(A) have in their '**Table of Functions and Subjective Tests'** a tick mark for FNPT II indicating that the following is required:

Accurate portrayal of environment relating to flight simulator attitudes.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 1 - Appendices - Appendix 1 to CS FSTD(A).300 Flight Simulation Training Device Standards - 4. Sound System p. 26-27

comment | *10* comment by: *Marduc Aeronautical Consults*

5. general FSTD

a. A suitable ventilation system with filtered air should be available.
b. A suitable temperature control system should be in place.
c. A suitable air recirculation system shoud be in place.
d. A suitable reading light for the instructors and obsevers seats shoud be in place.
e. A suitable air quality/desinfection system should be inplace.
f. A suitable storage place for all the required applicable aircraft manuals and documents (AFM, MMEL and sim ops manuals)
g. There should be suitable sound reduction insulation in place to block outside noises.

response | *Noted*

resulting text | Thank you for your proposal. Partially it is already considered by FSTD manufacturers. The introduction of a general requirement for FSTD according to your proposal is not within the scope of this NPA.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart B: Terminology - AMC to CS FSTD(A).200 Terminology and abbreviations p. 29

comment | *155* comment by: *CAE*

Abbreviations
CS, EASA, and others not on the list
Add CS, EASA and other relevant abbreviation from EASA terminology

response | *Noted*

CS is mentioned and explained in NPA 2008-22a (Explanatory Note and Appendices) on page 14 and on the first page of each CS saying:

Certification Specifications for ... Flight Simulation Training Devices
CS-FSTD (..)

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart B: Terminology - AMC to CS FSTD(A).200 Terminology and abbreviations - 1 Terminology p. 29-33

comment | *136* comment by: *FCAA*

AMC to CSFSTD(A).200 does not define the word "snapshot" that is widely used in the document.

response | *Noted*

"Snapshot" is defined in CS-FSTD (A) on page 2-B-5 and in CS-FSTD (H) on page 2-B-4 in the chapter 'Terminology'

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart B: Terminology - AMC to CS FSTD(A).200 Terminology and abbreviations - 2 Abbreviations p. 34-37

comment | *16* comment by: *UK CAA*

Page: 2-B-9

Paragraph No: BOOK 2 SUBPART B: AMC to CS-FSTD(A). 200, 2 – Abbreviations

Comment:
The definitions of 1^{st} segment references JAR 25 and the definitions of 2^{nd} and 3^{rd} segment reference PART 25. There appears to be inconsistencies in the referencing of the performance standards. Clarification is required as to the usage of the correction references.

Justification:
Correct referencing and, hence, understanding of the all terms used in CS-FSTD(A) is essential to ensure that data is collected and FSTD's are designed and manufactured in accordance with correct definitions and terminology.

Proposed Text (if applicable):
Ensure that the correct performance standard is referenced in the definitions of 1^{st}, 2^{nd} and 3^{rd} segments. It is assumed that Part 25 is the relevant standard.

response | *Partially accepted*

The correct reference is CS-25. The text will be corrected accordingly.

comment | *63* comment by: *Thales Training & Simulation*

1st Segment - The reference to '(JAR 25)' should be replaced by '(Part 25') to make the definition of 1st Segment consistent with the definitions for 2nd Segment and 3rd Segment.

response | *Partially accepted*

See response to comment 16

comment | *118* comment by: *Boeing*

Page: 2-b-7
Paragraph: [Abbreviation and definition of "IOS"]

EDITORIAL COMMENT: The abbreviation and definition of "IOS" are incorrectly on the same line as the definition of "in." "IOS" and its definition should be on a separate line below "in."

JUSTIFICATION: Corrects an apparent typographical error.

response | *Accepted*

The definition of "IOS" has been moved to a separate line.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 1 to CS FSTD(A).300 Qualification basis - 1 Introduction p. 38-42

comment | *37* comment by:*Alteon*

We did not found any specific requirement which defines the amount of manual testing to be included within a recurrent QTG.

However, reference: AMC No.1 to CS-FSTD(A).300 1.6.2.i.(vi) defines manual test procedures as part of the QTG,

and, reference: Appendix 6 to AMC No.1 to CS-FSTD(A).300 Recurrent Evaluations, para 2.4 states
'The FSTD should still retain the capability to over-plot both automatic and manual validation test results with reference data'

We recommend to further define the amount of QTG to be run between recurrent evaluations of a device.

response | *Noted*

Thank you for your recommendation.
The amount of QTG tests (100%) to be run between recurrent evaluations is determined in OR.ATO.305(a).
There is no requirement to run the QTGs manually between recurrent evaluations however if there is no auto test the QTG has to be run manually (CS-FSTD(A) Section 2.1.3)

comment | *46* comment by:*ECA- European Cockpit Association*

Change paragraph 1.5.1 as follows:
1.5.1 The FSTD should be assessed in those areas that are essential to completing the flight crewmember training, testing and checking process. This includes the FSTDs' longitudinal and lateraldirectional responses; performance in takeoff, climb, cruise, descent, approach, landing; specific operations; control checks;flight deck, flight engineer, and instructor station functions checks; and certain additional requirements depending on the complexity or Qualification Level of the FSTD. The motion and visual systems (~~**where applicable**~~) will be evaluated to ensure their proper operation. Tolerances listed for parameters in the validation tests (Paragraph 2) of this AMC are the maximum acceptable for FSTD qualification and should not be confused with FSTD design tolerances.

Justification:
Delete "where applicable". Whenever installed the systems need to be evaluated, when not installed nobody would try to do so anyhow.

response | *Not accepted*

The expression is just saying, that motion systems or visual systems are not required for <u>all</u> FSTD.

comment | *47* comment by:*ECA- European Cockpit Association*

Comment on paragraph 1.5.4.:
These paragraphs are very unspecific and partially in contradiction with the

	AMCs. In general the term "approved data" is not clear enough and should be thoroughly defined. The JAA wording for the definition of approved data would be appriopriate.
response	*Noted* Approved data in the case of FFS or FTD could mean aircraft and systems data which have been part of the aircraft certification. (The 'approval' of simulator data under OSD (Part-21) is still up for discussion between EASA and stakeholders) or in case of FNPT and BITD approved data are a set of data, derived from a specific aeroplane or a class of aeroplanes, which are accepted by the Authority for the initial qualification testing, demonstrating correct trend and magnitude.

comment	*48* comment by:*ECA- European Cockpit Association* Comment on paragraph 2.2.2: See comment 47. In general the term approved data is not clear enough and should be thoroughly defined. The JAA wording for the definition of this concept would be appropriate.
response	*Noted* See response to comment 47 above.

comment	*49* comment by:*ECA- European Cockpit Association* Comment on paragraph 2.2.2.1: add a sentence after last paragraph: 2.2.2.1 [...] If a flight condition or operating condition is shown which does not apply to the qualification level sought, it should be disregarded. FSTD results should be labelled using the tolerances and units specified **but do not induce negative training**.
response	*Not accepted* Paragraph 2.2.2.1 refers to FSTD validation tests. If an additional validation test has been added (for instance as a part of the flight envelope) which is not required for the qualification level sought, it will not be considered. Validation tests just represent a kind of spot check of the data used to simulate the aeroplane/helicopter or class of aeroplanes/helicopters. So the (additional) validation test itself could not induce negative training.

comment	*50* comment by:*ECA- European Cockpit Association* Comment on paragraph 2.2.2.3: Either specify for which FSTDs this applies (as before Level A) or delete the paragraph. Justification: The way this is written right now, CT&M could easily show up for high level devices as well and therefore dillute the standards.
response	*Not accepted* The columns in the 'Table of FSTD Validation Tests' clearly indicate for which devices CT&M is acceptable. A mix-up for instance with high level devices is excluded.

comment	*77* comment by: *Thales Training & Simulation* **Para 1.6.1. i. vi** The wording implies that the manual test procedure cannot be referred to during the running of the manual test as the manual test procedure is part of the QTG document. This is illogical, you have to read the procedure to be able to use it. The wording also implies that it is acceptable to alter the cockpit instrumentation to assist the pilot in flying the test manually. This will result in the device being used in an artificial manner which is incorrect.
response	*Noted* The text is unchanged since JAR-STD. It is obvious that the test procedure should be known by the pilot. Otherwise he/she does not know what to do. Parts of the instrumentation, not necessarily needed for the specific test, may be used to support the pilot for instance doing the correct input at a certain time to follow manually as close as possible to the flight test (e.g. using DME to display the value for the elevator). That will replace aural instructions given by another person reading the procedure. The objective of the test is to see the reaction of the FSTD on inputs like in a flight test without using the automatic test.

comment	*100* comment by: *ALSIM Simulateurs* Proposed text: 1.5.4 For FNPTs and BITDs generic Validation Data~~data packages~~ can be used. In this case, for an initial evaluation, only Correct Trend and Magnitude (CT&M) can be used. The tolerances listed in this AMC are applicable for recurrent evaluations and should be applied to ensure the device remains at the standard initially qualified. For initial qualification testing of FNPTs and BITDs, Validation Data will be used. They may be derived from a specific aeroplane within the class of aeroplane the FNPT or BITD is representing or they may be based on information from several aeroplanes within the class. ~~With the concurrence of the Authority,~~ it may be in the form of a manufacturer's previously approved set of ~~Validation~~ Data for the applicable FNPT or BITD. Once the set of data for ~~a specific~~an applicable FNPT or BITD has already been accepted and approved by ~~the Authority~~a competent Authority, it will become the Validation Data that will be used as reference ~~for subsequent recurrent evaluations with the application of the stated tolerances~~for any new initial evaluation of similar applicable FNPT or BITD without further technical requirements. For a specific FNPT or BITD, the approved Master QTG resulting of an initial evaluation procedure becomes the Data that will be used as reference for subsequent recurrent evaluations with the application of the stated tolerances. Consequently, the initial set of data is not discussed any further during subsequent evaluations. Comment: **Generic data packages:** the term of "data packages" may be confusing with the second paragraph stating what is required in terms of validation data.

With the concurrence of the Authority: it means that the set of Data could be subject to subjective interpretation from an Authority to another. As a result, a same set of Data could be approved by an EASA member state and not by another.
This is in contradiction with the basis of the EASA on common rules in the field of civil aviation (refer to the regulation EC 216/2008 establishing a European Aviation Safety Agency) stating that:

"[The objective is] *to promote cost-efficiency in the regulatory and certification processes and to avoid duplication at national and European level*" **(Chapter I, article 2)**

"*Member States shall, without further technical requirements or evaluation, recognise certificates issued in accordance with this Regulation*" **(Chapter II, article 11)**

Consequently, a mutual recognition system in the Validation Data field should be possible: when a set of Data for an applicable FNPT or BITD has already been approved by a competent Authority, the same set of data should be automatically approved by another member state Authority for an initial qualification of similar applicable device *without further technical requirements or evaluation*.

The "*Master QTG*" terminology instead of "*Validation data*" should be used for recurrent evaluations in order to avoid a misunderstanding. Please report to the "MQTG" definition in CS-FSTD A, book 2, subpart B, page 2-B-3: "*The competent Authority approved QTG which incorporates the results of tests witnessed by the Authority. The MQTG serves as the reference for future evaluation*".
This is particularly true for the FNPT and BITD where, unlike the Full Flight Simulators, the reference Data used for the initial Qualification is not necessary a Datapackage. It implies in this case that only the MQTG can become the reference Data during the life of the device and in particular at each recurrent regulatory inspection.

response *Noted*

The text will be partly changed as follows:

For FNPTs and BITDs generic data packages can be used; for an initial evaluation only Correct Trend and Magnitude (CT&M) should be used.

The changes you are proposing in the second paragraph of your comment are referring to a mutual recognition of Validation Data for a "similar" FNPT or BITD. Although these proposals are valid they are out of the scope of this NPA.

comment *101* comment by:*ALSIM Simulateurs*

Proposed text:

1.5.4 (...)

The substantiation of the set of data used to build the Validation Data should be in the form of an engineering report and shall show that the proposed Validation Data are representative of the aeroplane or the class of aeroplane modelled.
This report may include flight test data, manufacturer's design data,

	information from the Aeroplane Flight Manual (AFM) and Maintenance Manuals, results of approved or commonly accepted simulations or predictive models, recognized theoretical results, information from the public domain, subjective assessment of qualified pilot, or other sources as deemed necessary by the FSTD manufacturer to substantiate the proposed model. <u>Comment:</u> An important remark was supposed to be validated during the NPA11 process (refer to the "CRD document to NPA11", page 65, remark n°183). After checking, it appears that this validated remark is not reported neither in the JAR FSTD-A regulation nor in the current NPA22. Our comment was the following and it is still valid: according to the JAA letter regarding the "FNPT Validation Data Requirements" located at http://www.jaa.nl/operations/secured/fstd/fnpt_validation.html : *« An acceptable mean to substantiate the objective Handling Qualities tests would be to subjectively check the FNPT device with a qualified pilot approved by the Authority, and determine whether or not the FNPT device is relevant of the aircraft or class of aircraft simulated. Hence subjective assessment from both the operator and the manufacturer could be accepted as validation data for the Handling Qualities tests »*.
response	*Partially accepted* Your proposal has already been accepted during NPA-STD 11 The text will be amended by: *..., subjective assessment of <u>a</u> qualified pilot,....*

comment	*102* comment by:*ALSIM Simulateurs* <u>Proposed text:</u> 1.6.2 xi. Source data. For FFS and FTD only, copy of the aeroplane source data, clearly marked with the document, page number, issuing authority, and the test number and title as specified in subpara (i) above. Computer generated displays of flight test data overplotted with FSTD data are insufficient on their own for this requirement. For FNPT and BITD, copy of the source data included in the Engineering report. <u>Comment:</u> It would be very useful to have for each test an EASA list of the parameters under scrutiny. The reference to the RAeS Handbook Vol I & II could be used but is not sufficient because this document has been designed only for FFS and does not take into account the FNPT and BITD particularity. For FNPT and BITD, flight test data are not always used and so are not always available. Therefore, aeroplane source data are one of the possible source data but not the only one. Consequently, it can't be provided for each validation test.
response	*Partially accepted* Source data. Copy of the aeroplane source data (FFS/FTD) or Validation Data

	(FNPT/BITD) , clearly marked with the document, page number, issuing authority, and the test number and title as specified in subpara (i) above. Computer generated displays of flight test data (FFS/FTD) or Validation Data (FNPT/BITD) overplotted with FSTD data are insufficient on their own for this requirement.

comment	*148* comment by:*CAE* AMC No. 1 to CS-FSTD(A).300 No reference to eQTG (Electronic QTG) Suggest addressing eQTG guideline as per FAA 14 CFR Part 60 and with reference to ARINC 436
response	*Accepted* The following additional Para 1.6.3 on page 2-C-4 will be added: *1.6.3 An electronic qualification test guide (eQTG) is an acceptable media for presentation of a QTG. The format of the eQTG must be acceptable to a competent authority.*

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 1 to CS FSTD(A).300 Qualification basis - 2 FSTD Validation Tests - 2.1 General p. 42-44

comment	*103* comment by:*ALSIM Simulateurs* <u>Proposed text:</u> 2.1.5 The table of FSTD Validation Tests in this AMC indicates the required tests. Unless noted otherwise, FSTD tests should represent aeroplane performance and handling qualities at operating weights and, for FFS and FTD, at centres of gravity (cg) positions typical of normal operation. <u>Comment:</u> Traditionally, Operators of FNPT and BITD do not use different centers of gravity because the goal of an FNPT is to train to navigational procedures where the handling qualities at different centers of gravity are not required.
response	*Not accepted* The Agency fully supports your comment, but we don't see a need to change the text because the paragraph clearly states that, unless noted otherwise, weight(s) and cg(s) should be typical of normal operation.

comment	*119* comment by:*Boeing* *Page: 2-c-5* *Paragraph: 2.1.2* **<u>EDITORIAL COMMENT:</u>** The reference to "ACJ" is incorrect. This text should instead read: *"Certain tests in this ~~ACJ~~**<u>AMC</u>** are not . . . ".* **<u>JUSTIFICATION</u>:** Corrects an apparent typographical error.
response	*Accepted* Yes, this is a typographical error and will be corrected.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 1 to CS FSTD(A).300 Qualification basis - 2 FSTD Validation Tests - 2.2 Test requirements p. 44-45

comment | *76* comment by: *Thales Training & Simulation*

Para 2.2.2.1 Para 3 says "...minimum tolerance should be agreed with the authority..."

This refers to parameters that have a % tolerance where the test conditions are about zero. For such values around zero a minimum absolute tolerance to be agreed with the authority.

If such a condition were worthy of this type of statement, the tolerances affected should be identified and the CSFSTD(A) document updated to reflect the absolute tolerance required, for each case, rather than leaving it up to local interpretation.

response | *Noted*

Thank you for your recommendation.

The paragraph is taken from JAR-FSTD A and you will still find the same paragraph in the new ICAO doc. 9625, 3rd edition, Volume I, drafted by an International Working Group (IWG) after reviewing the existing technical criteria and expanding these accordingly.

Criteria like this will remain unchanged within this NPA. A change of the requirements according to your proposal by determination of absolute tolerances (and other technical changes) will become part of a new (rulemaking) task where different experts should be consulted and proposals should be made. This will probably done as well during a first revision of the ICAO doc. 9625, 3rd edition.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 1 to CS FSTD(A).300 Qualification basis - 2 FSTD Validation Tests - 2.3 Table of FSTD Validation Tests p. 46

comment | *2* comment by: *MVA*

table of validation tests: The first column of the FSTD Level shoud be named with „FFS", instead of FS.

response | *Accepted*

The first column of the FSTD level will be changed to "FFS"

comment | *36* comment by: *ECA- European Cockpit Association*

Comment on 2.3 Table of FTSD Validation Test:
In the main the NPA is a direct copy of the JAR_FSTD-A dated 0508. I am not an engineer, but if the system have been adhering to JAR requirements, then there should be no problem adapting the NPA. The first inspection principles seem reasonable, however, I have a slight reservation where in several areas, the statement “For FTD’s may be a snapshot test”. A snapshot may comply

	with the parameters demanded, however, it is a snapshot and not a qualitative long duration test and must be susceptible to performance drift.
response	*Not accepted* In most of the validation test cases (80%, trim tests and stability tests), where snapshot tests are possible, the statement in the requirement is: *'May be a series of snapshot tests'* or *'two consecutive* snapshots' to cover a longer duration of the test. Climb tests (all eng. and one eng. inop 2nd segm.) for FTD could be single snapshot tests. They are sufficient to demonstrate that the recorded ROC matches the aeroplane. For more justification see *'Aeroplane Flight Simulation Training Device Evaluation Handbook', Vol. I, Objective Testing, 4th edition, Oct 2009*.

comment	*38* comment by:*Mechtronix* Please read attached document for a list of the extra requirements now found in both JAR-FSTD A and CS-FSTD(A) that were not in the original JAR documents.
response	*Noted* See response to comment 39 below.

comment	*39* comment by:*Mechtronix* Attachment#4 Please see attached file for comment pertaining to the extra requirements now found in the Table of FSTD Validation Tests.
response	*Noted* JAA NPA-STD 11 and 12 resulted in the JAA-wide agreed and accepted documents JAR-FSTD A and H. These FSTD A and H documents are the basis for NPA 2008-22 (d,e), where structural changes have been made due to the Implementing Rules. It is outside the scope of this NPA to introduce technical changes when transferring from FSTD-A to CS-FSTD (A) (even if they are back to those as listed in the STD documents) . Technical changes will require a new rulemaking task including a new NPA. Since all Implementing Rules and CSs, including those for FSTDs, will be kept updated on a regular basis, proposed changes will be considered within future rulemaking tasks, e.g. like the alignment with the new ICAO doc. 9625, 3rd edition.

comment	*104* comment by:*ALSIM Simulateurs* Add a “Init.” column for FNPT (as for the BITD and FTD) containing CT&M For BITD, the column “Init.” should contain “CT&M” instead of sometimes some tick. Comment: In oder to be coherent with SUBPART C – AEROPLANE FLIGHT SIMULATION TRAINING DEVICES

AMC No. 1 to CSFSTD(A).300 Qualification basis

"1.5.4 *For FNPTs and BITDs generic data packages can be used. In this case, for an initial evaluation only Correct Trend and Magnitude (CT&M) can be used. The tolerances listed in this AMC are applicable for recurrent evaluations and should be applied to ensure the device remains at the standard initially qualified*".
P2-C-2
"*For the initial qualification of FNPTs and BITDs no tolerances are to be applied and the use of CT&M is to be assumed throughout.*"
p2-C-8 (§2-2-2-3)

response *Accepted*

The Agency follows your proposal by adding the following to the comment column of the Validation Test Table (first line):

For FNPT and BITD CT&M should be used for initial evaluations. The tolerances should be applied for recurrent evaluations (see section 1.5.4).

comment *144* comment by: *Airbus S.A.S.*

This is a general comment about the aim of QTG testing. EASA should clarify if the objective of the QTG testing is to evaluate the situation that the pilot may meet in flight or to check the aerodynamic conditions, whether or not a pilot is likely to experience them in flight.

Two examples of this question are the VMU and the Rudder response tests.

- The VMU (Minimum Unstick Speed) test (refer to Table 2.3, 1.b.(3)) reflects specific aircraft behaviour, required to determine real aircraft performances and tune engineering design models. However real VMU flight tests carried out during aircraft certification can only be matched surfaces driven on Airbus training simulators. This is due to flight controls that will limit the pilot action, so that this speed is never reached in commercial flight (these limitations can specifically be removed during these VMU tests on the flight test airplane only).
As a consequence there are two possible alternatives:

Either to provide in the Data Package the real VMU test and the simulator manufacturer will only be able to provide a surface driven match of Airbus reference data.

Or to provide a test that will only be similar to the VMU test (high attitude take-off for example), but that could be matched end-to-end.

- The Rudder response (refer to Table 2.3, 2.d.(6)) test requires to be run with stability augmentation ON and OFF. To switch this system OFF on Airbus aircraft requires the use of a dedicated flight test bench, which is not available on the STD. We thus suggest that this test is performed with stability augmentation OFF only if accessible directly from the cockpit, and thus does not apply to Airbus aircraft.

To cover this issue, Airbus suggests adding to the test requirement a note such as 'Test with stability augmentation ON and OFF if the function is accessible directly to the pilot'.

response	*Noted* The purpose of the QTG is to validate the performance and handling qualities of the simulated A/C. Those specific test requirements should be mentioned in the RQTG (Recommended Qualification Test Guide - Airbus).

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 1 to CS FSTD(A).300 Qualification basis - 2 FSTD Validation Tests - 2.3 Table of FSTD Validation Tests - 1 Performance p. 46

comment	*149* comment by:*CAE* **2-C-9** a.(2) Rate of Turn. "+- 10% or" appears in Tests section and should not because it is already in Tolerance section. ."+- 10% or" should be removed from Tests section
response	*Accepted* "Turn Rate. +- 10% or" will be removed from the test description column

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 1 to CS FSTD(A).300 Qualification basis - 2 FSTD Validation Tests - 2.3 Table of FSTD Validation Tests - 1 Performance - a. Taxy p. 46

comment	*78* comment by:*Thales Training & Simulation* Test 1.a.(2) Rate of Turn vs. Nosewheel Steering There is a spurious "Turn Rate. ± 10% or" in the TESTS field that should be removed.
response	*Accepted* This part will be removed from the test description column (see response to comment 149)

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 1 to CS FSTD(A).300 Qualification basis - 2 FSTD Validation Tests - 2.3 Table of FSTD Validation Tests - 1 Performance - b. Take-off p. 47-52

comment	*1* comment by:*CRB* The tolerance for test 1b1 is currently confusing due to extra line feeds making it look as though text is missing: The extra line between "± 5% or" and "± 61 m (200 ft)" should be removed and preferrably the "± 5% or" and "± 61 m (200 ft)" text should not have a line feed between them so that the text flows. It would then read:

	± 5% or ± 1.5 s time and ± 5% or ± 61 m (200 ft) distance
response	*Accepted* Extra line feed will be deleted to avoid confusion.

comment	*51* comment by:*ECA- European Cockpit Association* Comment on b.1: Either delete or explain Tolerance +/- 1.5 s. Justification: What scientific or test data leads to this new value? As it is a change to JAA, it needs to be explained. All changes to JARs need to be substantiated by a RIA.
response	*Not accepted* 1. Reviewing the comments to NPA 11 of authorities and stakeholders around the validation test requirements for T/O performance there was no comment addressing this tolerance. 2. As the requirements for FTD are included into this test which had a tolerance of +/- 5% time or **+/- 1 s** the tolerance of +/- 1.5 s in CS-FSTD(A) is now an alleviation and standards are not tightened. 3. If it reads "or" and unless otherwise stated the greater tolerance can be applied.

comment	*79* comment by:*Thales Training & Simulation* Test 1.b.7 Rejected Take-off Tolerance stated twice. "± 76 m (250 ft) ±76m (250 ft)". Remove one instance of "± 76 m (250 ft)" Clarify that only one rejected takeoff test is required: with autobrakes or manual.
response	*Partially accepted* The second tolerance "± 76 m (250 ft)" will be removed. The comment is correct and will not be changed because it is clear that only one test is required: • if autobrakes are available they should be used in the mode 'high' or • if only manual braking is possible, maximum manual braking should be applied.

comment	*150* comment by:*CAE* **2-C-14** b.(7) Rejected Take-off ."+- 76m (250 ft)" appears 2 times in Tolerances section. ."+- 76m (250 ft)" should appear only 1 time in Tolerances section.
response	*Accepted*

See comment to response 79 above.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 1 to CS FSTD(A).300 Qualification basis - 2 FSTD Validation Tests - 2.3 Table of FSTD Validation Tests - 1 Performance - c. Climb p. 52-53

comment

19 comment by: *UK CAA*

Page: 2-C-16

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD(A). 300, Table 2.3
Paragraph 1.c.(2)

Comment:
The standards required for FNPT have been changed from those originally defined in JAR-STD 3A. The tolerances specified for the rate of climb state 'but not less than AFM values'. FNPT devices have flight models that are generic by design and AFM data cannot be used as an absolute tolerance for these. (This is an anomaly introduced between JAR-STD 3A and JAR-FSTD(A) when JAR-FSTD(A) was published).

Justification:
JAR-FSTD(A) defines a standard that has been accepted by industry and regulators and is supposed to replicate the requirements of JAR-STD 1A, 2A, 3A and 4A. There is an anomaly between FSTD(A) and JAR-STD 3A that needs to be addressed in these final rules. JAR-STD forms the basis for JAR-FSTD, which in turn forms the basis for these IRs and CS. The requirements of JAR-STD are known and accepted standards. The text as proposed would tighten the standards unnecessarily in a manner that could not practically be complied with in most cases.

Proposed Text (if applicable):
(Proposed amendments *italicised and underlined*)

Modify COMMENTS section of Table 2.3, paragraph 1.c.(2) to read:

'*AFM values applicable to FS and FTD only.'*

(These requirements will then be consistent with the accepted standards of JAR-STD)

response

Partially accepted

The text in the tolerance column will be changed to:
...'*but not less than applicable AFM values*'
The requirement 'not less than AFM values' was part of STD 1A and is for instance not applicable to generic flight models representing a class of aeroplanes.

comment

80 comment by: *Thales Training & Simulation*

Test 1.c.(2) One Engine Inoperative Second Segment Climb

FTD **Init** Column should read CT&M and not T&M

response	*Accepted* Will be corrected to CT&M.

comment	*151* comment by:*CAE* **2-C-16** c.(2) One Engine Inoperative The "C" in "CT&M" is missing under the FTD Init column. The "C" in "CT&M" should be added.
response	*Accepted* See response to comment 80 above

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 1 to CS FSTD(A).300 Qualification basis - 2 FSTD Validation Tests - 2.3 Table of FSTD Validation Tests - 1 Performance - e. Stopping p. 55-56

comment	*52* comment by:*ECA- European Cockpit Association* Comment on e.1 and e.2: Either delete or explain Tolerance +/- 1.5 s. Justification: What scientific or test data leads to this new value? As it is a change to JAA, it needs to be explained. All changes to JARs need to be substantiated by a RIA.
response	*Noted* See response to your comment 51 above (validation test 1.b.1).

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 1 to CS FSTD(A).300 Qualification basis - 2 FSTD Validation Tests - 2.3 Table of FSTD Validation Tests - 1 Performance - f. Engines p. 56

comment	*20* comment by:*UK CAA* **Page: 2-C-19** **Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD(A). 300, Table 2.3** **Paragraph 1.f.(1) and 1.f.(2)** **Comment:** The standards required for FNPT have been changed from those originally defined in JAR-STD 3A. Paragraphs 1.f.(1) and 1.f.(2) now state in the COMMENTS field that CT&M is acceptable for FNPT as opposed to the absolute tolerance in JAR-STD 3A. (This is an anomaly introduced between JAR-STD 3A and JAR-FSTD(A) when JAR-FSTD(A) was published. **Justification:** JAR-FSTD(A) defines a standard that has been accepted by industry and regulators and is supposed to replicate the requirements of JAR-STD 1A, 2A,

	3A and 4A. There is an anomaly between FSTD(A) and JAR-STD 3A that needs to be addressed in these final rules. JAR-STD forms the basis for JAR FSTD, which in turn forms the basis for these IRs and CS. The requirements of JAR-STD are known and accepted standards. The text as proposed would alleviate the specified requirement and would result in an inconsistent compliance standard (CT&M as opposed to applying a specified tolerance). **Proposed Text (if applicable):** (Proposed amendments *italicised and underlined*) Modify COMMENTS section of Table 2.3, paragraphs 1.f.(1) and 1.f.(2) to remove *FNPT* from the text 'FTD, FNPT and BITD only:' (These requirements will then be consistent with accepted standards of JAR-STD)
response	*Not accepted* During NPA 11 the comment has been made to delete "for *piston engines*" because it remains unclear what tolerance has to be met for FNPT MCC devices with e.g. turboprop or FNPT based on Diesel powered aircraft. The commentator should take into account the statement in AMC No. 1 to CS-FSTD(A).300 paragraph 2.2.2.3 which he will find in JAR-FSTD A as well saying that for the initial qualification of FNPTs use of CT&M is to be assumed throughout. (see as well response to comment 29 below)

comment	*29* comment by: *UK CAA* **Page: 2-C-19** **Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD(A). 300, Table 2.3** **Paragraph 1.f.(1) and 1.f.(2)** **Comment:** The standards required for FTD have been changed from those originally defined in JAR-STD 2A. Paragraphs 1.f.(1) and 1.f.(2) as applicable to FTD states that CT&M is acceptable as a tolerance as opposed to the exact numerical tolerance with CT&M only being acceptable for piston engines as defined in JAR-STD 2A. (This is an anomaly introduced between JAR-STD 2A and JAR-FSTD(A) when JAR-FSTD(A) was published). **Justification:** JAR-FSTD(A) defines a standard that has been accepted by industry and regulators and is supposed to replicate the requirements of JAR-STD 1A, 2A, 3A and 4A. There is an anomaly between FSTD(A) and JAR-STD 2A that needs to be addressed in these final rules. JAR-STD forms the basis for JAR FSTD, which in turn forms the basis for these IRs and CS. The requirements of JAR-STD are known and accepted standards. The text as proposed would alleviate the specified requirement and would result in an inconsistent compliance standard (CT&M as opposed to applying a specified tolerance). **Proposed Text (if applicable):** (Proposed amendments *italicised and underlined*) Modify COMMENTS section of Table 2.3, paragraphs 1.f.(1) and 1.f.(2) to read '*For FTD: CT&M acceptable for piston engines*' .

	(These requirements will then be consistent with accepted standards of JAR-STD)
response	*Not accepted* See response to comment 20 above.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 1 to CS FSTD(A).300 Qualification basis - 2 FSTD Validation Tests - 2.3 Table of FSTD Validation Tests - 2 Handling qualities - a. Static control checks p. 57-59

comment	*53* comment by: *ECA- European Cockpit Association* Comment on a.7: Either delete or explain Tolerance +/-0.5 deg/s. Justification: What scientific or test data leads to this new value? As it is a change to JAA, it needs to be explained.
response	*Noted* During the NPA 11 process a recommendation has been made by an FSTD manufacturer to add an absolute tolerance with the following justification: when the rate becomes zero, it leads to a 0 deg/s tolerance. It was proposed to add a tolerance of +/- 0.5 deg/s. The NPA 11 working group and the JAA Ops Director accepted to add a +/-0.5 deg/s tolerance.

comment	*81* comment by: *Thales Training & Simulation* Test 2.a.(2) Roll Controller Position vs. Force and Surface Position Calibration Table format incorrect. In the Tests field, The text "Wheel Posn. vs Force only" should be separated from the rest of the text by a horizontal line, so that it shows applicability with the second set of tolerance and Flight conditions. (See correct implementation in 2.a.(1)).
response	*Accepted* Table format will be corrected

comment	*82* comment by: *Thales Training & Simulation* Test 2.a.(3) Rudder Pedal Position vs. Force and Surface Position Calibration. Table format incorrect. In the Tests field, The text "Pedal Posn. vs Force only" should be separated from the rest of the text by a horizontal line, so that it shows applicability with the second set of tolerance and Flight conditions. (See correct implementation in 2.a.(1)).
response	*Accepted* Table form will be corrected

comment	83	comment by: *Thales Training & Simulation*
	Test 2.c.(6) Pitch Trim Indicator vs. Surface Position Calibration Formatting problem. The way that the page break has occurred has confused matters. The content on Page 2-C-21 and 2-C-22 are the same test with the heading "Pitch Trim Indicator vs. Surface Position Calibration". It appears that the test title has been broken into two components, one which aligned with the FFS tolerances reading "Pitch Trim Indicator vs. Surface" and one tied win with the FTD, FNPT and BITD tolerances reading "Position Calibration". This formatting needs to be corrected to restore the correct title for this test and to clear up any confusion that may result from the existing format.	
response	*Noted* This refers to 2.a.(6). Although it is obvious by the numbering system (test (6)) and by the name/description of the test, that it is the same (<u>one</u>) test, a reformatting will be attempted. Formatting problems like this may occur due to page breaks which are sometimes necessary.	

comment	105	comment by: *ALSIM Simulateurs*
	2 Handling qualities a. Static control check Add the following note: Note: for FNPT and BITD, an acceptable mean of compliance would be to provide a rational about the calibration procedure. This procedure may include initial measurements at manufacturer facilities. A subjective assessment and/or computed control checks may be performed during subsequent recurrent evaluations. <u>Comment:</u> Such external devices to record forces directly at the control is out of the range of FNPT and BITD in terms of cost. Moreover, it is believed that providing a rational enables to show that QTG automatic testing tool gives sufficient elements to avoid the use external measurement system. According to the JAA letter regarding the "FNPT Validation Data Requirements" located at http://www.jaa.nl/operations/secured/fstd/fnpt_validation.html : "*An acceptable mean to substantiate the objective Handling Qualities tests would be to subjectively check the FNPT device with a qualified pilot approved by the Authority, and determine whether or not the FNPT device is relevant of the aircraft or class of aircraft simulated. Hence subjective assessment from both the operator and the manufacturer could be accepted as validation data for the Handling Qualities tests*".	
response	*Not accepted* The comment in the comment row is a general one. Check marks are set correctly in the relevant sections (for FFS, FTD,FNPT,BITD). The comment just says: ....permanent installations <u>could</u> be used.	

comment	108 comment by: *ALSIM Simulateurs*
	Split the test "Pitch Trim Indicator vs. Surface Position Calibration": -First line: unchanged -Second line: for FNPTs and BITDs, Pitch Trim Indicator vs Computed. In the column tolerances: 5% Comment: The control surface are usually not computed in the FNPTs and BITDs range of device. Nevertheless, it is possible to record a computed value which is the equivalent in percentage of the maximum displacement trim wheel value. This alternative mean of compliance is currently used and approved during FNPT and BITD qualification processes.
response	*Noted* Percentage could be transferred to elevator units and vv. The proposed change could be considered as a future rulemaking task.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 1 to CS FSTD(A).300 Qualification basis - 2 FSTD Validation Tests - 2.3 Table of FSTD Validation Tests - 2 Handling qualities - b. Dynamic control checks p. 60-63

comment	140 comment by: *AIRBUS*
	It is proposed to change the tolerance applied on overshoot amplitude for dynamic control checks, tests b(1), b(2), b(3). The new tolerance should be: "± 10% amplitude of first overshoot **or ± 5% amplitude of initial displacement** applied to all overshoots greater than 5% of initial displacement (Ad)." The current tolerance (10% amplitude of first overshoot) is very often impossible to match since it is well below the hardware tolerance of the control loading device. Example: for an initial displacement of 10 degrees (yaw pedal dynamic), all overshoots greater than 0.5 deg should be taken into account. Should the first overshoot have an amplitude close to 0.5 degree, the tolerance applied to all overshoots will be 0.05 degree! Up to now, the operator usually added a constant value to the tolerance (0.5 degree) and it was at the discretion of the authority to accept it or not. This proposition is made to adopt officially this tolerance.
response	*Noted* NPA 2008-22d (CS-FSTD A) partly reflects the content of JAR-FSTD A within a new structure as developed by the Agency. The transition from the technical part of JAR-FSTD to CS-FSTD does not include a review of the technical criteria. These criteria will remain unchanged until there will be a new, future rulemaking task as foreseen by the Agency to assure alignment with the new ICAO doc. 9625, 3rd edition, Volume I and II (Vol. II not yet available). **(STD -> FSTD)**

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 1 to CS FSTD(A).300 Qualification basis - 2 FSTD Validation Tests - 2.3 Table of FSTD Validation Tests - 2 Handling qualities - c. Longitudinal p. 64-68

comment *21* comment by: *UK CAA*

Page: 2-C-27

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD(A). 300, Table 2.3
Paragraph 2.c.(1)

Comment:
The standards required for FTD and FNPT have been changed from those originally defined in JAR-STD 3A. Paragraph 2.c.(1), Tests 'Power Change Dynamics' as applicable to FNPT and 'Power Change Force' as applicable to FNPT and BITD now only allows the tests to be performed in the Approach configuration. JAR-STD 3A and 4A allowed for the tests to be performed in either the Cruise or Approach configurations. (This is an anomaly introduced between JAR-STD 3A/4A and JAR-FSTD(A) when JAR-FSTD(A) was published).

Justification:
JAR-FSTD(A) defines a standard that has been accepted by industry and regulators and is supposed to replicate the requirements of JAR-STD 1A, 2A, 3A and 4A. There is an anomaly between FSTD(A) and JAR-STD 3A that needs to be addressed in these final rules. JAR-STD forms the basis for JAR FSTD, which in turn forms the basis for these IRs and CS. The text as proposed would change the standards and increase the associated regulatory burden due to imposition of a reduction in possible test flight conditions for no added safety benefit.

Proposed Text (if applicable):
(Proposed amendments *italicised and underlined*)

Modify FLIGHT CONDITIONS and FSTD LEVEL sections of Table 2.3, paragraph 2.c.(1), Test 'Power Change Dynamics' to add *Cruise* and make applicable to FNPT (II & MCC).

Modify FLIGHT CONDITIONS and FSTD LEVEL sections of Table 2.3, paragraph 2.c.(1), Test 'Power Change Force' to add *Cruise* and make applicable to FNPT (I, II & MCC) and BITD (Init, Rec).

(These requirements will then be consistent with accepted standards of JAR-STD)

response *Not accepted*

As with the various STD documents:
FFS: Approach
FTD: Approach to Go Around
FNPT, BITD: Approach or Cruise
the NPA 11 Working Group has omitted the 'Cruise'-case to simplify the diversity of tests for the different FSTDs and to harmonise the former STD requirements which have been developed by different working groups in the past (OPS/FCL). To provide an 'Approach' test instead of a 'Cruise' test is not an issue for devices to be developed in the future. Existing devices will be granted Grandfather Rights. If available data packages will be used for new

devices a new test case should be provided if necessary. Harmonisation and - if possible - simplification take priority over the replacement of a test (which is anyway generic and does not require a flight test).
The IWG came to the same conclusion when drafting the new ICAO doc. 9625, 3rd edition and carefully reviewing, comparing and harmonising the existing requirements.
There is no other comment from another authority or stakeholder regarding this issue.

comment | *22* | comment by: *UK CAA*

Page: 2-C-28

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD(A). 300, Table 2.3
Paragraph 2.c.(3)

Comment:
The standards required for FNPT have been changed from those originally defined in JAR-STD 3A. Paragraph 2.c.(3). The test as applicable to FNPT has a reduced pitch angle tolerance of 1.5deg, reduced from 2deg in JAR-STD 3A. (This is an anomaly introduced between JAR-STD 3A and JAR-FSTD(A) when JAR-FSTD(A) was published).

Justification:
JAR-FSTD(A) defines a standard that has been accepted by industry and regulators and is supposed to replicate the requirements of JAR-STD 1A, 2A, 3A and 4A. There is an anomaly between FSTD(A) and JAR-STD 3A that needs to be addressed in these final rules. JAR-STD forms the basis for JAR FSTD, which in turn forms the basis for these IRs and CS. The requirements of JAR-STD are known and accepted standards. The text as proposed would change the standards and increase the associated regulatory burden due to imposition of tighter tolerances unnecessarily for no added safety benefit.

Proposed Text (if applicable):
(Proposed amendments *italicised and underlined*)

Modify TOLERANCES section of Table 2.3, paragraph 2.c.(3) to add *'For FNPTs and BITDs, ±2° or ±20% pitch angle'*.

(These requirements will then be consistent with accepted standards of JAR-STD)

response | *Not accepted*

As with the following cases in the various STD documents:
FFS: +/- 1.5 deg or +/-20% pitch angle
FTD: +/- 1.5 deg or +/-20% pitch angle
FNPT II MCC: +/- 2.0 deg or +/-20% pitch angle
the NPA 11 Working Group has harmonised the different tolerances to simplify the former diversity for the different FSTDs which have been developed by different working groups in the past (OPS/FCL). The change of the tolerance for FNPT II MCC is not an issue for devices to be developed in the future. Existing devices will be granted Grandfather Rights. We strongly refer to AMC No. 1 to CS-FSTD(A).300 paragraph 2.2.2.3, last sentence. This means that the tolerance has to be applied to the recurrent QTG referring to the initial FNPT result (MQTG) - when the FNPT is compared to itself. As we learned from

FNPT manufacturers it is not an issue to meet this requirement as long as there has been no modification of the device in the meantime.

Harmonisation and - if possible - simplification take priority over the keeping of tolerance of former regulations as long as there is no additional burden put on the manufacturers and operators.

The IWG came to the same conclusion when drafting the new ICAO doc. 9625, 3rd edition and carefully reviewing, comparing and harmonising the existing requirements.

There is no other comment from another authority or stakeholder regarding this issue.

comment 23 comment by: *UK CAA*

Page: 2-C-29

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD(A). 300, Table 2.3
Paragraph 2.c.(6)

Comment:
The standards required for FNPT have been changed from those originally defined in JAR-STD 3A. Paragraph 2.c.(6) as applicable to FNPT now requires that the test is performed in the Cruise, Approach and Landing configurations as opposed to Cruise and Approach or Landing configurations required in JAR-STD 3A. (This is an anomaly introduced between JAR-STD 3A and JAR-FSTD(A) when JAR-FSTD(A) was published).

Justification:
JAR-FSTD(A) defines a standard that has been accepted by industry and regulators and is supposed to replicate the requirements of JAR-STD 1A, 2A, 3A and 4A. There is an anomaly between FSTD(A) and JAR-STD 3A that needs to be addressed in these final rules. JAR-STD forms the basis for JAR FSTD, which in turn forms the basis for these IRs and CS. The requirements of JAR-STD are known and accepted standards. The text as proposed gives rise to additional regulatory burden to undertake an added test for no added safety benefit.

Proposed Text (if applicable):
(Proposed amendments *italicised and underlined*)

Change the tabulated ticks (ü) in Book 2, page 2-C-29 to ensure the requirements are as follows:

Cruise is a requirement of FNPT II, MCC
Approach or Landing if appropriate is a requirement of FNPT II, MCC

(These requirements will then be consistent with accepted standards of JAR-STD)

response *Accepted*

The tick marks will be changed according to your proposal.

comment 24 comment by: *UK CAA*

Page: 2-C-30

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD(A). 300, Table 2.3 Paragraph 2.c.(7)

Comment:
The standards required for FNPT have been changed from those originally defined in JAR-STD 3A. Paragraph 2.c.(7) as applicable to FNPT now explicitly requires that the test provides data for 2 speeds above and two speeds below trim speed as opposed an objective demonstration of Longitudinal Static Stability in a manner defined by the FNPT manufacturer and operator and accepted by the Authority as was allowed under JAR-STD 3A. (This is an anomaly introduced between JAR-STD 3A and JAR-FSTD(A) when JAR-FSTD(A) was published).

Justification:
JAR-FSTD(A) defines a standard that has been accepted by industry and regulators and is supposed to replicate the requirements of JAR-STD 1A, 2A, 3A and 4A. There is an anomaly between FSTD(A) and JAR-STD 3A that needs to be addressed in these final rules. JAR-STD forms the basis for JAR FSTD, which in turn forms the basis for these IRs and CS. The requirements of JAR-STD are known and accepted standards. The text as proposed would give rise to additional regulatory burden to tighten the specifications for the test for no added safety benefit.

Proposed Text (if applicable):
(Proposed amendments *italicised and underlined*)

Modify COMMENTS section of Table 2.3, paragraph 2.c.(7) to state *‘FS only:* Data for at least two speeds above and two speeds below trim speed.’

(These requirements will then be consistent with accepted standards of JAR-STD)

response *Not accepted*

Comments explaining how to perform this test were missing in STD 3A. To see which column force is needed to maintain different airspeeds (deviating from the trim speed) it is reasonable to have more than one specific airspeed to be maintained. STD 3A gives not even a guidance about the initial situation. The Agency considers this comment therefore as appropriate. With regard to the part of your comment saying "...that the test provides data for..." we refer again to AMC No. 1 to CS-FSTD(A).300 paragraph 2.2.2.3

The IWG came to the same conclusion when drafting the new ICAO doc. 9625, 3rd edition and carefully reviewing, comparing and harmonising the existing requirements. The IWG even extends the existing comment.

There is no other comment from another authority or stakeholder regarding this issue.

comment *25* comment by: *UK CAA*

Page: 2-C-31

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD(A). 300, Table 2.3

Paragraph 2.c.(10)

Comment:
The standards required for FNPT II have been changed from those originally defined in JAR-STD 3A. Paragraph 2.c.(10). The test as applicable to FNPT has a reduced pitch angle tolerance of 1.5deg, reduced from 2deg in JAR-STD 3A. (This is an anomaly introduced between JAR-STD 3A and JAR-FSTD(A) when JAR-FSTD(A) was published).

Justification:
JAR-FSTD(A) defines a standard that has been accepted by industry and regulators and is supposed to replicate the requirements of JAR-STD 1A, 2A, 3A and 4A. There is an anomaly between FSTD(A) and JAR-STD 3A that needs to be addressed in these final rules. JAR-STD forms the basis for JAR FSTD, which in turn forms the basis for these IRs and CS. The requirements of JAR-STD are known and accepted standards The text as proposed would change the standards and increase the associated regulatory burden due to imposition of tighter tolerances unnecessarily for no added safety benefit.

Proposed Text (if applicable):
(Proposed amendments *italicised and underlined*)

Modify TOLERANCES section of Table 2.3, paragraph 2.c.(10) to add *'For FNPTs, ±2° or ±20% pitch angle'*.

(These requirements will then be consistent with accepted standards of JAR-STD)

response *Not accepted*

See response to comment 22 above (analogue justification)

comment 84 comment by: *Thales Training & Simulation*

Test 2.c.(1) Power Change Dynamics

Applicability columns for Power Change Force for FNPT II and MCC should not have ticks, as the Power Change Force is applicable to FNPT 1 and BITD only (see comment column). Propose removal of offending ticks for FNPT II and MCC.

response *Not accepted*

According to JAR-STD 3A and 4A:
FNPT I: Power Change Force
FNPT II (MCC): Power Change Dynamics and Power Change Force
BITD: Power Change Force (or Power Change Dynamics)
The comment column is correct saying: for FNPT I and BITD the power change force test only is acceptable.

comment 85 comment by: *Thales Training & Simulation*

Test 2.c.(2) Flap Change Dynamics

Applicability columns for Flap Change Force for FNPT II and MCC should not have ticks, as the Flap Change Force is applicable to FNPT 1 and BITD only (see comment column). Propose removal of offending ticks for FNPT II and MCC.

response

Not accepted

According to JAR-STD 3A and 4A:
FNPT I: Flap Change Force
FNPT II (MCC): Flap Change Dynamics <u>and</u> Flap Change Force
BITD: Flap Change Force (<u>or</u> Flap Change Dynamics)
The comment column is correct saying: for FNPT I and BITD the flap change force test only is acceptable.

comment

86 comment by: *Thales Training & Simulation*

Test 2.c.(4) Gear Change Dynamics

Applicability columns for Gear Change Force for FNPT II and MCC should not have ticks, as the Gear Change Force is applicable to FNPT 1 and BITD only (see comment column). Propose removal of offending ticks for FNPT II and MCC.

response

Not accepted

According to JAR-STD 3A and 4A:
FNPT I: Gear Change Force
FNPT II (MCC): Gear Change Dynamics <u>and</u> Gear Change Force
BITD : Gear Change Force (<u>or</u> Gear Change Dynamics)
The comment column is correct saying: for FNPT I and BITD the gear change force test only is acceptable.

comment

87 comment by: *Thales Training & Simulation*

Test 2.c.(4) Gear Change Dynamics
Tolerances:
Introduction of the following: "For FNPTs and BITDs, ± 2º or ± 20% pitch angle" Its introduction is inconsistent as Power change dynamics, Flap Change Dynamics and Gear Change dynamics are all tested in a similar way with the same tolerances but with different configuration changes. Gear Change Dynamics should not be a special case.

Propose removal of text " For FNPTs and BITDs, ± 2º or ± 20% pitch angle"

response

Not accepted

The tolerances for FNPTs and BITDs for the pitch angle have been transferred from JAR-STD 3A/4A to JAR-FSTD A and are the same now in NPA 2008-22d.

comment

88 comment by: *Thales Training & Simulation*

Test 2.c.(8) Stall Characteristics

Language - Comment column: " FNPT and BITD: Test need only determine the actuation of the stall warning device only." Two occurrences of "only" in the sentence. One is redundant. Suggest replace "need only" with "should".

response

Accepted

To avoid this redundancy "need only" will be replaced by "should"

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comment *26* comment by: *UK CAA*

Page: 2-C-31

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD(A). 300, Table 2.3
Paragraph 2.d.(1)

Comment:
The standards required for FNPT I have been changed from those originally defined in JAR-STD 3A. Paragraph 2.d.(1). The test is now applicable to FNPT I whereas it was not a requirement for FNPT I in JAR-STD 3A. (This is an anomaly introduced between JAR-STD 3A and JAR-FSTD(A) when JAR-FSTD(A) was published).

Justification:
JAR-FSTD(A) defines a standard that has been accepted by industry and regulators and is supposed to replicate the requirements of JAR-STD 1A, 2A, 3A and 4A. There is an anomaly between FSTD(A) and JAR-STD 3A that needs to be addressed in these final rules. JAR-STD forms the basis for JAR FSTD, which in turn forms the basis for these IRs and CS. The requirements of JAR-STD are known and accepted standards. The text as proposed gives rise to additional regulatory burden to undertake an added test for no added safety benefit.

Proposed Text (if applicable):
(Proposed amendments *italicised and underlined*)

Change the tabulated ticks (ü) in Book 2, page 2-C-31 to ensure that this test is not a requirement of FNPT I.

(These requirements will then be consistent with accepted standards of JAR-STD)

response *Not accepted*

JAA NPA-STD 11 and 12 resulted in the JAA-wide agreed and accepted documents JAR-FSTD A and H. These JAA documents are the basis for NPA 2008-22 (d,e), where only structural changes have been made. It is outside the scope of this NPA to introduce technical changes. Technical changes will require a new rulemaking task including a new NPA.
The validation test is applicable to FNPT I and BITD only if multi-engine. As indicated in the comment column it is important to demonstrate a realistic speed relationship between V_{MCA} and V_S. CT&M for the initial evaluation has been considered to be applicable for types I, II, III, IV and VI of FSTD acc. to the new ICAO doc. 9625 as well (see as well RAeS FSTD evaluation handbook, Vol. 1, 4th ed.). These types equal all level of FNPT.

comment *27* comment by: *UK CAA*

Page: 2-C-33

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD(A). 300, Table 2.3
Paragraph 2.d.(6)

Comment:
The standards required for FNPT have been changed from those originally defined in JAR-STD 3A. Paragraph 2.d.(6). The requirement is now to provide a test with stability augmentation on as well as off. The requirement was only to provide a stability augmentation off condition in JAR-STD 3A. (This is an anomaly introduced between JAR-STD 3A and JAR-FSTD(A) when JAR-FSTD(A) was published).

Justification:
JAR-FSTD(A) defines a standard that has been accepted by industry and regulators and is supposed to replicate the requirements of JAR-STD 1A, 2A, 3A and 4A. There is an anomaly between FSTD(A) and JAR-STD 3A that needs to be addressed in these final rules. JAR-STD forms the basis for JAR FSTD, which in turn forms the basis for these IRs and CS. The requirements of JAR-STD are known and accepted standards. The text as proposed gives rise to additional regulatory burden to undertake an added test for no added safety benefit.

Proposed Text (if applicable):
(Proposed amendments *italicised and underlined*)

Modify the COMMENTS section of Table 2.3, paragraph 2.d.(6) to add *'For FNPTs, test with stability augmentation off only'*.

(These requirements will then be consistent with accepted standards of JAR-STD)

response *Accepted*

The text will be modified according to your proposal.

comment *34* comment by: *UK CAA*

Page: 2-C-32

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD(A). 300, Table 2.3
Paragraph 2.d.(4)

Comment:
The standards required for FTD, FNPT and BITD have been changed from those originally defined in JAR-STD 2A, 3A and 4A. The requirement is now to provide a test in approach or landing configuration as well as the cruise condition. The requirement was only to provide a cruise condition case in JAR-STD 2A, 3A and 4A. (This is an anomaly introduced between JAR-STD 2A, 3A and 4A from JAR-FSTD(A) when JAR-FSTD(A) was published that needs to be resolved).

Justification:
JAR-FSTD(A) defines a standard that has been accepted by industry and regulators and is supposed to replicate the requirements of JAR-STD 1A, 2A, 3A and 4A. There is an anomaly between FSTD(A) and JAR-STD 3A that needs to be addressed in these final rules. JAR-STD forms the basis for JAR FSTD, which in turn forms the basis for these IRs and CS. The requirements of JAR-

	STD are known and accepted standards. The requirements of JAR-STD are known and accepted standards. The text as proposed gives rise to additional regulatory burden to undertake an added test for no added safety benefit. **Proposed Text (if applicable):** Modify the FSTD LEVEL section of Table 2.3, paragraph 2.d.(4) to ensure that the CRUISE condition is a requirement of all devices and all levels and that the APPROACH OR LANDING condition is a requirements of all levels of FTD, FNPT and BITD. (These requirements will then be consistent with accepted standards of JAR-STD)
response	*Accepted* Although the Agency cannot follow your proposed text, we assume that your intended proposal is that the *approach* or *landing* case should apply to FFS only. We will modify the table accordingly.

comment	*54* comment by: *ECA- European Cockpit Association* Comment on d.1: editorial comment: delete as follows: ± 3 kts airspeed ~~**± 61m (200ft)**~~ ~~**± 20% of**~~
response	*Accepted* This will be deleted as proposed.

comment	*89* comment by: *Thales Training & Simulation* Test 2.d.(1) Minimum Control Speed Air (VMCA) Spurious text in the TOLERANCE column: "± 61m (200ft) ± 20% of" should be removed.
response	*Accepted* This will be deleted as proposed. See comment No. 54 above.

comment	*90* comment by: *Thales Training & Simulation* Test 2.d.(1) Minimum Control Speed Air (VMCA) Spurious text in the FLIGHT CONDITIONS COLUMN column: "aeroplane)t" should be become "aeroplane)"
response	*Accepted* Text will be corrected.

comment	*91* comment by: *Thales Training & Simulation* Test 2.d.(6) Rudder Response The table has additional border lines that should have text in them. In the TOLERANCE fields should be: "± 2 deg/sec or ± 10% roll rate ± 2 deg bank". The FNPT II and MCC columns should have ticks.

	This does not appear in the final version of JAR FSTD A, but did appear in JAR STD 3A, but seems to have been removed in the transition to JAR STD A.
response	*Partially accepted* The additional border lines not having text in them are already (incorrectly) in JAR-FSTD A (page 2-C-52) and will be removed. Harmonising the requirements for FSTDs the tolerances for roll rate and bank angle have been removed for FNPT II / MCC during NPA 11 as they are not required for any other FSTD.

comment	*137* comment by:*FCAA* Attachment#5 The text in page 2-C-31 for row d.(1) and columns Tolerance and Flight Condition are not whole (see attached file). There is something missing (the text end to the word "of") and a typographic error ("... in the aeroplane)t...").
response	*Accepted* Wrong text in the tolerance field will be removed (see response to comment No. 54) and the text in the flight conditions row will be corrected (see response to comment No. 90)

comment	*152* comment by:*CAE* **2-C-31** d.(1) Minimum Control Speed ."+- 61m (200 ft) +- 20% of" appears in tolerance section and should not because not applicable. ."+- 61m (200 ft) +- 20% of" should be removed.
response	*Accepted* Wrong text in the tolerance field will be removed (see response to comment No. 54)

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comment	*17* comment by:*UK CAA* **Page: 2-C-40** **Paragraph No: BOOK 2 SUBPART C: AMC No.1 to CS-FSTD(A). 300, Table 2.3** **Comment:** Incorrect references to JAR-FSTD(A) as stated below: Para 3f – COMMENTS section of table. Para 3g – COMMENTS section of table. **Justification:** Reference to incorrect document.

	Proposed Text (if applicable): (Proposed amendments *<u>italicised and underlined</u>*) Replace reference to JAR-FSTD(A) with *<u>CS-FSTD(A)</u>* in the referenced paragraphs 3f and 3g of the table.
response	*Accepted* The references will be changed to CS-FSTD(A)

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comment	*40* comment by: *Rockwell Collins* Make the proposed correction: ***NPA 2008-22d*** ***Paragraph 4.a (2) on page 2-C-43*** ***under the Latency check Tolerance column*** 150 milliseconds or less after ~~controller~~ ***aircraft*** movement. 300 milliseconds or less after ~~controller~~ ***aircraft*** movement.
response	*Accepted*

comment	*41* comment by: *Rockwell Collins* ***Make the changes indicated in Bold Italic*** ***NPA 2008-22d*** ***Test 4.b.(4) on page 2-C-46*** ***For Calligraphic systems*** Highlight brightness should be measured by maintaining the full test pattern described in paragraph 4.b 3) above, super imposing a highlight on the centre white square of each channel and measuring the brightness using the 1°spot photometer. Light points are not acceptable. Use of calligraphic capabilities to enhance raster brightness is acceptable. ***For Raster only display devices the Highlight Brightness is measured using a White Raster and measuring the average brightness in each channel.***
response	*Not accepted* The introduction of technical changes, new technologies or measurement methods different from those used in the past and therefore being out of the scope of this NPA will be postponed to the future rulemaking task to align the regulations with the new ICAO doc. 9625, 3rd edition.

	Furthermore a justification for the change is missing.

comment	*92* comment by: *Thales Training & Simulation* Test 4.a.(2) Latency Test 4.a.2 on page 2-C-43 should reference New section 2 on latency test methods on page 2-C-89
response	*Accepted* A reference will be made

comment	*158* comment by: *Czech Airlines* **2)** CS-FSTD (A) Book 2 4. Visual System b. Display System Tests Item (2) System geometry on page 2-C-45 We think, that tolerances, described for this item, are too big. The tolerance ± 1° for 5° squares and the relative spacing 1.5° of adjacent squares **can easily lead to distortions through whole 180° FOV, because the tolerances can be accumulated in vertical and/or horizontal directions.**
response	*Noted* Thank you for your input. JAA NPA-STD 11 and 12 resulted in the JAA-wide agreed and accepted documents JAR-FSTD A and H. These JAA documents are the basis for NPA 2008-22 (d,e), where only structural changes have been made. It is outside the scope of this NPA to introduce technical changes. Technical changes will require a new rulemaking task including a new NPA. Since all Implementing Rules and CSs, including those for FSTDs, will be kept updated on a regular basis, proposed changes will be considered within future rulemaking tasks, e.g. the alignment with the new ICAO doc. 9625, 3rd edition. When drafting the new ICAO document the International Working Group did a technical review and modified already the requirements for system geometry.

comment	*159* comment by: *Czech Airlines* **3)** CS-FSTD (A) Book 2 4. Visual System b. Display System Tests Item (6) Lightpoint Size on page 2-C-46 There is not described in the document, what color these light points should be to fulfill this test! According to our opinion **the color of these light points should be white** to show, that the visual system is capable to depict perfectly focused and converged **white light points**.

There is described in the comments to this Light point Size test, that test pattern consists of centrally located single row of light points in each channel. **But every system should demonstrate the capability to depict small focused and converged white light points across the whole channel (sides, corners), not in the middle of each channel only.**

response *Noted*

Thank you for your proposal.

JAA NPA-STD 11 and 12 resulted in the JAA-wide agreed and accepted documents JAR-FSTD A and H. These JAA documents are the basis for NPA 2008-22 (d,e), where only structural changes have been made. It is outside the scope of this NPA to introduce technical changes. Technical changes will require a new rulemaking task including a new NPA.
Since all Implementing Rules and CSs, including those for FSTDs, will be kept updated on a regular basis, proposed changes will be considered within future rulemaking tasks, e.g. the alignment with the new ICAO doc. 9625, 3rd edition.
When drafting the new ICAO document the International Working Group did a technical review and modified the requirements for the light point size test (added '*white* light points' and 'movable light points in all axes').

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comment *55* comment by: *ECA- European Cockpit Association*

Comment on h (1) (b) E (i) and (ii):
Should also be applicable for FNPT II and MCC.

Justification:
As FNPT II and MCC qualified FSTD are used for basic IFR training, and especially under MPL II additionally for Multi Crew introduction, the simulators should be tested accordingly.

response *Noted*

Your comment refers to instrument approaches and landing, manually, with and without F/D to 100 ft below CAT I minima,
(i) with cross-wind
(ii) with wind shear

For FNPT II (MCC) subjective cross-wind tests are covered as a part of the 'T/O' tests and 'visual approaches and landings' tests and Simulators *are* tested accordingly anyway.
For FNPT II (MCC) manual CAT I approaches with and without F/D are covered as well and
Simulators *are* tested accordingly anyway.

Subjective wind shear tests are not required for FNPT II (MCC) but Simulators *are* tested accordingly.

	JAA NPA-STD 11 and 12 resulted in the JAA-wide agreed and accepted documents JAR-FSTD A and H. These JAA documents are the basis for NPA 2008-22 (d,e), where only structural changes have been made. It is outside the scope of this NPA to introduce technical changes. Technical changes will require a new rulemaking task including a new NPA. Since all Implementing Rules and CSs, including those for FSTDs, will be kept updated on a regular basis, proposed changes will be considered within future rulemaking tasks, e.g. the alignment with the new ICAO doc. 9625, 3rd edition. When drafting the new ICAO document the International Working Group conducted an analysis identifying tasks to be accomplished for the training, testing and checking types applicable to the various licences (including MPL). The outcome of this process is a definition of fidelity levels of simulation features required to support these training tasks.

comment	*56* comment by:*ECA- European Cockpit Association* Comment on h (2) (c), (e, (f) and (g): Should also be applicable for FNPT II and MCC. Justification: As FNPT II and MCC qualified FSTD are used for basic IFR training, and especially under MPL II additionally for Multi Crew introduction, the simulators should be tested accordingly.
response	*Noted* We agree to your comment but we can only address this during a future update because this is out of the scope of this actual rulemaking task.

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comment	*57* comment by:*ECA- European Cockpit Association* Comment on i (3), (5) and (6): Should also be applicable for FNPT II and MCC. Justification: As FNPT II and MCC qualified FSTD are used for basic IFR training, and especially under MPL II additionally for Multi Crew introduction, the simulators should be tested accordingly.
response	*Not accepted* i (3): is covered for FNPT II (MCC), see section k and l of the 'Table of Functions and Subjective Tests' i (5): no wind shear model required for FNPT i (6): is covered for FNPT II (MCC), see section f of the 'Table of Functions and Subjective Tests'

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comment	*58* comment by: *ECA- European Cockpit Association* Comment on l (1) (f) and (g): Should also be applicable for FNPT II and MCC. Justification: As FNPT II and MCC qualified FSTD are used for basic IFR training, and especially under MPL II additionally for Multi Crew introduction, the simulators should be tested accordingly.
response	*Not accepted* This is covered for FNPT II (MCC), see ticks in the table.

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comment	*153* comment by: *CAE* **2-C-70** m. Visual System No reference to currency requirements of the visual scenes installed and available for training on the FSTD. ICAO 9625 edition 3 recommends visual databases used in training to be maintained current. The FAA 14 CFR Part 60, FSTD initial and continuing qualification and use, requires all visual databases used in FAA approved training to be maintained current as well. CAE recommends similar requirements and guidelines to those mentioned above.
response	*Noted* JAA NPA-STD 11 and 12 resulted in the JAA-wide agreed and accepted documents JAR-FSTD A and H. These JAA documents are the basis for NPA 2008-22 (d,e), where only structural changes have been made. It is outside the scope of this NPA to introduce technical changes. Technical changes will require a new rulemaking task including a new NPA. Since all Implementing Rules and CSs, including those for FSTDs, will be kept updated on a regular basis, proposed changes will be considered within future rulemaking tasks, e.g. the alignment with the new ICAO doc. 9625, 3rd edition. **bubble 3**

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comment | *33* | comment by: *UK CAA*

Page: 2-C-77

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD(A). 300, Table of Functions and Subjective Checks, paragraph O.(1).(c)

Comment:
The standards required for FTD have been changed from those originally defined in JAR-STD 2A. The requirement is no longer to assess significant airplane sounds as part of the subjective checks. The requirement under JAR-STD 2A was to assess these as part of a subjective check. (This is an anomaly introduced between JAR-STD 2A from JAR-FSTD(A) when JAR-FSTD(A) was published).

Justification:
JAR-FSTD(A) defines a standard that has been accepted by industry and regulators and is supposed to replicate the requirements of JAR-STD 1A, 2A, 3A and 4A. There is an anomaly between FSTD(A) and JAR-STD 3A that needs to be addressed in these final rules. JAR-STD forms the basis for JAR FSTD, which in turn forms the basis for these IRs and CS. The requirements of JAR-STD known and accepted standards. The requirement for the checks related to significant aeroplane sound is retained for FNPTs which are ostensibly "lower level" devices The text as proposed would reduce the standards for FTD and create an anomaly between the standards required for the differing device types.

Proposed Text (if applicable):

Change the tabulated ticks (ü) in Book 2, page 2-C-77 to ensure that the requirements of paragraph O.(1).(c) are a requirement of FTD 1 & 2.

(These requirements will then be consistent with accepted standards of JAR-STD)

response | *Accepted*

The Table of Functions and Subjective Tests in JAR-STD 2A requires for FTD in general: "Significant aeroplane noise such as engine, flaps, gear, spoiler extension/retraction, thrust reverser to a comparable level of that found in the aeroplane" while there is no specific test mentioned and tolerance given in the Table of Validation Tests.
So it is not traceable why there are no ticks in JAR-FSTD A nor in CS-FSTD(A) for the same subjective test.

The same subjective test as mentioned above ("...") is required for all types of devices as described in ICAO doc. 9625, 3rd edition.

As the ticks seem to be omitted unintentionally in the table of functions and subjective tests of JAR-FSTD A and by that in CS-FSTD(A) the Agency follows your proposal to have ticks in the named paragraph for FTD Level 1 and 2.

comment	*59* comment by:*ECA- European Cockpit Association* Comment on o (c): Should also be applicable for FNPT II and MCC. Justification: As FNPT II and MCC qualified FSTD are used for basic IFR training, and especially under MPL II additionally for Multi Crew introduction, the simulators should be tested accordingly.
response	*Noted* Paragraph o.(1)(c) is already applicable to FNPT II (MCC)

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comment	*66* comment by:*FlightSafety International* **Comment** Section 1.4 in it's entirety is editorial opinion. **Proposal** Delete section 1.4 **Impact to Flight Safety** Editorial opinion has no place in a regulatory document, no matter how well-intentioned the statement may be.
response	*Accepted* Section 1.4 will be deleted as it is already daily practice and the content therefore is outdated.

comment	*146* comment by:*Airbus S.A.S.* Attachment#6 Appendix 1 to AMC No.1 to CS-FSTD(A).300, Validation Test tolerances, para. 1.5, states: *'When engineering simulator data are used, the basis for their use is that the reference data are produced using the same simulation models as used in the equivalent flight training simulator; i.e., the two sets of results should be 'essentially' similar. The use of flight test based tolerances may undermine the basis for using engineering simulator data, because an essential match is needed to demonstrate proper implementation of the data package.'* This implies that the simulation industry should align itself with the simulation choices made by the airplane manufacturer that provides the validation source data, and thus the simulator manufacturer has a role of a model integrator, rather than a simulation designer. General practice in the industry is to provide the best simulation solutions to the industry based on internal constraints and experience. Thus whilst the same aircraft source data is used across the industry, differing simulation choices may be made depending on the entity that is performing the modelling, i.e.:

	Simulator Manufacturer for Training Devices Aeroplane manufacturer on engineering simulators (also called Real Time Simulator or RTS) Please, refer to the attached file. Whilst the overall performance is within A/C tolerances since each entity strives to provide the best quality possible, differences may arise which are difficult and time consuming to explain thus costly. Airbus proposes to establish a list presenting those critical systems that should follow the aircraft manufacturers models to require 20% tolerances and to include it into the AIRBUS Validation Data Roadmap.
response	*Noted* While a simulator manufacturer should, as far as possible, perform all testing in a fully integrated manner, the engineering data as provided by the aircraft manufacturer sometimes are generated by test performed in a uniquely surface-driven manner. This may cause deviations from the engineering data of more than 20% of flight test data tolerances. Nevertheless, a rationale should explain (in the RQTG or VDR / QTG for the relevant test) why a different simulation model has been used and why the match of a fully integrated simulation result compared to the engineering reference data is within flight test data tolerances, but is deviating significantly from 20% of flight test data tolerances for a large portion of the test. That helps to ease the traceability for the simulator operator and the competent authority and to avoid concerns during the (re-)qualification process which might have been solved by engineering judgement before being raised. There might be other reasons as well for not using the A/C manufacturer's model, e.g. the simulator manufacturer's model is more accurate, is more accepted by the majority of pilots using this device, etc.. Aligning CS-FSTD(A) with ICAO doc. 9625, 3rd edition within a future rulemaking task will alleviate the 20% tolerance requirement and change it to 40%.

comment	*147*	comment by: *Airbus S.A.S.*
	Present practice at Airbus is to update the reference data only when critica systems or models are changed, and this only if these critical systems or models change significantly the flight dynamic behaviour. This option was chosen to avoid excessive costs both on Airbus side and on client side since a new reference means new testing and thus cost. Since the tolerances have been reduced to 20%, this is no longer possible, and thus does not support the general effort of the industry to reduce costs and delays. Airbus proposes to stick to the draft ICAO "Manual of Criteria for the Qualification of Flight Simulators" 9625 - Edition 4 – that includes 40% tolerances and that results from concurrent and co-operative activities with the involvement of the stakeholders.	
response	*Noted* Already in JAR-FSTD A the "20% of the corresponding 'flight test' tolerances"	

were a guideline and engineering judgement might be required in the application of this tolerance on a case by case basis.

NPA 2008-22d (CS-FSTD A) partly reflects the content of JAR-FSTD A within a new structure as developed by the Agency. The transition from the technical part of JAR-FSTD to CS-FSTD does not include a review of the technical criteria. These criteria remain currently unchanged. This issue will, however, be taken up in a new, future rulemaking task as foreseen by the Agency to assure alignment with the new ICAO doc. 9625, 3rd edition, Volume I and II (Vol. II not yet available).

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comment *14* comment by: *UK CAA*

Page: 2-C-81

Paragraph No: BOOK 2 SUBPART C: Appendix 2 to AMC No.1 to CS-FSTD(A).300, para 1.1

Comment:
Paragraph 1.1 declares that the respective state civil aviation authority responsible for an FSTD evaluation is the final authority to approve the data to be used as the validation material for the QTG.

Justification:
With no guidance published on acceptability criteria of validation test data, both in type of data and where the data is used (i.e. for particular tests) there is great potential for differing acceptability criteria and hence standards to be applied by different authorities. It is essential that there is consistency in the acceptance of validation data.

Proposed Text (if applicable):
EASA should publish guidance on acceptability criteria of validation test data, detailing criteria for the type of data in use (flight test, AFM, engineering etc) and how this type of data is to be used (which tests etc).

response *Noted*

Appendix 2 describes the 'Validation Data Roadmap (VDR)' provided by the aeroplane validation data supplier. VDRs are related to FFSs.

Although guidelines on acceptability criteria of validation test data could be of help, it remains however difficult for the NAA to approve the data to be used as validation material for the QTG. Rather than approving flight test data or engineering data itself, the evaluation of the process of how these data have been gathered or processed is important.
For the initial evaluation of a first simulator of a new type of aeroplane a Joint Simulator Evaluation Team (JSET) has been formed by experienced inspectors of different NAAs. These NAAs have been checked by standardisation teams on a regular basis and they mutually recognise their simulator qualifications. One task of the JSET (now called SET) was the evaluation of the data gathering process (audit) which finally leads to the acceptance of the VDR as mentioned above and to the evaluation of the first FFS. So the expertise is already

available.

There could be very different criteria to be considered for the VDR, depending on the actual case, such that the drafting of a general guideline covering all is more than difficult.

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comment | *60* comment by:*ECA- European Cockpit Association*

Comment on paragraph 1.14:change text as follows:
1.14 The transport delay test should account for ~~**the worst case mode**~~**both daylight and night modes** of operation of the visual system. The tolerance is as required in the validation test tables and motion response shall occur before the end of the first video scan containing new information.

Justification:
Instead of: "worst case mode",
a) what is worst case mode?
b) no guarantee that if worst case mode works the respective other one is satisfactory too.

response | *Partially accepted*

An FNPT II (MCC) just requires night/dusk or day. Daylight and night modes only apply to FFS. To cover all cases the amended text should read:

1.14 The transport delay test should account for ~~**the worst case mode both daylight and night modes**~~ **daylight, twilight (dusk, dawn) and night modes (as applicable)** of operation of the visual system. The tolerance is as required in the validation test tables and motion response shall occur before the end of the first video scan containing new information.

comment | *93* comment by:*Thales Training & Simulation*

Latency Test Methods guidance material

The text thaThe text that has been introduced to provide guidance for Latency Tests is too superficial and does not deal with the significant issues of how the testing should be conducted. Guidance on issues such as determining the Aircraft response time and the FSTD response time which are key to understanding the Latency Test are not even dealt with. ICAO 9625 V3 has a more detailed explanation in the equivalent guidance material section. See attachment.

The text th

response | *Noted*

The alignment of CS-FSTD(A) with ICAO doc. 9625, 3rd edition within a new, future rulemaking task as foreseen by the Agency will consider the more detailed explanation.

comment	*95* comment by: *Thales Training & Simulation*
	Recurrent Evaluations Validation Test Data Presentation (Page 2-C-91) The text in this section seems to been aimed at the highest level devices (e.g. Level D). There should be guidance on how to deal with lower level devices and in particular the devices where CT&M is used for the initial evaluation, but recurrent evaluations will be against the MQTG results.
response	*Noted*

comment	*97* comment by: *Thales Training & Simulation*
	ACJ No.1 JARFFS Approved or Qualified before 1 April 1998 FSTD A.035 ACJ No.1 JAR FTDs Approved or Qualified before 1 July 2000 FSTD A.036 ACJ No.1 JAR FNPTs Approved or Qualified before 1 July 1999 FSTD A.037 Are sections from JAR FSTD A that have not been carried forward into the EASA document. These sections deal with the issue of Grandfather Rights for FFS, FTD and FNPT respectively. Although there are references to Grandfather rights in the Glossary of terms other information and guidance on this subject seems to have been removed. and does not seem to appear in the EASA document. Note that the letter of application for qualification refers to grandfather rights. If Grandfather rights are to be supported this information should be available.
response	*Noted* These topics will be addressed in the Cover Regulation.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 1 to CS FSTD(A).300 Qualification basis - Appendix 6 to AMC No.1 to CS FSTD(A).300 Recurrent Evaluations - Validation Test Data Presentation p. 128

comment	*94* comment by: *Thales Training & Simulation*
	Recurrent Evaluations Validation Test Data Presentation (Page 2-C-91) The text in this section seems to been aimed at the highest level devices (e.g. Level D). There should be guidance on how to deal with lower level devices and in particular the devices where CT&M is used for the initial evaluation, but recurrent evaluations will be against the MQTG results.
response	*Accepted* According to your proposal, Para 2.2 on page 2-C-91 will be modified as follows: *For FFS and FTD (when tests are not based on CT&M) there are no suggested tolerances between recurrent and MQTG validation test results. Investigation of any discrepancy between the MQTG and recurrent FFS/FTD performance is left*

to the discretion of the FSTD operator and the competent authority.
For devices where CT&M is used for the initial evaluation, the test result for recurrent evaluation will be acceptable if it is within the tolerances (as given in AMC No. 1 to CS-FSTD(A).300 Paragraph 2.3 'Table of FSTD Validation Tests') to the MQTG FSTD test result.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 1 to CS FSTD(A).300 Qualification basis - Appendix 7 to AMC No.1 to CS FSTD(A).300 Applicability of CS-FSTD Amendments to FSTD Data Packages for Existing Aeroplanes	p. 129-130

comment | *18* comment by:*UK CAA*

Page: 2-C-92

Paragraph No: BOOK 2 SUBPART C: Appendix 7 to AMC No.1 to CS-FSTD(A). 300, 1st paragraph

Comment:
Incorrect reference to JAR-FSTD(A) in first line of this paragraph.

Justification:
Reference to incorrect document.

Proposed Text (if applicable):
(Proposed amendments *italicised and underlined*)

Replace reference to JAR-FSTD(A) with *CS-FSTD(A)*

Note: This is the **fourth** comment identifying incorrect cross-references in CS-FSTD(A). It is recommended that a further review is carried out to check all cross references are correct in this part and the other parts of this NPA.

response | *Accepted*

The reference will be changed to CS-FSTD(A).300 Para 2.3.
We accept your comment and will re-check all cross-references.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 1 to CS FSTD(A).300 Qualification basis - Appendix 8 to AMC No.1 to CS FSTD(A).300 General technical requirements for FSTD Qualification Levels	p. 131

comment | *154* comment by:*CAE*

2-C-94
There is no guidance on design and qualification of airplane FTD devices
CAE suggests adding FTD guidance material as is done in AMC No. 3 to CS FSTD(H).300 on pages 2-C-86 to 2-C-88 with the appropriate modifications applicable to the aeroplanes CS-FSTD(A)

response | *Noted*

JAA NPA-STD 11 and 12 resulted in the JAA-wide agreed and accepted documents JAR-FSTD A and H. These JAA documents are the basis for NPA

	2008-22 (d,e), where only structural changes have been made. It is outside the scope of this NPA to introduce changes. Changes will require a new rulemaking task including a new NPA. Since all Implementing Rules and CSs, including those for FSTDs, will be kept updated on a regular basis, proposed changes will be considered within future rulemaking tasks, e.g. the alignment with the new ICAO doc. 9625, 3rd edition with the new classification of FSTD and a harmonisation between Vol. I (Aeroplanes, published) and Vol. II (Rotary Wings, not yet available)

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 1 to CS FSTD(A).300 Qualification basis - Appendix 8 to AMC No.1 to CS FSTD(A).300 General technical requirements for FSTD Qualification Levels - Table 1 – General technical requirements for Level A, B, C and D Full Flight Simulators p. 132

comment	*67* comment by:*FlightSafety International* **Comment** The Level D requirement states: " There shall be complete fidelity of sounds and motion buffets." Complete fidelity is impossible to achieve, and the tolerances stated in the standards reflect that fact. **Proposal** Change the requirement to read "Fidelity of sounds and motion buffets shall meet the minimum requirements for Level D as stated in the Table of Function and Subjective Tests." **Impact to Flight Safety** Requiring "complete fidelity" is technically impossible and that fact has been long recognized by all previous FSTD technical standards. The engineering, hardware, and software resources required to achieve and maintain complete fidelity would add a tremendous financial burden on FSTD manufacturers and operators, to the point of making it impossible to continue in business.
response	*Accepted* Text will be changed to: *There shall be complete fidelity of sounds and motion buffets validated through objective tests.*

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 3 to CS FSTD(A).300 Guidance on Design and Qualification of FNPTs p. 138-142

comment	*106* comment by:*ALSIM Simulateurs* Attachment[#7](#) Proposed text: 2 Design Standards 2.3 Cockpit/Flight Deck Components As with any training device, the components used within the cockpit/flight deck area do not need to be aircraft parts: however, any parts used should be representative of typical training aeroplanes and should be robust enough to

	endure the training tasks. With the current state of technology the use of simple CRT monitor based representations and touch screen controls would not be acceptable. The training tasks envisaged for these devices are such that appropriate layout and feel is very important. The training tasks envisaged for these devices are such that appropriate layout and feel is very important. ~~i.e. the altimeter subscale knob needs to be physically located on the altimeter~~. The use of CRTs with physical overlays incorporating operational switches/knobs/buttons replicating an aeroplane instrument panel may be acceptable. 2.4 Data 2.4.1 Data Collection and Model Development Data to tune the generic model to represent a more specific aeroplane can be obtained from many sources without recourse to expensive flight test: (a) Aeroplane design data (b) Flight and Maintenance Manuals (c) Observations on ground and in air Data obtained on the ground and in flight can be measured and recorded using a range of simple means such as: (a) Video (b) Pencil and paper (c) Stopwatch (d) New technologies (i.e. GPS) Any such data gathering should take place at representative masses ~~and centres of gravity~~. <u>Comment:</u> This is an old example from the time when Glass Cockpit avionics were not commonly used for general aviation. Today, it is usual to see Glass Cockpit avionics fitted general aviation aircraft like Diamond, Cessna, Piper... where the altimeter subscale knob is not physically located on the altimeter. See "*picture_1*" in attached file. Traditionally, Operators of FNPT and BITD do not use different centers of gravity because the goal of an FNPT is to train to navigational procedures where the handling qualities at different centers of gravity are not required.
response	*Partially accepted* a) The example will be changed to: *i.e. the altimeter subscale knob needs to be physically located where it is in the represented class of aeroplane either equipped with Glass Cockpit avionics or classic instruments.* b) "Representative masses and centres of gravity" refers to data collection, development of a data package and model development and does not refer to the operator's use of different CGs during training. This remains unchanged.

comment	*121*	comment by: *Irish Aviation Authority*
	In 2.4.1 there are two lists containing (a), (b) & (c). The numbering should be altered so that there is no confusion. DCr 270509	
response	*Not accepted* Reference to the paragraph number alone is considered sufficient, as these are	

just two listings.

comment | *138* comment by: *FCAA*

On page 2-C-103 paragraph 3 presents requirements concerning visual systems of FNPTs. The first sentence presents:

"Unless otherwise stated, the visual requirements are as specified for a Level A FFS."

Pages 1-A1-14 and 1-A1-15 also present requirements for visual systems. On those pages there are requirements that are valid for FFS level A but not for FNPT II.

To make the presentation of the page 2-C-103 more unambiguous, we suggest that the word "below" is added to the sentence, so that pages 2-C-103 and 1-A1-14/15 are in correspondence in an even better way. The presentation should therefore be:

"Unless otherwise stated **below**, the visual requirements are as specified for a Level A FFS."

response | *Accepted*

To improve clarity the word "below" will be added.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 4 to CS FSTD(A).300 Guidance on Design and Qualification of BITDs p. 143-146

comment | *107* comment by: *ALSIM Simulateurs*

Proposed text:

3.2

Any such data gathering should take place at representative masses ~~and centres of gravity~~. Development of such a data package including justification and the rationale for the design and intended performance, the measurement methods and recorded parameters should be carefully documented and available for inspection by the Authority as part of the qualification process.

Comment:

Traditionally, Operators of FNPT and BITD do not use different centers of gravity because the goal of an FNPT is to train to navigational procedures where the handling qualities at different centers of gravity are not required.

response | *Not accepted*

"Representative masses and centres of gravity" refers to data collection, development of a data package and model development and does not refer to the operator's use of different CGs during training.
Text remains unchanged.

comment | *122* comment by: *Irish Aviation Authority*

	In 3.2 there are two lists each containing (a) through (c). The numbering should be revised so that there is no confusion. DCr 270509
response	*Not accepted* Reference to the paragraph number alone is considered sufficient, as these are just two listings.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 5 to CS FSTD(A).300 Guidance on Evaluations of Electrical Motion Systems for FFSs p. 147-148

comment	*68* comment by:*FlightSafety International* **Comment** AMC No. 5 is all personal, highly-biased editorial opinion. Electric motion systems have been qualified and accepted under the same conditions as hydraulic and/or pneumatic systems and are held to the same technical standards. **Proposal** Delete this AMC in it's entirety. **Impact to Flight Safety** This AMC provides no useful information to FSTD operators, manufacturers, or the Authority. It is a biased, personal opinion that is not backed by any factual technical evidence. It leads one to believe that an electric motion system is somehow 'different' or inferior to it's hydraulic counterpart and prejudices the reader against such systems without any facts to back up the opinion.
response	*Accepted* AMC No. 5 will be deleted as it is already daily practice. Already today and as from the intended publication date of the Implementing Rules, Electrical Motion Systems will no longer belong to 'new technologies', and even now the new ICAO doc. 9625, 3rd edition does not distinguish any more between the different motion systems because the same requirements have to be applied to all of them.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 6 to CS FSTD(A).300 Guidance on Enhanced Visual System (EVS) and Qualification of FFSs p. 149-151

comment	*61* comment by:*ECA- European Cockpit Association* Comment on paragraph 5.1: FFS Evaluation specialist? How and qualified by whom is someone becoming an FFS evaluation specialist. Requirements? Qualifications? Outlined where?
response	*Noted* With your comment to paragraph 5.1 you are referring to the subjective

	evaluation of EVS system functions carried out by an FFS Evaluation Specialist within the qualification process of an FFS. Either the inspector him/herself is qualified for this evaluation or the evaluation will be assisted by another qualified person when special expertise is needed. <u>AMC 1 to AR.GEN.200(a)(2):</u> 'Qualification and Training of Inspectors' section 1.h. : h. suitable technical training appropriate to the role and tasks of the inspector, in particular for those areas requiring approvals. <u>AMC 4 to AR.ATO.200(a)(1):</u> 'Composition of the evaluation team' says that either the (technical/flight) inspectors of the competent authority are qualified for the specific task (e.g. to evaluate the EVS) or a qualified person (crew training, type rated on the aeroplane being simulated) *sufficiently experienced to assist the technical team. This person should fly out at least part of the functions and subjective tests* (e.g. EVS) <u>AMC No. 1 to CS-FSTD(A).300 on page 2-C-63:</u> 3.1.1 ... *In order to assure the functions tests are conducted in an efficient and timely manner, operators are encouraged to coordinate with the appropriate Authority responsible for the evaluation so that any skills, experience or <u>expertise needed by the Authority</u> in charge of the evaluation team are available*. Since the qualification of the inspecting staff is described in the above referenced paragraphs we decided to delete section 5.1

comment	*142* comment by:*CAE* Will each aircraft type have a JOEB report associated with EVS and will the JOEB report always cover "training and checking requirements".
response	*Noted* When an OEB is required according to the implementing rules, a report will be available, and if the aeroplane is fitted with EVS, training and checking requirements for this equipment will be part of the report.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 7 to CS FSTD(A).300 Guidance on Old Visual Systems and New Visual Scenes for FFSs	p. 152-153

comment	*62* comment by:*ECA- European Cockpit Association* Comment on paragraph 2.6: change text as follows: 2.6. For these specific scenes, the specifications to have at least one dedicated taxi route from the gate to a specific runway (single designated route) that can be followed using the appropriate airfield charts, taxi lights and taxi signs (also under low visibility conditions) remain valid. Also, the prevention of runway incursions (safety) is paramount, therefore stop bars should be correctly modelled and switchable on/off. If no switchable feature exists, then they should be modelled ~~**“on”**~~<u>**"off"**</u> where the instructor will grant clearance to cross.

Justification:
This is not only negative trainig, but worse, and totally against worlwide philosophy. There should never be a situation where pilots are **trained** to cross a lit stopbar, not even when granted by the "controller". There is enough incident / accident data available to proof this!

response *Partially accepted*

This CS will apply to future devices where stop bars are always switchable. So the sentence beginning with "If no switchable...." will be deleted.

comment *145* comment by: *CAE*

What are the parameters which define a "real" visual scene; we suggest that the basic elements which are required to class a visual scene as "real" are clearly defined, including the standard associated with features relevant to the scene. The FAA CFR Part 60 has introduced Class I, II and III airports and defined specific requirements for each category and we recommend that a similar approach is adopted to better define the standards for visuals scenes.

response *Noted*

JAA NPA-STD 11 and 12 resulted in the JAA-wide agreed and accepted documents JAR-FSTD A and H. These JAA documents are the basis for NPA 2008-22 (d,e), where only structural changes have been made. It is outside the scope of this NPA to introduce technical changes or different classes for visual scenes. Changes like this will require a new rulemaking task including a new NPA.
Since all Implementing Rules and CSs, including those for FSTDs, will be kept updated on a regular basis, proposed changes will be considered within future rulemaking tasks, e.g. the alignment with the new ICAO doc. 9625, 3rd edition. But even this new document does not consider different classes for visual scenes. The requirements for visual scenes are as layed down for instance in the table of Appendix 1 to CS-FSTD(A).300 'Flight Simulation Training Device Standards'.

B. Draft Rules - V. Draft Decision CS-FSTD(A) - Book 2 - Subpart C: Aeroplane Flight Simulation Training Devices - AMC No. 2 to CS FSTD(A).300(c)(1) Engineering Simulator Validation Data – Approval Guidelines p. 155-156

comment *96* comment by: *Thales Training & Simulation*

ACJ No.1 JAR FFS Approved or Qualified before 1 April 1998 FSTD A.035

ACJ No.1 JAR FTDs Approved or Qualified before 1 July 2000 FSTD A.036

ACJ No.1 JAR FNPTs Approved or Qualified before 1 July 1999
FSTD A.037

Are sections from JAR FSTD A that have not been carried forward into the EASA document. These sections deal with the issue of Grandfather Rights for FFS, FTD and FNPT respectively.

Although there are references to Grandfather rights in the Glossary of terms other information and guidance on this subject seems to have been removed.

	and does not seem to appear in the EASA document. Note that the letter of application for qualification refers to grandfather rights. If Grandfather rights are to be supported this information should be available.
response	*Noted* These topics will be addressed in the Cover Regulation.

Appendix A — Resulting text to Draft Opinion for Implementing Rule

SUBPART A - APPLICABILITY

CS–FSTD(A).001 Applicability

(a) CS-FSTD(A) as amended applies to approved training organisations operating a **f**~~F~~light **s**~~S~~imulation **t**~~T~~raining **d**~~D~~evice~~s~~ (FSTD) or in **the** case of BITDs only, manufacturers seeking initial qualification of FSTDs.

(b) The version of the CS-FSTD(A) agreed by the competent authority and used for the issue of the initial qualification shall be applicable for future recurrent qualifications of the FSTD, unless recategorised.

SUBPART B - TERMINOLOGY

CS–FSTD(A).200 Terminology

Because of the technical complexity of FSTD qualification, it is essential that standard terminology is used throughout. The following principal terms and abbreviations should be used in order to comply with CS–FSTD(A). Further terms and abbreviations are contained in AMC**1-** ~~to~~ CS**-**FSTD(A).200.

(a) **'**Flight **s**~~S~~imulation **t**~~T~~raining **d**~~D~~evice (FSTD)**'** ~~. A training device which is a Full Flight Simulator (FFS), a Flight Training Device (FTD), a Flight & Navigation Procedures Trainer (FNPT) , or a Basic Instrument Training Device (BITD).~~ ***means*** **a training device which is:**

In the case of aeroplanes, a f~~F~~ull f~~F~~light s~~S~~imulator (FFS), a f~~F~~light t~~T~~raining d~~D~~evice (FTD), a f~~F~~lightn~~N~~avigation p~~P~~rocedures t~~T~~rainer (FNPT), or a b~~B~~asic i~~I~~nstrument t~~T~~raining d~~D~~evice (BITD)

In the case of helicopters, a f~~F~~ull f~~F~~light s~~S~~imulator (FFS), a f~~F~~light t~~T~~raining d~~D~~evice (FTD) orafFlight n~~N~~avigation p~~P~~rocedures t~~T~~rainer (FNPT).

(b) **'**Full **f**~~F~~light **s**~~S~~imulator (FFS)**' means**~~.~~**a**~~A~~ full size replica of a specific type or make, model and series ~~aeroplane~~ **aircraft** flight deck**/cockpit**, including the assemblage of all equipment and computer programmes necessary to represent the aeroplane in ground and flight operations, a visual system providing an out of the flight deck**/cockpit** view, and a force cueing motion system. It is in compliance with the minimum standards for FFS **q**~~Q~~ualification.

(c) **'**Flight **t**~~T~~raining **d**~~D~~evice (FTD)**' means a**~~.A~~ full size replica of a specific ~~aeroplane~~ **aircraft** type's instruments, equipment, panels and controls in an open flight deck**/cockpit** area or an enclosed ~~aeroplane~~ **aircraft** flight deck**/cockpit**, including the assemblage of equipment and computer software programmes necessary to represent the ~~aeroplane~~ **aircraft** in ground and flight conditions to the extent of the systems installed in the device. It does not require a force cueing motion or visual system. It is in compliance with the minimum standards for a specific FTD **l**~~L~~evel of **q**~~Q~~ualification.

(d) **'**Flight and **n**~~N~~avigation **p**~~P~~rocedures **t**~~T~~rainer (FNPT)**' means a**~~.A~~ training device which represents the flight deck**/** ~~or~~ cockpit environment including the assemblage of equipment and computer programmes necessary to represent an ~~aeroplane~~ **aircraft** or class of aeroplane in flight operations to the extent that the systems appear to function as in an ~~aeroplane~~**aircraft**. It is in compliance with the minimum standards for a specific FNPT **l**~~L~~evel of **q**~~Q~~ualification.

(e) **'**Basic **i**~~I~~nstrument **t**~~T~~raining **d**~~D~~evice (BITD)**' means**~~.~~**a**~~A~~ ground**-**based training device which represents the student pilot's station of a class of aeroplanes. It may use screen based instrument panels and spring loaded flight controls, providing a training platform for at least the procedural aspects of instrument flight.

(f) **‘**Other **t**~~T~~raining **d**~~D~~evice (OTD)**’**~~. A~~ **means** ~~training~~**a training** aid other than **an** ~~FFS, FTD, FNPT or BITD~~**FSTD** which provides for training where a complete flight deck**/cockpit** environment is not necessary.

~~*Flight Simulation Training Device User Approval (FSTD User Approval)*. The extent to which an FSTD of a specified Qualification Level may be used by persons, organisations or enterprises as approved by the competent authority. It takes account of aeroplane to FSTD differences and the operating and training ability of the organisation.~~

(g) **‘**Flight **s**~~S~~imulation **t**~~T~~raining **d**~~D~~evice **u**~~U~~ser (FSTD **u**~~U~~ser)**’ means the organisation or person requesting training, checking or testing through the use of an FSTD.**~~. The person, organisation or enterprise requesting training, checking and testing credits through the use of an FSTD.~~

(h) **‘**Flight **s**~~S~~imulation **t**~~T~~raining **d**~~D~~evice **q**~~Q~~ualification (FSTD **q**~~Q~~ualification)**’ means the level of technical ability of an FSTD as defined in the compliance document.**

~~The level of technical ability of an FSTD as defined in the compliance document.~~

(i) **‘**BITD **m**~~M~~anufacturer**’ means**~~.~~**t**~~T~~hat organisation or enterprise being directly responsible to the competent authority for requesting the initial BITD model qualification.

(j) **‘**BITD **m**~~M~~odel**’**~~. A~~ **means a** defined hardware and software combination, which has obtained a qualification. Each BITD will equate to a specific model and be a serial numbered unit.

(k) **‘**Qualification **t**~~T~~est **g**~~G~~uide (QTG)**’means a document designed to demonstrate that the performance and handling qualities of an FSTD are within prescribed limits with those of the aircraft, class of aeroplane or type of helicopter and that all applicable requirements have been met. The QTG includes both the data of the aircraft, class of aeroplane or type of helicopter and FSTD data used to support the validation.**~~. A document designed to demonstrate that the performance and handling qualities of an FSTD agree within prescribed limits with those of the aeroplane and that all applicable regulatory requirements have been met. The QTG includes both the aeroplane and FSTD data used to support the validation.~~

SUBPART C – AEROPLANE FLIGHT SIMULATION TRAINING DEVICES

CS–FSTD(A).300 Qualification basis

(a) Any FSTD submitted for initial evaluation ~~will~~ **shall** be evaluated against applicable CS–FSTD(A) criteria for the **q**~~Q~~ualification **l**~~L~~evels applied for. Recurrent evaluations of a**n** FSTD ~~will~~ **shall** be based on the same version of CS-FSTD(A) that was applicable for its initial evaluation. An upgrade ~~will~~ **shall** be based on the currently applicable version of CS-FSTD(A).

(b) A**n** FSTD shall be assessed in those areas that are essential to completing the flight crewmember training, **testing** and checking process as applicable.

(c) The FSTD shall be subjected to:

1. **v**~~V~~alidation tests**;**~~,~~ and
2. **f**~~F~~unctions and subjective tests.

(d) The QTG, including all data, supporting material and information should be submitted in a format to allow efficient review and evaluation before the FSTD can gain a qualification level. Where applicable, the QTG should be based on the aircraft validation data as defined by the operational suitability data (OSD) established in accordance with Part-21.

Appendix 1 to CS-FSTD(A).300 Flight Simulation Training Device Standards

This appendix describes the minimum **f**~~F~~ull **f**~~F~~light **s**~~S~~imulator (FFS), **f**~~F~~light ~~T~~**t**raining **d**~~D~~evice (FTD), **f**~~F~~light and **n**~~N~~avigation **p**~~P~~rocedures **t**~~T~~rainer (FNPT) and **b**~~B~~asic **i**~~I~~nstrument **t**~~T~~raining **d**~~D~~evices (BITD) requirements for qualifying devices to the required **q**~~Q~~ualification **l**~~L~~evels. Certain requirements included in this ~~book~~ ~~**appendix**~~**CS** should be supported with a statement of compliance (SOC) and, in some designated cases, an objective test. The SOC ~~will~~ **shall** describe how the requirement was met. The test results should

show that the requirement has been attained. In the following tabular listing of FSTD standards, statements of compliance are indicated in the compliance column.
For FNPT use in **m**~~M~~ulti-**c**~~C~~rew **c**~~C~~o~~-~~operation (MCC) training the general technical requirement are expressed in the MCC column with additional systems, instrumentation and indicators as required for MCC training and operation.
For MCC ~~(Multi Crew Co-operation)~~ **the** minimum technical requirements are as for **FNPT I**~~L~~evel II, with the following additions or amendments:

1	Turbo-jet or turbo-prop engines~~.~~
2	Performance reserves, in **the** case of an engine failure, to be in accordance with ~~Part~~**CS-**25. These may be simulated by a reduction in the aeroplane gross mass~~.~~
3	Retractable landing gear~~.~~
4	Pressurisation system~~.~~
5	De-icing systems
6	Fire detection / suppression system
7	Dual controls
8	Autopilot with automatic approach mode
9	2 VHF transceivers including oxygen masks intercom system
10	2 VHF NAV receivers (VOR, ILS, DME)
11	1 ADF receiver
12	1 Marker receiver
13	1 transponder
The following indicators shall be located in the same positions on the instrument panels of both pilots:	
1	Airspeed
2	Flight attitude with flight director
3	Altimeter
4	Flight director with ILS (HSI)
5	Vertical speed
6	ADF
7	VOR
8	Marker indication (as appropriate)
9	Stop watch (as appropriate)

FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
		A	B	C	D	1	2	I	II	MCC		
	1. General											
a.1	A fully enclosed flight deck	✓	✓	✓	✓							
a.2	A cockpit/flight deck sufficiently enclosed to exclude distraction, which will replicate that of the aeroplane or class of aeroplane simulated						✓	✓	✓	✓	✓	
a.3	Flight deck, a full scale replica of the aeroplane simulated. Equipment for operation of the cockpit windows shall be included in the FSTD, but the actual windows need not be operable. The flight deck, for FSTD purposes, consists of all that space forward of a cross section of the fuselage at the most extreme aft setting of the pilots' seats. Additional required flight crew member duty stations and those required bulkheads aft of the pilot seats are also considered part of the flight deck and shall replicate the aeroplane.	✓	✓	✓	✓							Flight deck observer seats are not considered to be additional flight crew member duty stations and may be omitted. Bulkheads containing items such as switches, circuit breakers, supplementary radio panels, etc. to which the flight crew may require access during any event after pre-flight cockpit preparation is complete are considered essential and may not be omitted. Bulkheads containing only items such as landing gear pin storage compartments, fire axes or extinguishers, spare light bulbs, aircraft document pouches etc. are not considered essential and may be omitted. Such items, or reasonable facsimile, shall still be available in the FSTD but may be relocated to a suitable location as near as practical to the original position. Fire axes and any similar purpose instruments need only be represented in silhouette.
a.4	Direction of movement of controls and switches identical to that in the aeroplane.	✓	✓	✓	✓							
a.5	A full size panel of replicated system(s) which will have actuation of controls and switches that replicate those of the aeroplane simulated.					✓	✓					The use of electronically displayed images with physical overlay incorporating operable switches, knobs, buttons replicating aeroplane instruments panels may be acceptable to the competent authority.
a.6	Cockpit/flight deck switches, instruments, equipment, panels, systems, primary and secondary flight controls sufficient for the training events to be							✓	✓	✓	✓	For Multi-Crew Cooperation (MCC) qualification additional instrumentation and indicators may be required. See table at start of this appendix. For BITDs the switches and controls size and

FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
		A	B	C	D	1	2	I	II	MCC		
	accomplished shall be located in a spatially correct flight deck area and will operate as, and represent those in, that aeroplane or class of aeroplane.											shape and their location in the cockpit shall be representative.
a.7	Crew members' seats shall be provided with sufficient adjustment to allow the occupant to achieve the design eye reference position appropriate to the aeroplane or class of aeroplane and for the visual system to be installed to align with that eye position.						✓		✓	✓		
b.1	Circuit breakers that affect procedures and/or result in observable cockpit indications properly located and functionally accurate.	✓	✓	✓	✓	✓	✓		✓	✓		
c.1	Flight dynamics model that accounts for various combinations of drag and thrust normally encountered in flight corresponding to actual flight conditions, including the effect of change in aeroplane attitude, sideslip, thrust, drag, altitude, temperature, gross weight, moments of inertia, centre of gravity location, and configuration.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	For FTD levels 1 and 2 aerodynamic modelling sufficient to permit accurate systems operation and indication is acceptable. For FNPTs and BITDs class-specific modelling is acceptable.
d.1	All relevant instrument indications involved in the simulation of the applicable aeroplane shall automatically respond to control movement by a flight crew member or induced disturbance to the simulated aeroplane; e.g., turbulence or wind shear.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	For FNPTs instrument indications sufficient for the training events to be accomplished. Reference AMC3-CS-FSTD(A).300. For BITDs instrument indications sufficient for the training events to be accomplished. Reference AMC4-CS-FSTD(A).300.
d.2	Lighting environment for panels and instruments shall be sufficient for the operation					✓	✓	✓	✓	✓	✓	For FTD level 2 lighting environment shall be as per aeroplane.

FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
		A	B	C	D	1	2	I	II	MCC		
	being conducted.											
e.1	Communications, navigation, and caution and warning equipment corresponding to that installed in the applicant's aeroplane with operation within the tolerances prescribed for the applicable airborne equipment.	✓	✓	✓	✓	✓	✓					For FTD 1 applies where the appropriate systems are replicated.
e.2	Navigation equipment corresponding to that of the replicated aeroplane or class of aeroplanes, with operation within the tolerances prescribed for the actual airborne equipment. This shall include communication equipment (interphone and air/ground communications systems).							✓	✓	✓	✓	
e.3	Navigational data with the corresponding approach facilities. Navigation aids should be usable within range without restriction.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	For FTD 1 applies where navigation equipment is replicated. For all FFSs and FTDs 2 where used for area or airfield competence training or checking, navigation data should be updated within 28 days. For FNPTs and BITDs complete navigational data for at least five different European airports with corresponding precision and non-precision approach procedures including current updating within a period of three months.
f.1	In addition to the flight crew member duty stations, three suitable seats for the instructor, delegated examiner and competent authority inspector. The competent authority shall consider options to this standard based on unique cockpit configurations. These seats shall provide adequate vision to the pilot's panel and forward windows.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	For FTDs and FNPT's suitable seating arrangements for the instructor and examiner or competent authority's inspector should be provided. For BITDs suitable viewing arrangements for the instructor shall be provided.

FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
		A	B	C	D	1	2	I	II	MCC		
	Observer seats need not represent those found in the aeroplane but in the case of FSTDs fitted with a motion system, the seats shall be adequately secured to the floor of the FSTD, fitted with positive restraint devices and be of sufficient integrity to safely restrain the occupant during any known or predicted motion system excursion.											
g.1	FSTD systems shall simulate applicable aeroplane system operation, both on the ground and in flight. Systems shall be operative to the extent that all normal, abnormal, and emergency operating procedures can be accomplished.	✓	✓	✓	✓	✓	✓		✓	✓		For FTD level 1, applies where system is simulated. For FNPTs systems shall be operative to the extent that it shall be possible to perform all normal, abnormal and emergency operations as may be appropriate to the aeroplane or class of aeroplanes being simulated and as required for the training.
h.1	Instructor controls shall enable the operator to control all required system variables and insert abnormal or emergency conditions into the aeroplane systems.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Where applicable and as required for training the following shall be available: - position and flight freeze; - a facility to enable the dynamic plotting of the flight path on approaches, commencing at the final approach fix, including the vertical profile; - hard copy of map and approach plot
i.1	Control forces and control travel shall correspond to that of the replicated aeroplane. Control forces shall react in the same manner as in the aeroplane under the same flight conditions.	✓	✓	✓	✓		✓	✓	✓	✓	✓	For FTD level 2 control forces and control travel should correspond to that of the replicated aeroplane with CT&M. It is not intended that the device should be flown manually other than for short periods when the autopilot is temporarily disengaged. For FNPT level I and BITDs control forces and control travel shall broadly correspond to that of the replicated aeroplane or class of aeroplane. Control force changes due to an increase/decrease in aircraft speed are not necessary. In addition for FNPT level II and MCC control

FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
		A	B	C	D	1	2	I	II	MCC		
												forces and control travels shall respond in the same manner under the same flight conditions as in the aeroplane or class of aeroplane being simulated.
j.1	Ground handling and aerodynamic programming shall include: (1) Ground Effect. For example: round-out, flare, and touchdown. This requires data on lift, drag, pitching moment, trim, and power ground effect. (2) Ground reaction – reaction of the aeroplane upon contact with the runway during landing to include strut deflections, tyre friction, side forces, and other appropriate data, such as weight and speed, necessary to identify the flight condition and configuration. (3) Ground handling characteristics – steering inputs to include crosswind, braking, thrust reversing, deceleration and turning radius.	✓	✓	✓	✓				✓	✓		Statement of compliance required. Tests required. For level 'A' FFS, generic ground handling to the extent that allows turns within the confines of the runway, adequate control on flare, touchdown and roll-out (including from a crosswind landing) only is acceptable. For FNPTs a generic ground handling model need only be provided to enable representative flare and touch down effects.
k.1	Wind shear models shall provide training in the specific skills required for recognition of wind shear phenomena and execution of recovery manoeuvres. Such models shall be representative of measured or accident derived winds, but may include simplifications which ensure repeatable encounters. For example, models may consist of independent variable winds in			✓	✓							Tests required. See AMC1-CS-FSTD(A).300, 2.3, g.

FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
		A	B	C	D	1	2	I	II	MCC		
	multiple simultaneous components. Wind models shall be available for the following critical phases of flight: (1) Prior to take-off rotation (2) At lift-off (3) During initial climb (4) Short final approach											
l.1	Instructor controls for environmental effects including wind speed and direction shall be provided.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	For FTDs environment modelling sufficient to permit accurate systems operation and indication.
m.1	Stopping and directional control forces shall be representative for at least the following runway conditions based on aeroplane related data: (1) Dry (2) Wet (1) Icy (4) Patchy wet (5) Patchy icy (6) Wet on rubber residue in touchdown zone.			✓	✓							Statement of compliance required. Objective tests required for (1), (2), (3); subjective check for (4), (5), (6).
n.1	Brake and tyre failure dynamics (including antiskid) and decreased brake efficiency due to brake temperatures shall be representative and based on aeroplane related data.			✓	✓							Statement of compliance required. Subjective test is required for decreased braking efficiency due to brake temperature, if applicable.
o.1	A means for quickly and effectively conducting daily testing of FSTD programming and hardware shall be available.	✓	✓	✓	✓							Statement of compliance required.

FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
		A	B	C	D	1	2	I	II	MCC		
p.1	Computer capacity, accuracy, resolution, and dynamic response shall be sufficient to fully support the overall fidelity, including its evaluation and testing.	✓	✓	✓	✓	✓	✓					Statement of compliance required.
q.1	Control feel dynamics shall replicate the aeroplane simulated. Free response of the controls shall match that of the aeroplane within the tolerances specified. Initial and upgrade evaluations will include control free response (pitch, roll and yaw controller) measurements recorded at the controls. The measured responses shall correspond to those of the aeroplane in take-off, cruise, and landing configurations. (1) For aeroplanes with irreversible control systems, measurements may be obtained on the ground if proper pitot static inputs are provided to represent conditions typical of those encountered in flight. Engineering validation or aeroplane manufacturer rationale will be submitted as justification to ground test or omit a configuration. (2) For FSTDs requiring static and dynamic tests at the controls, special test fixtures shall not be required during initial evaluation if the FSTD operator's MQTG shows both text fixture results and alternate test method results such as computer			✓	✓							Tests required.

FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
		A	B	C	D	1	2	I	II	MCC		
	data plots, which were obtained concurrently. Repetition of the alternate method during initial evaluation may then satisfy this requirement.											

FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
		A	B	C	D	1	2	I	II	MCC		
r.1	One of the following two methods is acceptable as a means to prove compliance: (1) Transport Delay: A transport delay test may be used to demonstrate that the FSTD system response does not exceed 150 m~~illiseconds~~s. This test shall measure all the delay encountered by a step signal migrating from the pilot's control through the control loading electronics and interfacing through all the simulation software modules in the correct order, using a handshaking protocol, finally through the normal output interfaces to the motion system, to the visual system and instrument displays. (2) Latency: The visual system, flight deck instruments and initial motion system response shall respond to abrupt pitch, roll and yaw inputs from the pilot's position within 150 m~~illiseconds~~s of the time, but not before the time, when the aeroplane would respond under the same conditions.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Tests required. For level 'A' & 'B' FFSs, and applicable systems for FTDs, FNPTs and BITDs the maximum permissible delay is 300 m~~illiseconds~~s.

FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
		A	B	C	D	1	2	I	II	MCC		
s.1	Aerodynamic modelling shall be provided. This shall include, for aeroplanes issued an original type certificate after June 1980, low altitude level flight ground effect, Mach effect at high altitude, normal and reverse dynamic thrust effect on control surfaces, aeroelastic representations, and representations of non-linearities due to sideslip based on aeroplane flight test data provided by the manufacturer.			✓	✓							Statement of compliance required. Mach effect, aeroelastic representations, and non-linearities due to sideslip are normally included in the FSTD aerodynamic model. The Statement of Compliance shall address each of these items. Separate tests for thrust effects and a Statement of compliance are required.
t.1	Modelling that includes the effects of airframe and engine icing.			✓	✓				✓	✓		Statement of compliance required. SOC shall describe the effects that provide training in the specific skills required for recognition of icing phenomena and execution of recovery.
u.1	Aerodynamic and ground reaction modelling for the effects of reverse thrust on directional control shall be provided.		✓	✓	✓							Statement of compliance required.
v.1	Realistic aeroplane mass properties, including mass, centre of gravity and moments of inertia as a function of payload and fuel loading shall be implemented.	✓	✓	✓	✓							Statement of compliance required at initial evaluation. SOC shall include a range of tabulated target values to enable a demonstration of the mass properties model to be conducted from the instructor's station.
w.1	Self-testing for FSTD hardware and programming to determine compliance with the FSTD performance tests shall be provided. Evidence of testing shall include FSTD number, date, time, conditions, tolerances, and the appropriate dependent variables portrayed in comparison with the aeroplane standard.			✓	✓							Statement of compliance required. Tests required.

FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
		A	B	C	D	1	2	I	II	MCC		
x.1	Timely and permanent update of hardware and programming subsequent to aeroplane modification sufficient for the qualification level sought.	✓	✓	✓	✓	✓	✓					
y.1	Daily pre-flight documentation either in the daily log or in a location easily accessible for review is required.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	2. Motion system											
a.1	Motion cues as perceived by the pilot shall be representative of the aeroplane, e.g. touchdown cues shall be a function of the simulated rate of descent.	✓	✓	✓	✓							For FSTDs where motion systems are not specifically required, but have been added, they will be assessed to ensure that they do not adversely affect the qualification of the FSTD.
b.1	A motion system shall: (1) provide sufficient cueing, which may be of a generic nature to accomplish the required tasks;	✓										Statement of compliance required. Tests required.
	(2) have a minimum of 3 degrees of freedom (pitch, roll & heave); and		✓									
	(3) produce cues at least equivalent to those of a six-degrees-of-freedom synergistic platform motion system.			✓	✓							
c.1	A means of recording the motion response time as required.	✓	✓	✓	✓							
d.1	Motion effects programming shall include: (1) effects of runway rumble, oleo deflections, groundspeed, uneven runway, centreline lights and taxiway characteristics;	✓	✓	✓	✓							For level 'A' FFS: effects may be of a generic nature sufficient to accomplish the required tasks.

FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
		A	B	C	D	1	2	I	II	MCC		
	(2) buffets on the ground due to spoiler/speedbrake extension and thrust reversal; (3) bumps associated with the landing gear; (4) buffet during extension and retraction of landing gear; (5) buffet in the air due to flap and spoiler/speedbrake extension; (6) approach to stall buffet; (7) touchdown cues for main and nose gear; (8) nose wheel scuffing; (9) thrust effect with brakes set; (10) Mach and manoeuvre buffet; (11) tyre failure dynamics ; (12) engine malfunction and engine damage; and (13) tail and pod strike.											
e.1	Motion vibrations: tests with recorded results that allow the comparison of relative amplitudes versus frequency are required. Characteristic motion vibrations that result from operation of the aeroplane in so far as vibration marks an event or aeroplane state that can be sensed at the flight deck shall be present. The FSTD shall be programmed and instrumented in such a manner that the characteristic vibration modes can be measured and compared with aeroplane data.				✓							Statement of compliance required. Tests required.
	3. Visual System											
a.1	The visual system shall meet	✓	✓	✓	✓				✓	✓		For FTDs, FNPT 1s and BITDs, when visual

FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
		A	B	C	D	1	2	I	II	MCC		
	all the standards enumerated as applicable to the level of qualification requested by the applicant.											systems have been added by the FSTD operator even though not attracting specific credits, they will be assessed to ensure that they do not adversely affect the qualification of the FSTD. For FTDs if the visual system is to be used for the training of manoeuvring by visual reference (such as route and airfield competence) then the visual system should at least comply with that required for level A FFS.
b.1	Continuous minimum collimated visual field-of-view of 45 degrees horizontal and 30 degrees vertical field of view simultaneously for each pilot.	✓	✓									SOC is acceptable in place of this test.
b.2	Continuous, cross-cockpit, minimum collimated visual field of view providing each pilot with 180 degrees horizontal and 40 degrees vertical field of view. Application of tolerances require the field of view to be not less than a total of 176 measured degrees horizontal field of view (including not less than ±88 measured degrees either side of the centre of the design eye point) and not less than a total of 36 measured degrees vertical field of view from the pilot's and co-pilot's eye points.			✓	✓							Consideration shall be given to optimising the vertical field of view for the respective aeroplane cut-off angle.
b.3	A visual system (night/dusk or day) capable of providing a field-of-view of a minimum of 45 degrees horizontally and 30 degrees vertically, unless restricted by the type of aeroplane, simultaneously for each pilot, including adjustable cloud base and visibility.								✓	✓		The visual system need not be collimated but shall be capable of meeting the standards laid down in Parts 2 and 3 (Validation, Functions and Subjective Tests - See AMC1-CS-FSTD(A).300). SOC is acceptable in place of this test.
c.1	A means of recording the visual response time for visual systems.	✓	✓	✓	✓				✓	✓		
d.1	System geometry. The system fitted shall be free from optical	✓	✓	✓	✓				✓	✓		Test required. A statement of compliance is acceptable in place of this test.

FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
		A	B	C	D	1	2	I	II	MCC		
	discontinuities and artefacts that create non-realistic cues.											
e.1	Visual textural cues to assess sink rate and depth perception during take-off and landing shall be provided.	✓	✓	✓	✓							For level 'A' FFS visual cueing shall be sufficient to support changes in approach path by using runway perspective.
f.1	Horizon and attitude shall correlate to the simulated attitude indicator.	✓	✓	✓	✓							Statement of compliance required.
g.1	Occulting - a minimum of ten levels shall be available.	✓	✓	✓	✓							Occulting shall be demonstrated. Statement of compliance required.
h.1	Surface (Vernier) resolution shall occupy a visual angle of not greater than 2 arc minutes in the visual display used on a scene from the pilot's eyepoint.			✓	✓							Test and statement of compliance required containing calculations confirming resolution.
i.1	Surface contrast ratio shall be demonstrated by a raster drawn test pattern showing a contrast ratio of not less than 5:1.			✓	✓							Test and statement of compliance required.
j.1	Highlight brightness shall be demonstrated using a raster drawn test pattern. The highlight brightness shall not be less than 20 cd/m^2 (6ft-lamberts).			✓	✓							Test and statement of compliance required. Use of calligraphic lights to enhance raster brightness is acceptable.
k.1	Light point size – not greater than 5 arc minutes.			✓	✓							Test and statement of compliance required. This is equivalent to a light point resolution of 2.5 arc minutes.
l.1	Light point contrast ratio – not less than 10:1.	✓	✓									Test and statement of compliance required.
l.2	Light point contrast ratio – not less than 25:1.			✓	✓							Test and statement of compliance required.
m.1	Daylight, twilight and night visual capability as applicable for level of qualification sought.	✓	✓	✓	✓							Statement of compliance required for system capability. System objective and scene content tests are required.
m.2	The visual system shall be capable of meeting, as a minimum, the system brightness and contrast ratio criteria as applicable for level	✓	✓	✓	✓							

FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
		A	B	C	D	1	2	I	II	MCC		
	of qualification sought.											
m.3	Total scene content shall be comparable in detail to that produced by 10 000 visible textured surfaces and (in day) 6 000 visible lights or (in twilight or night) 15 000 visible lights, and sufficient system capacity to display 16 simultaneously moving objects.			✓	✓							
m.4	The system, when used in training, shall provide in daylight, full colour presentations and sufficient surfaces with appropriate textural cues to conduct a visual approach, landing and airport movement (taxi). Surface shading effects shall be consistent with simulated (static) sun position.			✓	✓							
m.5	The system, when used in training, shall provide at twilight, as a minimum, full colour presentations of reduced ambient intensity, sufficient surfaces with appropriate textural cues that include self-illuminated objects such as road networks, ramp lighting and airport signage, to conduct a visual approach, landing and airport movement (taxi). Scenes shall include a definable horizon and typical terrain characteristics such as fields, roads and bodies of water and surfaces illuminated by representative ownship lighting (e.g. landing lights). If provided, directional horizon			✓	✓							

FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
		A	B	C	D	1	2	I	II	MCC		
	lighting shall have correct orientation and be consistent with surface shading effects.											
m.6	The system, when used in training, shall provide at night, as a minimum, all features applicable to the twilight scene, as defined above, with the exception of the need to portray reduced ambient intensity that removes ground cues that are not self-illuminating or illuminated by ownship lights (e.g. landing lights).	✓	✓	✓	✓							
	4. Sound System											
a.1	Significant flight deck sounds which result from pilot actions corresponding to those of the aeroplane or class of aeroplane.	✓	✓	✓	✓		✓	✓	✓	✓	✓	For FNPT level I and BITD engine sounds only need **to** be available
b.1	Sound of precipitation, rain removal equipment and other significant aeroplane noises perceptible to the pilot during normal and abnormal operations and the sound of a crash when the FSTD is landed in excess of limitations.			✓	✓							Statement of compliance required.
c.1	Comparable amplitude and frequency of flight deck noises, including engine and airframe sounds. The sounds shall be coordinated with the required weather.				✓							Tests required.
d.1	The volume control shall have an indication of sound level setting which meets all qualification requirements.	✓	✓	✓	✓							

Certification Specifications

for

Aeroplane

Flight Simulation Training Devices

CS-FSTD(A)

Book 2

Acceptable Means of Compliance

SUBPART B – TERMINOLOGY

AMC**1-** ~~to~~ CS-FSTD(A).200 Terminology and abbreviations

1 Terminology

In addition to the principal terms defined in the requirement itself, additional terms used in the context of CS–FSTD(A) and CS-FSTD(H) have the following meanings:

a ‘Acceptable **c**~~C~~hange**’ means a**~~. A~~ change to configuration, software etc., which qualifies as a potential candidate for alternative approach to validation.

b ‘Aircraft **p**~~P~~erformance **d**~~D~~ata**’ are performance** data published by the aircraft manufacturer in documents such as the ~~Aeroplane or Rotorcraft~~**aircraft f**~~F~~light **m**~~M~~anual **(AFM)**, **o**~~O~~perations **m**~~M~~anual, **p**~~P~~erformance **e**~~E~~ngineering **m**~~M~~anual, or equivalent.

c ‘Airspeed**’ means c**~~. C~~alibrated airspeed unless otherwise specified (knots).

d ‘Altitude**’ means** ~~.~~ **p**~~P~~ressure altitude (m~~etres~~ or f~~eet~~) unless specified otherwise.

e ‘Audited **e**~~E~~ngineering **s**~~S~~imulation’ ~~.~~ **means a**~~A~~n aircraft manufacturer’s engineering simulation ~~which~~ **that** has undergone a review by the appropriate ~~regulatory~~ **competent a**~~A~~uthorities and been found to be an acceptable source of supplemental validation data.

f ‘Automatic **t**~~T~~esting’ **means**~~.~~ **f**~~F~~light ~~Synthetic~~ **simulation t**~~T~~raining **d**~~D~~evice (FSTD) testing wherein all stimuli are under computer control.

g ‘Bank’~~.~~ **means b**~~B~~ank/**r**~~R~~oll angle (degrees)**.**

h ‘Baseline’ **means** ~~.~~**a**~~A~~ fully ~~flight-test~~**flight test** validated production aircraft simulation. **It m**~~M~~ay represent a new aircraft type or a major derivative.

i ‘Breakout’~~.~~ **means t**~~T~~he force required at the pilot’s primary controls to achieve initial movement of the control position.

j ‘Closed **l**~~L~~oop **t**~~T~~esting’~~.~~ **is a**~~A~~ test method for which the input stimuli are generated by controllers which drive the FSTD to follow a pre-defined target response.

k ‘Computer **c**~~C~~ontrolled **a**~~A~~ircraft’~~.M~~ **means a**~~A~~n aircraft where the pilot inputs to the control surfaces are transferred and augmented via computers.

l ‘Control **s**~~S~~weep’~~.~~ **means a**~~A~~ movement of the appropriate pilot’s control from neutral to an extreme limit in one direction (**f**~~F~~orward, **a**~~A~~ft, **r**~~R~~ight, or **l**~~L~~eft), a continuous movement back through neutral to the opposite extreme position, and then a return to the neutral position.

m ‘Convertible FSTD’~~.~~ **means a**~~A~~n FSTD in which hardware and software can be changed so that the FSTD becomes a replica of a different model or variant, usually of the same type aircraft. The same FSTD platform, cockpit shell, motion system, visual system, computers, and necessary peripheral equipment can thus be used in more than one simulation.

n ‘Critical **e**~~E~~ngine **p**~~P~~arameter’ **means**~~.~~ **t**~~T~~he engine parameter ~~which~~ **that** is the most appropriate measure of propulsive force.

o ‘Damping (critical)’**: critical damping**~~is~~ **means** that minimum **d**~~D~~amping of a second order system such that no overshoot occurs in reaching a steady state value after being displaced from a position of equilibrium and released. This corresponds to a relative **d**~~D~~amping ratio of 1:0

p ‘Damping (over-damped)’**:**~~.~~**a**~~A~~n ~~OVER-DAMPED~~**over-damped** response is that **d**~~D~~amping of a second order system such that it has more **d**~~D~~amping than is required for **c**~~C~~ritical **d**~~D~~amping, as described above. This corresponds to a relative **d**~~D~~amping ratio of more than 1:0.

q ‘Damping (under-damped)’**:**~~.~~**a**~~A~~n ~~UNDER-DAMPED~~**under-damped** response is that **d**~~D~~amping of a second order system such that a displacement from the equilibrium position and free release results in one or more overshoots or oscillations before reaching a steady state value. This corresponds to a relative **d**~~D~~amping ratio of less than 1:0.

r ‘Daylight **v**~~V~~isual’~~.~~ **means a**~~A~~ visual system capable of meeting, as a minimum, system brightness, contrast ratio requirements and performance criteria appropriate for the level of qualification sought. The system, when used in training, should provide full colour presentations and sufficient surfaces with appropriate textural cues to successfully conduct a visual approach, landing and airport movement (taxi).

s ‘Deadband’~~.~~ **means t**~~T~~he amount of movement of the input for a system for which there is no reaction in the output or state of the system observed.

~~t Distance. Distance **is given** in **n**Nautical **m**Miles **(NM)** unless specified otherwise.~~

~~u~~ **t** ‘Driven’~~.~~ **means a**~~A~~ state where the input stimulus or variable is ‘driven’ or deposited by automatic means, generally a computer input. The input stimulus or variable may not necessarily be an exact match to the flight test comparison data – but simply driven to certain predetermined values.

~~v~~ **u** ‘Engineering **s**~~S~~imulation’~~.~~ **means a**~~A~~n integrated set of mathematical models representing a specific aircraft configuration, which is typically used by the aircraft manufacturer for a wide range of engineering analysis tasks including engineering design, development and certification**.**~~;and~~ **It is also used** to generate data for checkout, proof-of-match/validation and other training FSTD data documents.

~~w~~ **v** ‘Engineering **s**~~S~~imulator’~~.The term for~~ **means** the aircraft manufacturer’s simulator**,** which typically includes a full-scale representation of the simulated aircraft flight deck, operates in real**-**time and can be flown by a pilot to subjectively evaluate the simulation. It contains the engineering simulation models, which are also released by the aircraft manufacturer to the industry for FSTDs**.**~~;and~~ **The engineering simulator** may or may not include actual on-board system hardware in lieu of software models.

~~x~~ **w** ‘Engineering **s**~~S~~imulator **d**~~D~~ata’~~.~~ **means d**~~D~~ata generated by an engineering simulation or engineering simulator, depending on the aircraft manufacturer’s processes.

~~y~~ **x** ‘Engineering **s**~~S~~imulator **v**~~V~~alidation **d**~~D~~ata’~~.~~ **means v**~~V~~alidation data generated by an engineering simulation or engineering simulator.

~~z~~ **y** ‘Entry into **s**~~S~~ervice’~~.~~ **r**~~R~~efers to the original state of the configuration and systems at the time a new or major derivative aircraft is first placed into commercial operation.

~~aa~~ **z** ‘Essential ~~M~~**m**atch’~~.~~ **m**~~M~~**eans a**~~A~~ comparison of two sets of computer-generated results for which the differences should be negligible because essentially the same simulation models have been used. Also known as a virtual match.

~~bb FSTD Approval. The extent to which an FSTD of a specified Qualification Level may be used by an operator or training organisation as agreed by the competent authority. It takes account of differences between aircraft and FSTDs and the operating and training ability of the organisation.~~

~~cc~~**aa** ‘FSTD **d**~~D~~ata’~~.~~ **means t**~~T~~he various types of data used by the FSTD manufacturer and the applicant to design, manufacture, test and maintain the FSTD.

~~dd~~ **bb** **'**FSTD **e**~~E~~valuation'~~.~~ **m**~~M~~**eans a**~~A~~ detailed appraisal of an FSTD by the **competent a**~~A~~uthority to ascertain whether or not the standard required for a specified **q**~~Q~~ualification **l**~~L~~evel is met.

~~ee~~ **cc** **'**FSTD **o**~~O~~perator**'**~~.~~ **m**~~M~~**eans t**~~T~~hat organisation directly responsible to the competent authority for requesting and maintaining the qualification of a particular FSTD.

~~ff FSTD **q**Qualification **l**Level. The level of technical capability of a FSTD.~~

~~gg~~ **dd** **'**Flight **t**~~T~~est **d**~~D~~ata**'**~~.~~ **means a**~~A~~ctual aircraft data obtained by the aircraft manufacturer (or other supplier of acceptable data) during an aircraft flight test programme.

~~hh~~ **ee** **'**Free **r**~~R~~esponse'~~.~~ **means t**~~T~~he response of the aircraft after completion of a control input or disturbance.

~~ii~~ **ff** **'**Frozen/**l**~~L~~ocked**'** ~~.~~**is a**~~A~~ state where a variable is held constant with time.

~~jj~~ **gg** **'**Fuel used**'**~~.~~ **means the m**~~M~~ass of fuel used (kilos or pounds)

~~kk~~ **hh** **'**Full **s**~~S~~weep**'** ~~.~~**means the m**~~M~~ovement of the controller from neutral to a stop, usually the aft or right stop, to the opposite stop and then to the neutral position.

~~ll~~ **ii** **'**Functional **p**~~P~~erformance'~~.~~ **means a**~~A~~n operation or performance that can be verified by objective data or other suitable reference material that may not necessarily be flight test data.

~~mm~~ **jj** **'**Functions **t**~~T~~est**'** ~~.~~**means a**~~A~~ quantitative and/or qualitative assessment of the operation and performance of an FSTD by a suitably qualified evaluator. The test can include verification of correct operation of controls, instruments, and systems of the simulated aircraft under normal and non-normal conditions. Functional performance is that operation or performance that can be verified by objective data or other suitable reference material which may not necessarily be **f**~~F~~light **t**~~T~~est **d**~~D~~ata.

~~nn~~ **kk** **'**Grandfather **r**~~R~~ights'~~.~~ **means t**~~T~~he right of an FSTD operator to retain the **q**~~Q~~ualification **l**~~L~~evel granted under a previous regulation of a**n** EASA Member State. **It a**~~A~~lso **means** the right of an FSTD user to retain the training and testing/checking credits ~~which~~ **that** were gained under a previous regulation of a**n** EASA Member State.

~~oo~~ **ll** **'**Ground **e**~~E~~ffect**'** ~~.~~**means t**~~T~~he change in aerodynamic characteristics due to modification of the air flow past the aircraft caused by the presence of the ground.

~~pp~~ **mm** 'Hands-off **m**~~M~~anoeuvre**'** **means** ~~.~~**a**~~A~~ test manoeuvre conducted or completed without pilot control inputs.

~~qq~~ **nn** 'Hands-on **m**~~M~~anoeuvre**'**~~.~~ **means a**~~A~~ test manoeuvre conducted or completed with pilot control inputs as required.

~~rr~~ **oo** 'Heavy**'** **means with**~~.~~ **o**~~O~~perational mass at or near maximum for the specified flight condition.

~~ss~~ **pp** 'Height'~~.~~ **means the h**~~H~~eight above ground ~~=~~ ***/*** AGL (m~~eters~~ or f~~eet~~)

~~tt~~ **qq** 'Highlight **b**~~B~~rightness'~~.~~ **means t**~~T~~he maximum displayed brightness~~, which~~ **that** satisfies the appropriate brightness test.

~~uu~~ **rr** 'Icing **a**~~A~~ccountability'~~.~~ **means a**~~A~~ demonstration of minimum required performance whilst operating in maximum and intermittent maximum icing conditions of the applicable airworthiness requirement. Refers to changes from normal (as applicable to the individual aircraft design) in take-off, climb (en-route, approach, landing) or landing operating procedures or performance data, in accordance with the AFM~~/RFM~~, for flight in icing conditions or with ice accumulation on unprotected surfaces.

~~vv~~ **ss** **'**Integrated **t**~~T~~esting**' means**~~.~~ **t**~~T~~esting of the FSTD such that all aircraft system models are active and contribute appropriately to the results. None of the aircraft system models should be substituted with models or other algorithms intended for testing only. This may be accomplished by using controller displacements as the input. These controllers should represent the displacement of the pilot's controls and these controls should have been calibrated.

~~ww~~ **tt** **'**Irreversible **c**~~C~~ontrol **s**~~S~~ystem'~~.~~ **means a**~~A~~ control system in which movement of the control surface will not backdrive the pilot's control on the flight deck.

~~xx~~ **uu** **'**Latency**'**~~.~~ **means t**~~T~~he additional time, beyond that of the basic perceivable response time of the aircraft due to the response time of the FSTD.

~~yy~~ **vv** **'**Light**'**~~.~~ **means with o**~~O~~perational mass at or near minimum for the specified flight condition.

~~zz~~ **ww** **'**Line **o**~~O~~riented **f**~~F~~light **t**~~T~~raining (LOFT)**'**~~.~~**r**~~R~~efers to ~~aircrew~~ **flight crew** training which involves full mission simulation of situations which are representative of line operations, with special emphasis on situations which involve communications, management and leadership. It means 'real-time', full-mission training.

~~aaa~~ **xx** **'**Manual **t**~~T~~esting**' means**~~.~~ FSTD testing where~~in~~ the pilot conducts the test without computer inputs except for initial setup. All modules of the simulation should be active.

~~bbb~~ **yy** **'**'Master **q**~~Q~~ualification **t**~~T~~est **g**~~G~~uide (MQTG)**'**~~.~~**means t**~~T~~he competent authority approved QTG which incorporates the results of tests witnessed by the **competent a**~~A~~uthority. The MQTG serves as the reference for future evaluations.

~~ccc~~ **zz** **'**Medium**'**~~.~~ **means the** ~~N~~**n**ormal operational weight for flight segment.

~~ddd~~ **aaa** 'Night **v**~~V~~isual**'**~~.~~ **means a**~~A~~ visual system capable of meeting, as a minimum, the system brightness and contrast ratio requirements and performance criteria appropriate for the level of qualification sought. The system, when used in training, should provide, as a minimum, all features applicable to the twilight scene, as defined below, with the exception of the need to portray reduced ambient intensity that removes ground cues that are not self-illuminating or illuminated by own ship lights (e.g. landing lights).

~~eee~~ **bbb** 'Nominal**'**~~.~~ **means the n**~~N~~ormal operational weight, configuration, speed etc. for the flight segment specified.

~~fff~~ **ccc** **'**Non-normal **c**~~C~~ontrol**'**~~.~~ **is a**~~A~~ term used in reference to **c**~~C~~omputer **c**~~C~~ontrolled **a**~~A~~ircraft. Non-normal Control is the state where one or more of the intended control, augmentation or protection functions are not fully available.

~~(~~NOTE: Specific terms such as ALTERNATE, DIRECT, SECONDARY, BACKUP, etc, may be used to define an actual level of degradation~~)~~.

~~ggg~~ **ddd** 'Normal **c**~~C~~ontrol**'**~~.A~~ **is a** term used in reference to **c**~~C~~omputer **c**~~C~~ontrolled **a**~~A~~ircraft. Normal **c**~~C~~ontrol is the state where the intended control, augmentation and **p**~~P~~rotection **f**~~F~~unctions are fully available.

~~hhh~~ **eee** 'Objective **t**~~T~~est (**o**~~O~~bjective **t**~~T~~esting)**' means**~~.~~ **a**~~A~~ quantitative assessment based on comparison with data.

~~iii~~ **fff** **'**One **s**~~S~~tep**'**~~.~~ **r**~~R~~efers to the degree of changes to an aircraft that would be allowed as an acceptable change, relative to a fully ~~flight-test~~**flight test** validated simulation. The intention of the alternative approach is that changes would be limited to one, rather than a series, of steps away from the baseline configuration. It is understood, however, that those changes ~~which~~ **that** support the primary change (e.g. weight, thrust rating and control system gain changes accompanying a body length change) are considered part of the 'one step'.

~~jjj Operator. A person, organisation or enterprise engaging in or offering to engage in an aircraft operation.~~

~~kkk~~ **ggg** **'**Power **l**~~L~~ever **a**~~A~~ngle**'**~~.~~ **means t**~~T~~he angle of the pilot's primary engine control lever(s) on the flight deck. This may also be referred to as PLA, ~~THROTTLE~~**throttle**, or ~~POWER LEVER~~**power lever**.

~~lll~~ **hhh** **'**Predicted **d**~~D~~ata**' means**~~.~~ **d**~~D~~ata derived from sources other than type**-**specific aircraft flight tests.

~~mmm~~ **iii** **'**Primary **r**~~R~~eference **d**~~D~~ocument**'**~~.~~ **means a**~~A~~ny regulatory document which has been used by a competent authority to support the initial evaluation of a**n** FSTD.

~~nnn~~ **jjj** **'**Proof-of-**m**~~M~~atch (POM)**'**~~.~~**means a**~~A~~ document ~~which~~ **that** shows agreement within defined tolerances between model responses and flight test cases at identical test and atmospheric conditions.

~~ooo~~ **kkk** **'**Protection **f**~~F~~unctions**'**~~.~~ **means s**~~S~~ystems functions designed to protect an aircraft from exceeding its flight and manoeuvre limitations.

~~ppp~~ **lll** **'**Pulse **i**~~I~~nput**'**~~.~~ **means a**~~A~~n abrupt input to a control followed by an immediate return to the initial position.

~~qqq Qualification Test Guide (QTG). The primary reference document used for the evaluation of an FSTD. It contains test results, statements of compliance and other information to enable the evaluator to assess if the FSTD meets the test criteria described in this manual.~~

~~rrr~~ **mmm** **'**Reversible **c**~~C~~ontrol **s**~~S~~ystem**'**~~.~~ **means a**~~A~~ partially powered or unpowered control system in which movement of the control surface will backdrive the pilot's control on the flight deck and/or affect its feel characteristics.

~~sss~~ **nnn** **'**Robotic **t**~~T~~est**'**~~.~~ **means a**~~A~~ basic performance check of a system's hardware and software components. Exact test conditions are defined to allow for repeatability. The components are tested in their normal operational configuration and may be tested independently of other system components.

~~ttt Sideslip. Sideslip Angle (degrees)~~

~~uuu~~ **ooo** **'**Snapshot**'**~~.~~ **means a**~~A~~ presentation of one or more variables at a given instant of time.

~~vvv~~ **ppp** **'**Statement of **c**~~C~~ompliance (SOC)**'**~~.~~ **means a**~~A~~ declaration that specific requirements have been met.

~~www~~ **qqq** **'**Step **i**~~I~~nput**'**~~.~~ **means a**~~A~~n abrupt input held at a constant value.

~~xxx~~ **rrr** **'**Subjective **t**~~T~~est (**s**~~S~~ubjective **t**~~T~~esting)**'**~~.~~**means a**~~A~~ qualitative assessment based on established standards as interpreted by a suitably qualified person.

~~yyy~~ **sss** **'**Throttle **l**~~L~~ever **a**~~A~~ngle (TLA)**'**~~.~~**means t**~~T~~he angle of the pilot's primary engine control lever(s) on the flight deck.

~~zzz~~ **ttt** **'**Time **h**~~H~~istory**'**~~.~~ **means a**~~A~~ presentation of the change of a variable with respect to time.

~~aaaa~~ **uuu** **'**Transport **d**~~D~~elay**'**~~.~~ **means t**~~T~~he total FSTD system processing time required for an input signal from a pilot primary flight control until the motion system, visual system, or instrument response. It is the overall time delay incurred from signal input until output response. It does not include the characteristic delay of the aircraft simulated.

~~bbbb~~ **vvv** **'**Twilight (**d**~~D~~usk/**d**~~D~~awn) **v**~~V~~isual**'**~~.~~ **means a**~~A~~ visual system capable of meeting, as a minimum, the system brightness and contrast ratio requirements and performance criteria appropriate for the level of qualification sought. The system, when used in training, should provide, as a minimum, full colour presentations of reduced ambient intensity (as compared with a daylight visual system), sufficient to conduct a visual approach, landing and airport movement (taxi)

~~cccc~~ **www** **'**Update**'**~~.~~ **means t**~~T~~he improvement or enhancement of an FSTD.

~~dddd~~ **xxx** **'**Upgrade'~~.~~ **means t**~~T~~he improvement or enhancement of an FSTD for the purpose of achieving a higher qualification.

~~eeee~~ **yyy** **'**Validation **d**~~D~~ata**'**~~.~~ **means d**~~D~~ata used to prove that the FSTD performance corresponds to that of the aircraft~~.~~**, class of aeroplane or type of helicopter.**

~~ffff~~ **zzz** **'**Validation **f**~~F~~light **t**~~T~~est **d**~~D~~ata**'**~~.~~ **means p**~~P~~erformance, stability and control, and other necessary test parameters**,** electrically or electronically recorded in an aircraft using a calibrated data acquisition system of sufficient resolution and verified as accurate by the organisation performing the test**,** to establish a reference set of relevant parameters to which like FSTD parameters can be compared.

~~gggg~~ **aaaa** **'**Validation **t**~~T~~est**'**~~.~~ **means a**~~A~~ test by which FSTD parameters can be compared with the relevant validation data.

~~hhhh~~ **bbbb** **'**Visual **g**~~G~~round **s**~~S~~egment **t**~~T~~est**'**~~.~~ **means a**~~A~~ test designed to assess items impacting the accuracy of the visual scene presented to the pilot at a decision height (DH) on an **instrument landing system (**ILS**)** approach.

~~iiii~~ **cccc** **'**Visual **s**~~S~~ystem **r**~~R~~esponse **t**~~T~~ime**'**~~.~~ **means t**~~T~~he interval from an abrupt control input to the completion of the visual display scan of the first video field containing the resulting different information.

~~jjjj~~**dddd** **'**Well-**u**~~U~~nderstood **e**~~E~~ffect**' means**~~.~~ **a**~~A~~n incremental change to a configuration or system ~~which~~ **that** can be accurately modelled using proven predictive methods based on known characteristics of the change.

2 Abbreviations

A	=	**a**~~A~~eroplane
AC	=	Advisory Circular
ACJ	=	Advisory Circular Joint
A/C	=	**a**~~A~~ircraft
Ad	=	**t**~~T~~otal initial displacement of pilot controller (initial displacement to final resting amplitude)
ADF	**=**	**automatic direction finder**
AFM	=	**a**~~A~~ircraft **f**~~F~~light **m**~~M~~anual
AFCS	=	**a**~~A~~utomatic **f**~~F~~light **c**~~C~~ontrol **s**~~S~~ystem
AGL	=	**a**~~A~~bove **g**~~G~~round **l**~~L~~evel (m~~etres~~ or f~~ee~~t)
A_n	=	**s**~~S~~equential amplitude of overshoot after initial X axis crossing, e.g. A1 = 1st overshoot.
AEO	=	**a**~~A~~ll **e**~~E~~ngines **o**~~O~~perating
AOA	=	**a**~~A~~ngle of **a**~~A~~ttack (degrees)
ATO	**=**	**approved training organisation**
BC	=	ILS localizer back course
CAT I/II/III	=	**l**~~L~~anding category operations
CCA	=	**c**~~C~~omputer **c**~~C~~ontrolled **a**~~A~~eroplane
cd/m^2	=	**c**~~C~~andela/metre^2, 3.4263 candela/m^2 = 1 ft-Lambert
CG	=	**c**~~C~~entre of gravity
cm(s)	=	**c**~~C~~entimetre, centimetres
CS	**=**	**certification specifications**
CT&M	=	**c**~~C~~orrect **t**~~T~~rend and **m**~~M~~agnitude
daN	=	**d**~~D~~ecaNewtons
dB	=	**d**~~D~~ecibel
deg(s)	=	**d**~~D~~egree, degrees
DGPS	=	**d**~~D~~ifferential **g**~~G~~lobal **p**~~P~~ositioning **s**~~S~~ystem
DH	=	**d**~~D~~ecision **h**~~H~~eight
DME	=	**d**~~D~~istance **m**~~M~~easuring **e**~~E~~quipment
DPATO	=	**d**~~D~~efined **p**~~P~~oint **a**~~A~~fter **t**~~T~~ake-off
DPBL	=	**d**~~D~~efine**d** **p**~~P~~oint **b**~~B~~efore **l**~~L~~anding
EGPWS	=	**e**~~E~~nhanced **g**~~G~~round **p**~~P~~roximity **w**~~W~~arning **s**~~S~~ystem
EPR	=	**e**~~E~~ngine **p**~~P~~ressure **r**~~R~~atio
EW	=	**e**~~E~~mpty **w**~~W~~eight
FAA	=	United States Federal Aviation Administration~~ (U.S.)~~
FD	=	~~F~~**f**light **d**~~D~~irector
FOV	=	**f**~~F~~ield Of **v**~~V~~iew
FPM	=	**f**~~F~~eet **p**~~P~~er **m**~~M~~inute
~~FTO~~	~~=~~	~~Flying **flight t**Training **o**Organisation~~
ft	=	**f**~~F~~eet, 1 foot = 0.304801 metres
ft-Lambert	=	**f**~~F~~oot-Lambert, 1 ft-Lambert = 3.4263 candela/m^2
g	=	**a**~~A~~cceleration due to gravity (m~~etres~~ or f~~ee~~t/s^2), 1g = 9.81 m/s^2 or 32.2 f~~ee~~t/s^2
G/S	=	**g**~~G~~lideslope
GPS	=	**g**~~G~~lobal **p**~~P~~ositioning **s**~~S~~ystem

GPWS	=	**g**~~G~~round **p**~~P~~roximity **w**~~W~~arning **s**~~S~~ystem
H	=	**h**~~H~~elicopter
HGS	=	**h**~~H~~ead-up **g**~~G~~uidance **s**~~S~~ystem
HIS	**=**	**horizontal situation indicator**
IATA	=	International Air Transport Association
ICAO	=	International Civil Aviation Organisation
IGE	=	**i**~~I~~n **g** ~~G~~round **e**~~E~~ffect
ILS	=	**i**~~I~~nstrument **l**~~L~~anding **s**~~S~~ystem
IMC	=	**i**~~I~~nstrument **m**~~M~~eteorological **c**~~C~~onditions
in	=	**i**~~I~~nches 1 in = 2.54 cm
IOS	=	**i**~~I~~nstructor **o**~~O~~perating **s**~~S~~tation
IPOM	=	**i**~~I~~ntegrated proof of match
IQTG	=	International Qualification Test Guide (RAeS Document)
JAA	=	Joint Aviation Authorities
~~JAR~~	~~=~~	~~Joint Aviation Requirement~~
JAWS	=	Joint Airport Weather Studies
JOEB	**=**	**Joint Operations Evaluation Board (JAA)**
km	=	**k**~~K~~ilometres 1 km = 0.62137 Statute Miles
kPa	=	**k**~~K~~iloPascal (**k**~~K~~ilo Newton/**m**~~M~~etres^2). 1 psi = 6.89476 kPa
kts	=	**k**~~K~~nots calibrated airspeed unless otherwise specified, 1 **k**~~K~~not = 0.5148 m/s or 1.689 ft/s
lb	=	**p**~~P~~ounds
LOC	=	**l**~~L~~ocali**s**~~z~~er
LOFT	=	**l**~~L~~ine oriented flight training
LOS	=	**l**~~L~~ine oriented simulation
LDP	=	**l**~~L~~anding **d**~~D~~ecision **p**~~P~~oint
m	=	**m**~~M~~etres, 1 **m**~~M~~etre = 3.28083 f~~ee~~t
MCC	=	**m**~~M~~ulti-**c**~~C~~rew **c**~~C~~o–operation
MCTM	=	**m**~~M~~aximum certificated take-off mass (kilos/pounds)
MEH	=	**m**~~M~~ulti-engine **h**~~H~~elicopter
min	=	**m**~~M~~inutes
MLG	=	**m**~~M~~ain landing gear
mm	=	**m**~~M~~illimetres
MPa	=	**m**~~M~~egaPascals [1 psi = 6894.76 pascals]
MQTG	=	**m**~~M~~aster **q**~~Q~~ualification **t**~~T~~est **g**~~G~~uide
ms	=	**m**~~M~~illisecond(s)
MTOW	=	**m**~~M~~aximum **t**~~T~~ake-off **w**~~W~~eight
n	=	**s**~~S~~equential period of a full cycle of oscillation
N	=	~~NORMAL CONTROL~~**normal control, u** ~~U~~sed in reference to **c**~~C~~omputer **c**~~C~~ontrolled **a**~~A~~ircraft
N/A	=	**n**~~N~~ot **a**~~A~~pplicable
N1	=	**e**~~E~~ngine **l**~~L~~ow **p**~~P~~ressure **r**~~R~~otor revolutions per minute expressed in percent of maximum
N1/Ng	=	**g**~~G~~as **g**~~G~~enerator **s**~~S~~peed
N2	=	**e**~~E~~ngine **h**~~H~~igh **p**~~P~~ressure **r**~~R~~otor revolutions per minute expressed in percent of maximum

N2/Nf	=	**f**~~F~~ree **t**~~T~~urbine **s**~~S~~peed
~~NAA~~	~~=~~	~~**n**National **a**Aviation **a**Authority~~
NDB	=	**n**~~N~~on-directional beacon
NM	=	**n**~~N~~autical **m**~~M~~ile, 1 **n**~~N~~autical **m**~~M~~ile = 6 080 f~~ee~~t = 1 852 m
NN	=	**n**~~N~~on-normal control a state referring to computer**-**controlled aircraft
NR	=	**m**~~M~~ain **r**~~R~~otor **s**~~S~~peed
NWA	=	**n**~~N~~osewheel **a**~~A~~ngle (degrees)
OEB	**=**	**Operations Evaluation Board**
OEI	=	**o**~~O~~ne **e**~~E~~ngine **i**~~I~~noperative
OGE	=	**o**~~O~~ut of **g**~~G~~round **e**~~E~~ffect
OM-B	=	**o**~~O~~perations **m**~~M~~anual – **p**~~P~~art B (AFM)
OTD	=	**o**~~tO~~ther **t**~~T~~raining **d**~~D~~evice
P0	=	**t**~~T~~ime from pilot controller release until initial X axis crossing (X axis defined by the resting amplitude)
P1	=	**f**~~F~~irst full cycle of oscillation after the initial X axis crossing
P2	=	**s**~~S~~econd full cycle of oscillation after the initial X axis crossing
PANS	=	**p**~~P~~rocedure for air navigation services
PAPI	=	**p**~~P~~recision **a**~~A~~pproach **p**~~P~~ath **i**~~I~~ndicator **s**~~S~~ystem
PAR	=	**p**~~P~~recision approach radar
Pf	=	**i**~~I~~mpact or **f**~~F~~eel **p**~~P~~ressure
PLA	=	**p**~~P~~ower **l**~~L~~ever **a**~~A~~ngle
PLF	=	**p**~~P~~ower for **l**~~L~~evel **f**~~F~~light
Pn	=	**s**~~S~~equential period of oscillation
POM	=	**p**~~P~~roof-of-**m**~~M~~atch
PSD	=	**p**~~P~~ower **s**~~S~~pectral **d**~~D~~ensity
psi	=	pounds per square inch. (1 psi = 6·89476 kPa)
PTT	=	**p**~~P~~art-**t**~~T~~ask **t**~~T~~rainer
QTG	=	**q**~~Q~~ualification **t**~~T~~est **g**~~G~~uide
R/C	=	**r**~~R~~ate of **c**~~C~~limb (m~~etres~~/s or f~~ee~~t/min)
R/D	=	**r**~~R~~ate of **d**~~D~~escent (m~~etres~~/s or f~~ee~~t/min)
RAE	=	Royal Aerospace Establishment
RAeS	=	Royal Aeronautical Society
REIL	=	**r**~~R~~unway **e**~~E~~nd **i**~~I~~dentifier **l**~~L~~ights
RNAV	=	**r**~~R~~adio navigation
RVR	=	**r**~~R~~unway **v**~~V~~isual **r**~~R~~ange (m~~etres~~ or f~~ee~~t)
s	=	second(s)
sec(s)	=	second, seconds
sm	=	**s**~~S~~tatute **m**~~M~~ile 1 **s**~~S~~tatute **m**~~M~~ile = 5280 f~~ee~~t = 1609 m
SOC	=	**s**~~S~~tatement of **c**~~C~~ompliance
SUPPS	=	**s**~~S~~upplementary procedures referring to regional supplementary procedures
TCAS	=	**t**~~T~~raffic alert and **c**~~C~~ollision **a**~~A~~voidance **s**~~S~~ystem
~~TGL~~	~~=~~	~~Temporary Guidance Leaflet~~
T(A)	=	**t**~~T~~olerance applied to **a**~~A~~mplitude
T(p)	=	**t**~~T~~olerance applied to period
T/O	=	**t**~~T~~ake-off
Tf	=	**t**~~T~~otal time of the flare manoeuvre duration

Ti	=	**t**~~T~~otal time from initial throttle movement until a 10% response of a critical engine parameter
TLA	=	**t**~~T~~hrottle lever angle
TLOF	=	**t**~~T~~ouchdown and **l**~~L~~ift **o**~~O~~ff
TDP	=	**t**~~T~~ake-off **d**~~D~~ecision **p**~~P~~oint
Tt	=	**t**~~T~~otal time from Ti to a 90% increase or decrease in the power level specified
VASI	=	**v**~~V~~isual **a**~~A~~pproach **s**~~S~~lope **i**~~I~~ndicator ~~S~~**s**ystem
VDR	=	**v**~~V~~alidation **d**~~D~~ata **r**~~R~~oadmap
VFR	=	**v**~~V~~isual **f**~~F~~light **r**~~R~~ules
VGS	=	**v**~~V~~isual **g**~~G~~round **s**~~S~~egment
Vmca	=	**m**~~M~~inimum **c**~~C~~ontrol **s**~~S~~peed (**a**~~A~~ir)
Vmcg	=	**m**~~M~~inimum **c**~~C~~ontrol **s**~~S~~peed (**g**~~G~~round)
Vmcl	=	**m**~~M~~inimum **c**~~C~~ontrol **s**~~S~~peed (**l**~~L~~anding)
VOR	=	VHF omni-directional range
Vr	=	**r**~~R~~otate Speed
Vs	=	**s**~~S~~tall **s**~~S~~peed or minimum speed in the stall
V_1	=	**c**~~C~~ritical **d**~~D~~ecision **s**~~S~~peed
V_{TOSS}	=	**t**~~T~~ake-off **s**~~S~~afety **s**~~S~~peed
V_y	=	**o**~~O~~ptimum **c**~~C~~limbing **s**~~S~~peed
V_w	=	**w**~~W~~ind **v**~~V~~elocity
WAT	=	**w**~~W~~eight, **a**~~A~~ltitude, **t**~~T~~emperature
1st Segment	=	That portion of the take-off profile from lift-off to completion of gear retraction (~~JAR~~ **CS-**25)
2nd Segment	=	That portion of the take-off profile from after gear retraction to end of climb at V_2 and initial flap/slat retraction (**CS**~~Part~~-25)
3rd Segment	=	That portion of the take-off profile after flap/slat retraction is complete (**CS**~~Part~~**-**25)

SUBPART C – AEROPLANE FLIGHT SIMULATION TRAINING DEVICES

AMC~~ No.~~ 1**-**~~ to~~ CS**-**FSTD(A).300 Qualification basis

1. Introduction

1.1 Purpose.
This AMC establishes the criteria that define the performance and documentation requirements for the evaluation of FSTDs used for training, testing and checking of flight crewmembers. These test criteria and methods of compliance were derived from extensive experience of **competent a**~~A~~uthorities and the industry.

1.2 Background.

1.2.1 The availability of advanced technology has permitted greater use of FSTDs for training, testing and checking of flight crewmembers. The complexity, costs and operating environment of modern aircraft also encourage~~s~~ broader use of advanced simulation. FSTDs can provide more in-depth training than can be accomplished in aircraft and provide a safe and suitable learning environment. Fidelity of modern FSTDs is sufficient to permit pilot assessment with the assurance that the observed behaviour will transfer to the aircraft. Fuel conservation and reduction in adverse environmental effects are important by-products of FSTD use.

1.2.2 The methods, procedures, and testing criteria contained in this AMC are the result of the experience and expertise of **competent a**~~A~~uthorities, operators, and aeroplane and FSTD manufacturers. From 1989 to 1992 a specially convened international working group under the sponsorship of the Royal Aeronautical Society (RAeS) held several meetings with the stated purpose of establishing common test criteria that would be recognised internationally. The final RAeS document, entitled *International Standards for the Qualification of Airplane Flight Simulators*, dated January 1992 (ISBN 0–903409–98–4), was the core document used to establish these criteria and also the ICAO **Doc 9625** *Manual of Criteria for the Qualification of Flight Simulators* (1995 or as amended). An international review under the co-chair of FAA and JAA during 2001 was the basis for a major modification of the ICAO Manual~~of Criteria for the Qualification of Flight Simulators (1995 or as amended)~~ and for this ~~document~~**CS**.

1.2.3 In showing compliance with CS–FSTD(A).300, the **competent a**~~A~~uthority expects account to be taken of the IATA document entitled ***Flight Simulation Training Device Design & Performance Data Requirements*, 7th edition,** ~~'Design and Performance Data Requirements for Flight Simulators' – (1996 or as amended),~~ as appropriate to the **q**~~Q~~ualification **l**~~L~~evel sought. In any case early contact with the **competent a**~~A~~uthority is advised at the initial stage of FSTD build to verify the acceptability of the data.

1.3 Levels of FSTD qualification.

~~Parts~~ **Subparagraphs** 2 and 3 of this AMC describe the minimum requirements for qualifying **l**~~L~~evel A, B, C and D aeroplane FFS, **l**~~L~~evel 1 and 2 aeroplane FTDs, FNPT types I, II and II MCC and BITDs.

See also Appendix 1 to CS**-**FSTD(A).300

1.4 Terminology.

Terminology and abbreviations of terms used in this AMC are contained in AMC**1-**~~ to ~~CS**-**FSTD(A).200.

1.5 Testing for FSTD qualification.

1.5.1 The FSTD should be assessed in those areas that are essential to completing the flight crewmember training, testing and checking process. This includes the FSTD**'**s~~'~~ longitudinal and lateral-directional responses; performance in take-off, climb, cruise, descent, approach, landing; specific operations; control checks; flight deck, flight engineer, and instructor station functions checks; and certain additional requirements depending on the complexity or **q**~~Q~~ualification **l**~~L~~evel of the FSTD. The motion and visual systems (where applicable) ~~will~~ **should** be evaluated to ensure their proper operation. Tolerances listed for parameters in the validation tests (**subp**~~P~~aragraph 2) of this AMC are the maximum acceptable for FSTD qualification and should not be confused with FSTD design tolerances.

1.5.2 For FFSs and FTDs the intent is to evaluate the FSTD as objectively as possible. Pilot acceptance, however, is also an important consideration. Therefore, the FSTD ~~will~~ **should** be subjected to validation, and functions and subjective tests listed in ~~Part~~ 2 and 3 of this AMC.

Validation tests are used to compare objectively FFSs and FTDs with aircraft data to ensure that they agree within specified tolerances. Functions and subjective tests provide a basis for evaluating FSTD capability to perform over a typical training period and to verify correct operation of the FSTD.

1.5.3 For initial qualification of FFSs and FTDs aeroplane manufacturer~~'~~s**'** validation flight test data is preferred. Data from other sources may be used, subject to the review and concurrence of the **competent a**~~A~~uthority.

1.5.4 For FNPTs and BITDs generic data packages can be used~~. In this case,~~**;** for an initial evaluation only **c**~~C~~orrect **t**~~T~~rend and **m**~~M~~agnitude (CT&M) ~~can~~ **should** be used. The tolerances listed in this AMC are applicable for recurrent evaluations and should be applied to ensure the device remains at the standard initially qualified.

For initial qualification testing of FNPTs and BITDs, **v**~~V~~alidation **d**~~D~~ata ~~will~~ **should** be used. They may be derived from a specific aeroplane within the class of aeroplane the FNPT or BITD is representing or they may be based on information from several aeroplanes within the class. With the concurrence of the **competent a**~~A~~uthority, it may be in the form of a manufacturer's previously approved set of **v**~~V~~alidation ~~D~~**d**ata for the applicable FNPT or BITD. Once the set of data for a specific FNPT or BITD has been accepted and approved by the **competent a**~~A~~uthority, it will become the **v**~~V~~alidation **d**~~D~~ata that ~~will~~ **should** be used as reference for subsequent recurrent evaluations with the application of the stated tolerances.

The substantiation of the set of data used to build the **v**~~V~~alidation **d**~~D~~ata should be in the form of an engineering report and ~~shall~~ **should** show that the proposed **v**~~V~~alidation **d**~~D~~ata are representative of the aeroplane or the class of aeroplane modelled. This report may include flight test data, manufacturer's design data, information from the ~~Aeroplane~~ **aircraft f**~~F~~light **m**~~M~~anual ~~(AFM)~~ and **m**~~M~~aintenance **m**~~M~~anuals, results of approved or commonly accepted simulations or predictive models, recognized theoretical results, information from the public domain, **subjective assessment of a qualified pilot** or other sources as deemed necessary by the FSTD manufacturer to substantiate the proposed model.

1.5.5 In the case of new aircraft programmes, the aircraft manufacturer's data partially validated by flight test data~~,~~ may be used in the interim qualification of the FSTD. **This is consistent with the possible interim approval of operational suitability data (OSD) relative to FFSs in the type certification process under Part-21.** However, the FSTD should be re-evaluated following the release of the manufacturer's ~~approved~~ **final** data **in accordance with the final definition of scope of the aircraft validation source data to support the objective qualification of the OSD as approved under Part-21**. The schedule should be as agreed by the **competent a**~~A~~uthority, FSTD operator, FSTD manufacturer, and aircraft manufacturer.

1.5.6 FSTD operators seeking initial or upgrade evaluation of a**n** FSTD should be aware that performance and handling data for older aircraft may not be of sufficient quality to meet some of the test standards contained in this AMC. In this instance it may be necessary for an operator to acquire additional flight test data.

1.5.7 During FSTD evaluation, if a problem is encountered with a particular validation test, the test may be repeated to ascertain if the problem was caused by test equipment or FSTD operator error. Following this, if the test problem persists, an FSTD operator should be prepared to offer an alternative test.

1.5.8 Validation tests that do not meet the test criteria should be addressed to the satisfaction of the ~~Authority~~**competent authority**.

1.6 Qualification **t**~~T~~est **g**~~G~~uide (QTG).

1.6.1 The QTG is the primary reference document used for evaluating a**n** FSTD. It contains test results, statements of compliance and other information for the evaluator to assess if the FSTD meets the test criteria described in this AMC.

1.6.2 The FSTD operator (in **the** case of a BITD the manufacturer) should submit a QTG ~~that~~ **which** includes **the following**:

a. A title page with FSTD operator (in **the** case of a BITD the manufacturer) and approval **a**~~A~~uthority signature blocks.

b. A**n** FSTD information page (for each configuration in the case of convertible FSTDs) providing:

i. FSTD operator's FSTD identification number, for a BITD the model and serial number.

ii. **a**~~A~~eroplane model and series being simulated~~.~~**-** **f**~~F~~or FNPTs and BITDs aeroplane model or class being simulated.

iii. **r**~~R~~eferences to aerodynamic data or sources for aerodynamic model.

iv. **r**~~R~~eferences to engine data or sources for engine model.

v. **r**~~R~~eferences to flight control data or sources for flight controls model.

vi. **a**~~A~~vionic equipment system identification where the revision level affects the training and checking capability of the FSTD.

vii. FSTD model and manufacturer.

viii. **d**~~D~~ate of FSTD manufacture.

ix. FSTD computer identification.

x. **v**~~V~~isual system type and manufacturer (if fitted)~~.~~**; and**

xi. **m**~~M~~otion system type and manufacturer (if fitted).

c. Table of contents.

d. List of effective pages and log of test revisions.

e. Listing of all reference and source data.

f. Glossary of terms and symbols used.

g. Statements of **c**~~C~~ompliance (SOC) with certain requirements. SOC~~'~~s should refer to sources of information and show compliance rationale to explain how the referenced material is used, applicable mathematical equations and parameter values, and conclusions reached.

h. Recording procedures and required equipment for the validation tests.

i. The following items are required for each validation test:

i. Test title**:**~~.~~ **t**~~T~~his should be short and definitive, based on the test title referred to in paragraph 2.3 of this AMC;

ii. Test objective**:**~~.~~ **t**~~T~~his should be a brief summary of what the test is intended to demonstrate;

iii. Demonstration procedure**:**~~.~~ **t**~~T~~his is a brief description of how the objective is to be met;

iv. References**:**~~.~~ **t**~~T~~hese are the aeroplane data source documents including both the document number and the page or condition number;

v. Initial conditions**:**~~.~~ **a**~~A~~ full and comprehensive list of the test initial conditions is required;

vi. Manual test procedures**:**~~.~~ **p**~~P~~rocedures should be sufficient to enable the test to be flown by a qualified pilot, using reference to flight deck instrumentation and without reference to other parts of the QTG or flight test data or other documents;

vii. Automatic test procedures (if applicable)**;**~~.~~

viii. Evaluation criteria**:**~~.~~ **s**~~S~~pecify the main parameter(s) under scrutiny during the test;

ix. Expected result(s)**:**~~.~~ **t**~~T~~he aeroplane result, including tolerances and, if necessary, a further definition of the point at which the information was extracted from the source data. For FNPTs and BITDs, the initial validation test result including tolerances is sufficient**;**~~.~~

x. Test result**:**~~.~~ **d**~~D~~ated FSTD validation test results obtained by the FSTD operator. Tests run on a computer that is independent of the FSTD are not acceptable. For a BITD the validation test results are normally obtained by the manufacturer**.**~~;~~

xi. Source data**:**~~.~~ **c**~~C~~opy of the aeroplane source data **(in the case of**

FFS/FTD) or other validation data (in the case of FNPT/BITD), clearly marked with the document, page number, issuing authority, and the test number and title as specified in~~sub-para (i)~~**1.6.2.i.~~ii~~** above. Computer generated displays of flight test data **(in the case of FFS/FTD) or other validation data (in the case of FNPT/BITD)** overplotted with FSTD data are insufficient on their own for this requirement**. As applicable, the source data should be the data as defined by the operational suitability data (OSD) established in accordance with Part-21.;**~~.~~

xii. Comparison of results**:**~~.~~ **a**~~A~~n acceptable means of easily comparing FSTD test results with the validation data.

xiii. The preferred method is overplotting. The FSTD operator's FSTD test results should be recorded on a multi-channel recorder, line printer, electronic capture and display or other appropriate recording media acceptable to the **competent a**~~A~~uthority conducting the test. FSTD results should be labelled using terminology common to aeroplane parameters as opposed to computer software identifications. These results should be easily compared with the supporting data by employing cross plotting or other acceptable means. Aeroplane data documents included in the QTG may be photographically reduced only if such reduction will not alter the graphic scaling or cause difficulties in scale interpretation or resolution. Incremental scales on graphical presentations should provide resolution necessary for evaluation of the parameters shown in paragraph 2 **below**. The test guide will provide the documented proof of compliance with the FSTD validation tests in the tables in paragraph 2 **below**. For tests involving time histories, flight test data sheets, FSTD test results should be clearly marked with appropriate reference points to ensure an accurate comparison between the FSTD and aeroplane with respect to time. FSTD operators using line printers to record time histories should clearly mark that information taken from line printer data output for cross plotting on the aeroplane data. The cross plotting of the FSTD operator's FSTD data to aeroplane data is essential to verify FSTD performance in each test. The evaluation serves to validate the FSTD operator's FSTD test results.

j. A copy of the version of the primary reference document as agreed with the **competent a**~~A~~uthority and used in the initial evaluation should be included.

1.6.3 Use of an electronic qualification test guide (eQTG) can reduce costs, save time and improve timely communication, and is becoming a common practice. ARINC Report 436 defines an eQTG standard (see CS-FSTD(A).300(d)).

1.7 Configuration control. A configuration control system should be established and maintained to ensure the continued integrity of the hardware and software as originally qualified.

1.8 Procedures for initial FSTD qualification.

1.8.1 The request for evaluation should reference the QTG and also include a statement that the FSTD operator has thoroughly tested the FSTD and that it meets the criteria described in this ~~document~~**CS,** except as noted in the application form. The FSTD operator – for a BITD the manufacturer - should further certify that all the QTG checks~~,~~ for the requested **q**~~Q~~ualification **l**~~L~~evel~~,~~ have been achieved and that the FSTD is representative of the respective aeroplane or, for FNPTs and BITDs representative of the respective class of aeroplane.

1.8.2 A copy of the FSTD operator's or BITD manufacturer's QTG, marked with test results, should accompany the request. Any QTG deficiencies raised by the **competent a**~~A~~uthority should be addressed prior to the start of the on-site evaluation.

1.8.3 The FSTD operator may elect to accomplish the QTG validation tests while the FSTD is at the manufacturer's facility. Tests at the manufacturer's facility should be accomplished at the latest practical time prior to disassembly and shipment. The FSTD operator should then validate FSTD performance at the final location by repeating at least one-third of the validation tests in the QTG and submitting those tests to the **competent a**~~A~~uthority. After review**ing** ~~of~~ these tests, the ~~Au~~**competent au**thority ~~will~~ **should** schedule an initial evaluation. The QTG should be clearly annotated to indicate when and where each test was accomplished. This may not be applicable for BITDs that would normally undergo initial qualification at the manufacturer's facility.

1.9 FSTD recurrent qualification basis

1.9.1 Following satisfactory completion of the initial evaluation and qualification tests, a periodic check system should be established to ensure that FSTDs continue to maintain their initially qualified performance, functions and other characteristics.

1.9.2 The FSTD operator should run the complete QTG, which includes validation, functions & subjective tests, between each annual evaluation by the ~~Au~~**competent au**thority. As a minimum, the QTG tests should be run progressively in at least four approximately equal **three-**~~3~~ monthly blocks on an annual cycle. Each block of QTG tests should be chosen to provide coverage of the different types of validation, functions & subjective tests. Results ~~shall~~**should** be dated and retained in order to satisfy both the FSTD operator as well as the ~~Au~~**competent au**thority that the FSTD standards are being maintained. It is not acceptable that the complete QTG is run just prior to the annual evaluation.

2 FSTD Validation Tests

2.1 General

2.1.1 FSTD performance and system operation should be objectively evaluated by comparing the results of tests conducted in the FSTD with aeroplane data unless specifically noted otherwise. To facilitate the validation of the FSTD, an appropriate recording device acceptable to the ~~Au~~**competent au**thority should be used to record each validation test result. These recordings should then be compared to the approved validation data.

2.1.2 Certain tests in this ~~ACJ~~ **AMC** are not necessarily based upon validation data with specific tolerances. However, these tests are included here for completeness, and the required criteria should be fulfilled instead of meeting a specific tolerance.

2.1.3 The FSTD MQTG should describe clearly and distinctly how the FSTD will be set up and operated for each test. Use of a driver programme designed to accomplish the tests automatically is encouraged. Overall integrated testing of the FSTD should be accomplished to assure that the total FSTD system meets the prescribed standards.

Historically, the tests provided in the QTG to support FSTD qualification have become increasingly fragmented. During the development of the ICAO **Doc 9625** *Manual of Criteria for the Qualification of Flight Simulators*, 1993 by an RAeS Working Group, the following text was inserted:

"It is not the intent, nor is it acceptable, to test each Flight Simulator subsystem independently. Overall Integrated Testing of the Flight Simulator should be accomplished to assure that the total Flight Simulator system meets the prescribed standards."

This text was developed to ensure that the overall testing philosophy within a QTG fulfilled the original intent of validating the FSTD as a whole whether the testing was carried out automatically or manually.

To ensure compliance with this intent, QTGs should contain explanatory material ~~which~~ **that** clearly indicates how each test (or group of tests) is constructed and how the automatic test system is controlling the test e.g. which parameters are driven, free, locked and the use of closed and open loop drivers.

A test procedure with explicit and detailed steps for completion of each test must also be provided. Such information should greatly assist with the review of a QTG that involves an understanding of how each test was constructed in addition to the checking of the actual results

A manual test procedure with explicit and detailed steps for completion of each test should also be provided.

2.1.4 Submittals for approval of data other than flight test**s** should include an explanation of validity with respect to available flight test information. Tests and tolerances in this paragraph should be included in the FSTD MQTG.

For FFS devices representing aeroplanes certificated after January 2002 the MQTG should be supported by a **v**~~V~~alidation **d**~~D~~ata **r**~~R~~oadmap (VDR) as described in Appendix 2 to AMC**-**~~ No. ~~1**-**~~ to ~~CS**-**FSTD(A).300. Data providers are encouraged to supply a VDR for older aeroplanes.

For FFS devices representing aeroplanes certificated prior to January 1992, an operator may, after reasonable attempts have failed to obtain suitable flight test data, indicate in the MQTG where flight test data are unavailable or unsuitable for a specific test. For such a test, alternative data should be submitted to the ~~Au~~**competent au**thority for approval.

2.1.5 The table of FSTD **v**~~t~~~~V~~alidation **t**~~T~~ests in this AMC indicates the required tests. Unless noted otherwise, FSTD tests should represent aeroplane performance and handling qualities at operating weights and centres of gravity (cg) positions typical of normal operation.

For FFS devices, if a test is supported by aeroplane data at one extreme weight or cg, another test supported by aeroplane data at mid-conditions or as close as possible to the other extreme should be included. Certain tests, which are relevant only at one extreme weight or cg condition, need not be repeated at the other extreme. Tests of handling qualities should include validation of augmentation devices.

Although FTDs are not designed for the purpose of training and testing of flight handling skills, it will be necessary, particularly for FTD **l**~~L~~evel 2**,** to include tests which ensure stability and repeatability of the generic flight package. These tests are also indicated in the tables.

2.1.6 For the testing of **c**~~C~~omputer **c**~~C~~ontrolled **a**~~A~~eroplane (CCA) FSTDs, flight test data are required for both the normal (N) and non-normal (NN) control states, as applicable to the aeroplane simulated and, as indicated in the validation requirements of this paragraph. Tests in the non-normal state should always include the least augmented state. Tests for other levels of control state degradation may be required as detailed by the ~~Au~~**competent au**thority at the time of definition of a set of specific aeroplane tests for FSTD data. Where applicable, flight test data should record:

a. pilot controller deflections or electronically generated inputs including location of input; and

b. flight control surface positions unless test results are not affected by, or are independent of, surface positions.

2.1.7 The recording requirements of 2.1.6 a**.**~~)~~ and b**.**~~)~~ above apply to both normal and non-normal states. All tests in the table of validation tests require test results in the normal control state unless specifically noted otherwise in the comments section following the computer**-**controlled aeroplane designation (CCA). However, if the test results are independent of control state, non-normal control data may be substituted.

2.1.8 Where non-normal control states are required, test data should be provided for one or more non-normal control states including the least augmented state.

2.1.9 Where normal, non-normal or other degraded control states are not applicable to the aeroplane being simulated, appropriate rationales should be included in the aeroplane manufacturer's validation data roadmap (VDR), which is described in Appendix 2 to

AMC ~~No.~~ 1-~~to~~ CS-FSTD(A).300.

2.2 Test requirements

2.2.1 The ground and flight tests required for qualification are listed in the table of FSTD **v**~~V~~alidation **t**~~T~~ests. Computer-–generated FSTD test results should be provided for each test. The results should be produced on an appropriate recording device acceptable to the ~~Au~~**competent au**thority. Time histories are required unless otherwise indicated in the table of validation tests.

2.2.2 Approved validation data that exhibit rapid variations of the measured parameters may require engineering judgement when making assessments of FSTD validity. Such judgement should not be limited to a single parameter. All relevant parameters related to a given manoeuvre or flight condition should be provided to allow overall interpretation. When it is difficult or impossible to match FSTD to aeroplane data or approved validation data throughout a time history, differences should be justified by providing a comparison of other related variables for the condition being assessed.

2.2.2.1 Parameters, tolerances, and flight conditions. The table of FSTD validation tests in paragraph—2.3 below describes the parameters, tolerances, and flight conditions for FSTD validation. When two tolerance values are given for a parameter, the less restrictive may be used unless indicated otherwise.

Where tolerances are expressed as a percentage:

- for parameters that have units of percent, or parameters normally displayed in the cockpit in units of percent (e.g. N1, N2, engine torque or power), then a percentage tolerance ~~will~~ **should** be interpreted as an absolute tolerance unless otherwise specified (i.e. for an observation of 50% N1 and a tolerance of 5%, the acceptable range ~~shall~~**should** be from 45% to 55%)**; and**~~.~~

- for parameters not displayed in units of percent, a tolerance expressed only as a percentage ~~will~~ **should** be interpreted as the percentage of the current reference value of that parameter during the test, except for parameters varying around a zero value for which a minimum absolute value should be agreed with the ~~Au~~**competent au**thority

If a flight condition or operating condition is shown ~~which~~ **that** does not apply to the qualification level sought, it should be disregarded. FSTD results should be labelled using the tolerances and units specified.

2.2.2.2 Flight condition verification. When comparing the parameters listed to those of the aeroplane, sufficient data should also be provided to verify the correct flight condition. For example, to show the control force is within ± 2·2daN (5 ~~pounds~~**lb**) in a static stability test, data to show correct airspeed, power, thrust or torque, aeroplane configuration, altitude, and other appropriate datum identification parameters should also be given. If comparing short period dynamics on a**n** FSTD, normal acceleration may be used to establish a match to the aeroplane, but airspeed, altitude, control input, aeroplane configuration, and other appropriate data should also be given. All airspeed values should be assumed to be calibrated unless annotated otherwise and like values used for comparison.

2.2.2.3 Where the tolerances have been replaced by **correct trend** and **m**~~M~~agnitude~~'~~ (CT&M), the FSTD should be tested and assessed as representative of the aeroplane or class of aeroplane to the satisfaction of the ~~Au~~**competent au**thority. To facilitate future evaluations, sufficient parameters should be recorded to establish a reference. For the initial qualification of FNPTs and BITDs no tolerances are to be applied and the use of CT&M is to be assumed throughout.

2.2.2.4 Flight conditions. The flight conditions are specified as follows:

a. **g**~~G~~round-on ground, independent of aeroplane configuration**;**

b. **t**~~T~~ake-off - gear down with flaps in any certified takeoff position**;**

c. **s**~~S~~econd segment climb – gear up with flaps in any certified take off position**;**

d. **c**~~C~~lean – flaps and gear up**;**

e. **c**~~C~~ruise – clean configuration at cruise altitude and airspeed**;**

f. **a**~~A~~pproach – gear up or down with flaps at any normal approach positions as recommended by the aeroplane manufacturer**; and**

g. **l**~~L~~anding – gear down with flaps in any certified landing position.

2.3 Table of FSTD Validation Tests

2.3.1 A number of tests within the QTG have had their requirements reduced to **c**~~‘Correct~~ **t**~~Trend and~~ **m**~~Magnitude’ (~~CT&M~~)~~ for initial evaluations thereby avoiding the need for specific **f**~~F~~light **t**~~T~~est **d**~~D~~ata. Where CT&M is used it is strongly recommended that an automatic recording system be used to ‘footprint’ the baseline results**,** thereby avoiding the effects of possible divergent subjective opinions on recurrent evaluation.

However, the use of CT&M is not to be taken as an indication that certain areas of simulation can be ignored. It is imperative that the specific characteristics are present, and incorrect effects would be unacceptable.

2.3.2 In all cases the tests are intended for use in recurrent evaluations at least to ensure repeatability.

Table of FSTD Validation Tests

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
													For FNPT and BITD CT&M ~~shall~~should be used for initial evaluations. The tolerances ~~shall~~should be applied for recurrent evaluations (see AMC No.1 to CS-FSTD(A).300 1.5.4). It is accepted that tests and associated tolerances ~~will~~ only apply to a **l**~~L~~evel 1 FTD if that system or flight condition is simulated.
1. PERFORMANCE													
a. TAXI**i**~~Y~~													
(1) Minimum **r**~~R~~adius **t**~~T~~urn.	± 0·9 m (3 ft) or ± 20% of aeroplane turn radius.	Ground	**C T & M**	✓	✓	✓							Plot both main and nose gear-turning loci. Data for no brakes and the minimum thrust required to maintain a steady turn except for aeroplanes requiring asymmetric thrust or braking to turn.
(2) Rate of **t**~~T~~urn vs. **n**~~N~~osewheel **s**~~S~~teering **a**~~A~~ngle (NWA). ~~Turn Rate.~~ ~~± 10% or~~	± 10% or ± 2º/s turn rate.	Ground	**C T & M**	✓	✓	✓							Tests for a minimum of two speeds, greater than minimum turning radius speed, with a spread of at least 5 kts groundspeed.
b. TAKE-OFF													Note-All commonly used take-off flap settings should be demonstrated at least once either in minimum unstick speed (1b3), normal take-off (1b4), critical engine failure on take-off (1b5) or cross wind take-off (1b6).
(1) Ground **a**~~A~~cceleration **t**~~T~~ime and **d**~~D~~istance.	± 5% or ±1.5 s time and ± 5% or **± 61 m (200 ft) distance** ~~± 61 m (200 ft) distance~~	Take-off	**C T & M**	✓	✓	✓	**C T & M**	✓					Acceleration time and distance should be recorded for a minimum of 80% of the total time from brake release to V_R. May be combined with normal take-off (1b4) or rejected take-off (1b7). Plotted data should be shown using appropriate scales for each portion of the manoeuvre.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
													For FTD~~'~~s test limited to time only.
(2) Minimum **c**~~C~~ontrol **s**~~S~~peed, ground (V_{MCG}) aerodynamic controls only per applicable airworthiness requirement or alternative engine inoperative test to demonstrate ground control characteristics.	± 25% of maximum aeroplane lateral deviation or ± 1·5 m (5 ft) For aeroplanes with reversible flight control systems: ± 10% or ± 2·2 daN (5 lb) rudder pedal force	Take-off	**C T & M**	✓	✓	✓							Engine failure speed should be within ± 1 kt of aeroplane engine failure speed. Engine thrust decay should be that resulting from the mathematical model for the engine variant applicable to the ~~flight simulator~~ ~~**FSTD**~~**FFS** under test. If the modelled engine variant is not the same as the aeroplane manufacturer**'s**~~'~~ flight test engine, then a further test may be run with the same initial conditions using the thrust from the flight test data as the driving parameter. If a V_{MCG} test is not available an acceptable alternative is a flight test snap engine deceleration to idle at a speed between V1 and V1-10 kts, followed by control of heading using aerodynamic control only and recovery should be achieved with the main gear on the ground. To ensure only aerodynamic control, nose wheel steering should be disabled (i.e., castored) or the nosewheel held slightly off the ground.
(3) Minimum **u**~~U~~nstick **s**~~S~~peed (V_{MU}) or equivalent test to demonstrate early rotation take off characteristics.	± 3 kts airspeed ± 1·5º pitch angle	Take-off	**C T & M**	✓	✓	✓							V_{MU} is defined as the minimum speed at which the last main landing gear leaves the ground. Main landing gear strut compression or equivalent air/ground signal should be recorded. If a V_{MU} test is not available, alternative acceptable flight tests are a constant high-attitude take-off run through main gear lift-off, or an early rotation take-off. Record time history data from 10 kts before start of rotation until at least 5 s~~econds~~ after the occurrence of main gear lift-off.
(4) Normal **t**~~T~~ake-off.	± 3 kts airspeed ± 1·5º pitch angle ± 1·5º AOA	Take-off	**C T**	✓	✓	✓							Data required for near maximum certificated take-off weight at mid centre of gravity and light take-off

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
	± 6 m (20 ft) height For aeroplanes with reversible flight control systems: ± 10% or ± 2·2 daN (5 lb) column force		& M										weight at an aft centre of gravity. If the aeroplane has more than one certificated take-off configuration, a different configuration should be used for each weight. Record take-off profile from brake release to at least 61 m (200 ft) AGL. May be used for ground acceleration time and distance (1b1). Plotted data should be shown using appropriate scales for each portion of the manoeuvre.
(5) Critical **e**~~E~~ngine **f**~~F~~ailure on **t**~~T~~ake-off.	± 3 kts airspeed ± 1·5º pitch angle ± 1·5º AOA ± 6 m (20 ft) height ± 2º bank and sideslip angle ± 3° heading angle For aeroplanes with reversible flight control systems: ± 10% or ± 2·2 daN (5 lb) column force ± 10% or ± 1·3 daN (3 lb) wheel force ± 10% or ± 2·2 daN (5 lb) rudder pedal force.	Take-off	C T & M	✓	✓	✓							Record take-off profile to at least 61 m (200 ft) AGL. Engine failure speed should be within ± 3 kts of aeroplane data. Test at near maximum take-off weight.
(6) Crosswind **t**~~T~~ake-off.	± 3 kts airspeed ± 1·5º pitch angle ± 1·5º AOA ± 6 m (20 ft) height ± 2º bank and sideslip angle ± 3° heading Correct trends at airspeeds below 40 kts for rudder/pedal and heading. For aeroplanes with reversible flight	Take-off	C T & M	✓	✓	✓							Record take-off profile from brake release to at least 61 m (200 ft) AGL. Requires test data, including wind profile, for a crosswind component of at least 60% of the AFM value measured at 10m (33 ft) above the runway.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
	control systems: ± 10% or ± 2·2 daN (5 lb) column force ± 10% or ± 1·3 daN (3 lb) wheel force ± 10% or ± 2·2 daN (5 lb) rudder pedal force												
(7) Rejected **t**~~T~~ake-off.	± 5% time or ± 1·5 s ± 7·5% distance or ± 76 m (250 ft) ~~± 76m (250 ft)~~	Take-off	**C T & M**	✓	✓	✓							Record near maximum take-off weight. Speed for reject should be at least 80% of V_1. Autobrakes will be used where applicable. Maximum braking effort, auto or manual. Time and distance should be recorded from brake release to a full stop.
(8) Dynamic **e**~~E~~ngine **f**~~F~~ailure after **t**~~T~~ake-off.	± 20% or ± 2º/s body angular rates	Take-off	**C T & M**	✓	✓	✓							Engine failure speed should be within ± 3 kts of aeroplane data. Engine failure may be a snap deceleration to idle. Record hands off from 5 s before engine failure to + 5 s or 30 deg bank, whichever occurs first. Note: for safety considerations, aeroplane flight test may be performed out of ground effect at a safe altitude, but with correct aeroplane configuration and airspeed. CCA: Test in normal AND Non-normal Control state.
c. CLIMB													
(1) Normal **c**~~C~~limb **a**~~A~~ll **e**~~E~~ngines **o**~~O~~perating	± 3 kts airspeed ± 5% or ± 0·5 m/s (100 ft/min) R/C	Clean or specified climb configuration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Flight test data or aeroplane performance manual data may be used. Record at nominal climb speed and mid initial climb altitude. FSTD performance to be recorded over an interval of at least 300 m (1 000 ft). For FTD~~'~~s may be a **s**~~S~~napshot test.
(2) One **e**~~E~~ngine **i**~~I~~noperative **s**~~S~~econd **s**~~S~~egment	± 3 kts airspeed ± 5% or ± 0·5 m/s (100 ft/min) R/C but	2nd **s**~~S~~egment **c**~~C~~limb for FNPTs and		✓	✓	✓	**C T & M**	✓	✓	✓	✓	✓	Flight test data or aeroplane performance manual data may be used. Record at nominal climb speed. **FSTD**~~Flight simulator~~ performance

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
c~~C~~limb.	not less than **applicable** AFM values.	BITDs **g**~~G~~ear up and **t**~~T~~ake-off **f**~~F~~laps											to be recorded over an interval of at least 300m (1 000 ft). Test at WAT (**w**~~W~~eight, **a**~~A~~ltitude, ~~or~~ **or t**~~T~~emperature) limiting condition. For FTD~~'~~s may be a **s**~~S~~napshot test.
(3) One **e**~~E~~ngine **i**~~I~~noperative **e**~~E~~n**-**route **c**~~C~~limb.	± 10% time ± 10% distance ± 10% fuel used	Clean	✓	✓	✓	✓	**C T & M**	✓					Flight test data or aeroplane performance manual data may be used. Test for at least a 1 550 m (5 000 ft) segment.
(4) One **e**~~E~~ngine **i**~~I~~noperative **a**~~A~~pproach **c**~~C~~limb for aeroplanes with icing accountability if required by the flight manual for this phase of flight.	± 3 kts airspeed ± 5% or ± 0·5 m/s (100 ft/min) R/C but not less than AFM values	Approach			✓	✓							Flight test data or aeroplane performance manual data may be used. FSTD performance to be recorded over an interval of at least 300 m (1 000 ft). Test near maximum certificated landing weight as may be applicable to an approach in icing conditions. Aeroplane should be configured with all anti-ice and de-ice systems operating normally, gear up and go-around flap. All icing accountability considerations, in accordance with the flight manual for an approach in icing conditions, should be applied.
d. CRUISE/DESCENT													
(1) Level **f**~~F~~light **a**~~A~~cceleration	± 5% time	Cruise	**C T & M**	✓	✓	✓	✓	✓					Minimum of 50 kts increase using maximum continuous thrust rating or equivalent. For very small aeroplanes, speed change may be reduced to 80% of operational speed range.
(2) Level **f**~~F~~light **d**~~D~~eceleration	± 5% time	Cruise	**C T & M**	✓	✓	✓	✓	✓					Minimum of 50 kts decrease using idle power. For very small aeroplanes, speed change may be reduced to 80% of operational speed range.
(3) Cruise **p**~~P~~erformance	± 0·05 EPR or ± 5% N1 or ± 5% torque ± 5% fuel flow	Cruise	✓	✓	✓	✓	✓	✓					May be a single snapshot showing instantaneous fuel flow, or a minimum of two consecutive snapshots with a spread of at least ~~3~~ **three** minutes in steady flight.
(4) Idle **d**~~D~~escent	± 3 kts airspeed	Clean											Idle power stabilised descent at

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
	± 5% or ± 1·0 m/s (200 ft/min) R/D		✓	✓	✓	✓							normal descent speed at mid altitude. Flight simulator performance to be recorded over an interval of at least 300 m (1 000 ft).
(5) Emergency **d**~~D~~escent	± 5 kts airspeed ± 5% or ± 1·5 m/s (300 ft/min) R/D	As per AFM	✓	✓	✓	✓							Stabilised descent to be conducted with speedbrakes extended if applicable, at mid altitude and near VMO or according to emergency descent procedure. Flight simulator performance to be recorded over an interval of at least 900 m (3 000 ft).
e. STOPPING													
(1) Deceleration **t**~~T~~ime and **d**~~D~~istance, **m**~~M~~anual **w**~~W~~heel **b**~~B~~rakes, **d**~~D~~ry **r**~~R~~unway, **n**~~N~~o **r**~~R~~everse **t**~~T~~hrust.	± 5% or ±1.5 s time. For distances up to 1 220 m (4 000 ft) ± 61 m (200 ft) or ± 10%, whichever is the smaller. For distances greater than 1 220 m (4 000 ft) ± 5% distance.	Landing	**C T & M**	✓	✓	✓							Time and **d**~~D~~istance should be recorded for at least 80% of the total time from touchdown to a full stop. Data required for medium and near maximum certificated landing weight. Engineering data may be used for the medium weight condition. Brake system pressure should be recorded.
(2) Deceleration **t**~~T~~ime and **d**~~D~~istance, **r**~~R~~everse **t**~~T~~hrust, **n**~~N~~o **w**~~W~~heel **b**~~B~~rakes, **d**~~D~~ry **r**~~R~~unway.	± 5% or ±1.5 s time and the smaller of ± 10% or ± 61 m (200 ft) of distance.	Landing	**C T & M**	✓	✓	✓							Time and distance should be recorded for at least 80% of the total time from initiation of reverse thrust to full thrust reverser minimum operating speed. Data required for medium and near maximum certificated landing weights. Engineering data may be used for the medium weight condition.
(3) Stopping **d**~~D~~istance, **w**~~W~~heel **b**~~B~~rakes, **w**~~W~~et **r**~~R~~unway.	± 10% or ± 61 m (200 ft) distance	Landing			✓	✓							Either flight test or manufacturers performance manual data should be used where available. Engineering data, based on dry runway flight test stopping distance and the effects of contaminated runway braking coefficients, are an acceptable alternative.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
(4) Stopping **d**~~D~~istance, **w**~~W~~heel **b**~~B~~rakes, **i**~~I~~cy **r**~~R~~unway.	± 10% or ± 61 m (200 ft) distance	Landing			✓	✓							Either flight test or manufacturer's performance manual data should be used where available. Engineering data, based on dry runway flight test stopping distance and the effects of contaminated runway braking coefficients, are an acceptable alternative.
f. ENGINES													
(1) Acceleration	± 10% T_i or ± 0·25s ± 10% T_t	Approach or **l**~~L~~anding	**CT&M**	✓	✓	✓	✓	✓	✓	✓	✓	✓	T_i = Total time from initial throttle movement until a 10% response of a critical engine parameter. T_t = Total time from initial throttle movement to 90% of go around power. Critical engine parameter should be a measure of power (N1, N2, EPR, etc). Plot from flight idle to go around power for a rapid throttle movement. FTD, FNPT and BITD only: CT&M acceptable.
(2) Deceleration	± 10% T_I or ± 0·25s ± 10% T_t	Ground	**CT&M**	✓	✓	✓	✓	✓	✓	✓	✓	✓	T_i = Total time from initial throttle movement until a 10% response of a critical engine parameter. T_t = Total time from initial throttle movement to 90% decay of maximum take-off power. Plot from maximum take-off power to idle for a rapid throttle movement. FTD, FNPT and BITD only: CT&M acceptable.
2. HANDLING QUALITIES													
a. STATIC CONTROL CHECKS													NOTE: Pitch, roll and yaw controller position vs. force or time ~~shall~~**should** be measured at the control. An alternative method ~~would be~~**is** to instrument the FSTD in an equivalent manner to the flight test aeroplane. The force and position data from this instrumentation ~~can~~ **should** be directly recorded and matched to the aeroplane data. Such a permanent installation could be used without any time for installation

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~**FFS**				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
													of external devices. CCA: Testing of position versus force is not applicable if forces are generated solely by use of aeroplane hardware in the FSTD.
(1) Pitch **c**~~C~~ontroller **p**~~P~~osition vs. **f**~~F~~orce and **s**~~S~~urface **p**~~P~~osition **c**~~C~~alibration.	± 0·9 daN (2 lbs) breakout. ± 2·2 daN (5 lbs) or ± 10% force. ± 2º elevator angle	Ground	✓	✓	✓	✓	**C T & M**	✓					Uninterrupted control sweep to stops. Should be validated (where possible) with inflight data from tests such as longitudinal static stability, stalls, etc. Static and dynamic flight control tests should be accomplished at the same feel or impact pressures.
Column **p**~~P~~osition vs. **f**~~F~~orce only.	± 2.2 daN (5 lbs) or ± 10% **f**~~F~~orce.	Cruise or **a**~~A~~pproach							✓	✓	✓	✓	FNPT 1 and BITD: **c**~~C~~ontrol forces and travel ~~shall~~**should** broadly correspond to that of the replicated class of aeroplane.
(2) Roll **c**~~C~~ontroller **p**~~P~~osition vs. **f**~~F~~orce and **s**~~S~~urface **p**~~P~~osition **c**~~C~~alibration. ~~Wheel Position vs. Force only.~~	± 0·9 daN (2 lbs) breakout ± 1·3 daN (3 lbs) or ± 10% force ± 2º aileron angle ± 3º spoiler angle	Ground	✓	✓	✓	✓	**C T & M**	✓					Uninterrupted control sweep to stops. Should be validated with in-flight data from tests such as engine out trims, steady state sideslips, etc. Static and dynamic flight control tests should be accomplished at the same feel or impact pressures.
Wheel position vs. force only.	± 1.3 daN (3 lbs) or ± 10% Force	Cruise or **a**~~A~~pproach							✓	✓	✓	✓	FNPT 1 and BITD: Control forces and travel ~~shall~~**should** broadly correspond to that of the replicated class of aeroplane
(3) Rudder **p**~~P~~edal **p**~~P~~osition vs. **f**~~F~~orce and **s**~~S~~urface **p**~~P~~osition **c**~~C~~alibration. ~~Pedal Position vs. Force~~	± 2·2 daN (5 lbs) breakout ± 2·2 daN (5 lbs) or ± 10% force ± 2º rudder angle	Ground	✓	✓	✓	✓	**C T & M**	✓					Uninterrupted control sweep to stops. Should be validated with in flight data from tests such as engine out trims, steady state sideslips, etc. Static and dynamic flight control tests should be accomplished at the same feel or impact pressures.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
~~only.~~													
Pedal position vs. force only.	± 2.2 daN (5 lbs) or ± 10% **f**~~F~~orce.	Cruise or **a**~~A~~pproach							✓	✓	✓	✓	FNPT 1 and BITD: Control forces and travel ~~shall~~**should** broadly correspond to that of the replicated class of aeroplane
(4) Nosewheel **s**~~S~~teering **c**~~C~~ontroller **f**~~F~~orce and **p**~~P~~osition **c**~~C~~alibration.	± 0·9 daN (2 lbs) breakout ± 1·3 daN (3 lbs) or ± 10% force ± 2º NWA	Ground	**C T & M**	✓	✓	✓							Uninterrupted control sweep to stops.
(5) Rudder **p**~~P~~edal **s**~~S~~teering **c**~~C~~alibration.	± 2º NWA	Ground	**C T & M**	✓	✓	✓							Uninterrupted control sweep to stops.
(6) Pitch **t**~~T~~rim **i**~~I~~ndicator vs. **s**~~S~~urface **p**~~P~~osition **c**~~C~~alibration	± 0·5º trim angle.	Ground	✓	✓	✓	✓							Purpose of test is to compare flight simulator against design data or equivalent.
	±1° of trim angle	Ground					✓	✓	✓	✓	✓	✓	BITD: Only applicable if appropriate trim settings are available, e.g. data from the AFM.
(7) Pitch **t**~~T~~rim **r**~~R~~ate	± 10% or ± 0.5 deg/s trim rate (°/s)	Ground and approach	✓	✓	✓	✓	✓	✓					Trim rate to be checked at pilot primary induced trim rate (ground) and autopilot or pilot primary trim rate in flight at go-around flight conditions.
(8) Alignment of **c**~~C~~ockpit **t**~~T~~hrottle **l**~~L~~ever vs. **s**~~S~~elected **e**~~E~~ngine **p**~~P~~arameter.	± 5º of TLA or ± 3% N1 or ± 0·03 EPR or ± 3% torque For propeller-driven aeroplanes, where the propeller levers do not have angular travel, a tolerance of ± 2 cm (± 0.8 in) applies.	Ground	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Simultaneous recording for all engines. The tolerances apply against aeroplane data and between engines. For aeroplanes with throttle detents, all detents to be presented. In the case of propeller-driven aeroplanes, if an additional lever, usually referred to as the propeller lever, is present, it should also be checked. Where these levers do not have angular travel a tolerance of ± 2 cm (± 0·8 inches) applies. May be a series of **s**~~S~~napshot tests.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD		
			A	B	C	D	Init	Rec	I	II	MCC	Rec		
(9) Brake **p**~~P~~edal **p**~~P~~osition vs. **f**~~F~~orce and **b**~~B~~rake **s**~~S~~ystem **p**~~P~~ressure **c**~~C~~alibration.	± 2·2 daN (5 lbs) or ± 10% force. ± 1·0 MPa (150 psi) or ± 10% brake system pressure.	Ground	**CT&M**	✓	✓	✓								Flight simulator computer output results may be used to show compliance. Relate the hydraulic system pressure to pedal position in a ground static test.
b. DYNAMIC CONTROL CHECKS														Tests 2b1, 2b2, and 2b3 are not applicable if dynamic response is generated solely by use of aeroplane hardware in the flight simulator. Power setting may be that required for level flight unless otherwise specified.
(1) Pitch **c**~~C~~ontrol.	<u>For underdamped systems:</u> ± 10% of time from 90% of initial displacement (A_d) to first zero crossing and ± 10(n+1)% of period thereafter ± 10% amplitude of first overshoot applied to all overshoots greater than 5% of initial displacement (A_d). ± 1 overshoot (first significant overshoot should be matched) <u>For overdamped systems:</u> ± 10% of time from 90% of initial displacement (A_d) to 10 % of initial displacement (0·1 A_d).	Take-off, **c**~~C~~ruise, and **l**~~L~~anding			✓	✓								Data should be for normal control displacements in both directions (approximately 25% to 50% full throw or approximately 25% to 50% of maximum allowable pitch controller deflection for flight conditions limited by the manoeuvring load envelope). Tolerances apply against the absolute values of each period (considered independently). n = The sequential period of a full oscillation. Refer to ~~paragraph~~ **AMC1-CS-FSTD(A).300** 2.4.1
(2) Roll **c**~~C~~ontrol.	<u>For underdamped systems:</u>	Take-off, **c**~~C~~ruise, and			✓	✓								Data should be for normal control displacement (approximately 25% to

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
	± 10% of time from 90% of initial displacement (A_d) to first zero crossing and ± 10(n+1)% of period thereafter. ± 10% amplitude of first overshoot applied to all overshoots greater than 5% of initial displacement (A_d). ± 1 overshoot (first significant overshoot should be matched) For overdamped systems: ± 10% of time from 90% of initial displacement (A_d) to 10 % of initial displacement (0·1 A_d).	**l**~~L~~anding											50% of full throw or approximately 25% to 50% of maximum allowable roll controller deflection for flight conditions limited by the manoeuvring load envelope). Refer to ~~paragraph~~ **AMC1-CS-FSTD(A).300** 2.4.1
(3) Yaw **c**~~C~~ontrol.	For underdamped systems: ± 10% of time from 90% of initial displacement (A_d) to first zero crossing and ± 10(n+1)% of period thereafter. ± 10% amplitude of first overshoot applied to all overshoots greater than 5% of initial displacement (A_d). ± 1 overshoot (first significant overshoot	Take-off, **c**~~C~~ruise, and **l**~~L~~anding			✓	✓							Data should be for normal displacement (**a**~~A~~pproximately 25% to 50% of full throw). Refer to ~~paragraph~~ **AMC1-CS-FSTD(A).300** 2.4.1

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
	should be matched) <u>For overdamped systems:</u> ± 10% of time from 90% of initial displacement (A_d) to 10 % of initial displacement (0·1 A_d).												
(4) Small **c**~~C~~ontrol **i**~~I~~nputs - pitch.	± 0·15 °/s body pitch rate or ± 20% of peak body pitch rate applied throughout the time history.	Approach or **l**~~L~~anding			✓	✓							Control inputs should be typical of minor corrections made while established on an ILS approach (approximately 0·5 to 2 °/s pitch rate). Test in both directions. Show time history data from 5 s~~econds~~ before until at least 5 s~~econds~~ after initiation of control input. CCA: Test in normal AND non-normal control state.
(5) Small **c**~~C~~ontrol **i**~~I~~nputs - roll	± 0·15 °/s body roll rate or ± 20% of peak body roll rate applied throughout the time history	Approach or **l**~~L~~anding			✓	✓							Control inputs should be typical of minor corrections made while established on an ILS approach (approximately 0·5 to 2 °/s roll rate). Test in one direction. For aeroplanes that exhibit non-symmetrical behaviour, test in both directions. Show time history data from 5 s~~econds~~ before until at least 5 ~~seconds~~ **s** after initiation of control input. CCA: Test in normal AND non-normal control state.
(6) Small **c**~~C~~ontrol **i**~~I~~nputs – yaw	± 0·15 °/s body yaw rate or ± 20% of peak body yaw rate applied throughout the time history	Approach or **l**~~L~~anding			✓	✓							Control inputs should be typical of minor corrections made while established on an ILS approach (approximately 0·5 to 2 °/s yaw rate). Test in one direction. For aeroplanes that exhibit non-symmetrical behaviour, test in both directions. Show time history data from 5 s~~econds~~ before until at least 5 s~~econds~~ after initiation of control input. CCA: Test in normal AND non-normal

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
													control state.
c. LONGITUDINAL													Power setting may be that required for level flight unless otherwise specified.
(1) Power **c**~~C~~hange **d**~~D~~ynamics.	± 3 kts airspeed ± 30 m (100 ft) altitude. ± 1.5º or ± 20% pitch angle	Approach	✓	✓	✓	✓	**C T & M**	✓		✓	✓		Power change from thrust for approach or level flight to maximum continuous or go-around power. Time history of uncontrolled free response for a time increment equal to at least 5 s~~ecs~~ before initiation of the power change to completion of the power change + 15 s~~ecs~~. CCA: Test in **n**~~N~~ormal AND **n**~~N~~on-normal **c**~~C~~ontrol state.
Power **c**~~C~~hange **f**~~F~~orce	± 2.2 daN (5 lbs) or ± 10% Force	Approach							✓	✓	✓	✓	For an FNPT I and a BITD the power change force test only is acceptable.
(2) Flap **c**~~C~~hange **d**~~D~~ynamics.	± 3 kts airspeed ± 30 m (100 ft) altitude. ± 1.5º or ± 20% pitch angle	Take-off through initial flap retraction and approach to landing	✓	✓	✓	✓	**C T & M**	✓		✓	✓		Time history of uncontrolled free response for a time increment equal to at least 5 s~~ecs~~ before initiation of the reconfiguration change to completion of the reconfiguration change + 15 s~~ecs~~. CCA: Test in **n**~~N~~ormal AND **n**~~N~~on-normal **c**~~C~~ontrol state.
Flap **c**~~C~~hange **f**~~F~~orce	± 2.2 daN (5 lbs) or ± 10% Force								✓	✓	✓	✓	For an FNPT I and a BITD the flap change force test only is acceptable.
(3) Spoiler / **s**~~S~~peedbrake **c**~~C~~hange **d**~~D~~ynamics.	± 3 kts airspeed ± 30 m (100 ft) altitude. ± 1.5 º or ± 20% pitch angle	Cruise	✓	✓	✓	✓	**C T & M**	✓		✓	✓		Time history of uncontrolled free response for a time increment equal to at least 5 s~~ecs~~ before initiation of the reconfiguration change to completion of the reconfiguration change + 15 s~~ecs~~. Results required for both extension and retraction. CCA: Test in **n**~~N~~ormal AND **n**~~N~~on-normal **c**~~C~~ontrol state.
(4) Gear **c**~~C~~hange **d**~~D~~ynamics.	± 3 kts airspeed ± 30 m (100 ft) altitude. ± 1.5º or ± 20%	Takeoff (retraction) and **a**~~A~~pproach	✓	✓	✓	✓	**C T &**	✓		✓	✓		Time history of uncontrolled free response for a time increment equal to at least 5 s~~ecs~~ before initiation of the configuration change to

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
	pitch angle For FNPTs and BITDs, ± 2º or ± 20% pitch angle	(extension)					M						completion of the reconfiguration change + 15 se~~cs~~. CCA: Test in **n**~~N~~ormal AND **n**~~N~~on-normal **c**~~C~~ontrol state.
Gear **c**~~C~~hange **f**~~F~~orce	± 2.2 daN (5 lbs) or ± 20% Force.	Take-off and **a**~~A~~pproach							✓	✓	✓	✓	For an FNPT I and a BITD the gear change force test only is acceptable.
(5) Longitudinal **t**~~T~~rim.	± 1º elevator ± 0·5º stabilizer ± 1º pitch angle ± 5% net thrust or equivalent	Cruise, **a**~~A~~pproach**,** and **l**~~L~~anding	✓	✓	✓	✓	**C T & M**	✓					Steady-state wings level trim with thrust for level flight. May be a series of snapshot tests. CCA: Test in **n**~~N~~ormal OR **n**~~N~~on-normal **c**~~C~~ontrol state.
	± 2 deg **p**~~P~~itch **c**~~C~~ontrol (**e**~~E~~levator & **s**~~S~~tabilizer) ± 2 deg **p**~~P~~itch ± 5% **p**~~P~~ower or **e**~~E~~quivalent	Cruise, **a**~~A~~pproach							✓	✓	✓	✓	May be a series of Snapshot tests. FNPT I and BITD may use equivalent stick and trim controllers.
(6) Longitudinal **m**~~M~~anoeuvring **s**~~S~~tability (**s**~~S~~tick **f**~~F~~orce/g).	± 2·2 daN (5 lbs) or ± 10% pitch controller force Alternative method: ± 1º or ± 10% change of elevator	Cruise, **a**~~A~~pproach**,** and **l**~~L~~anding	✓	✓	✓	✓				~~✓~~	~~✓~~	~~✓~~	Continuous time history data or a series of snapshot tests may be used. Test up to approximately 30º of bank for approach and landing configurations. Test up to approximately 45º of bank for the cruise configuration. Force tolerance not applicable if forces are generated solely by the use of aeroplane hardware in the FSTD~~.~~. Alternative method applies to aeroplanes which do not exhibit stick-force-per-g characteristics. CCA: Test in **n**~~N~~ormal AND **n**~~N~~on-normal **c**~~C~~ontrol state as applicable.
		Cruise, approach or landing if appropriate								✓	✓	✓	
(7) Longitudinal **s**~~S~~tatic **s**~~S~~tability.	± 2·2 daN (5 lbs) or ± 10% pitch controller force. Alternative method: ± 1° or ± 10%	Approach	✓	✓	✓	✓			✓ ~~**C T & M**~~	✓	✓	✓	Data for at least two speeds above and two speeds below trim speed. May be a series of snapshot tests. Force tolerance not applicable if forces are generated solely by the use of aeroplane hardware in the

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
	change of elevator												FSTD. Alternative method applies to aeroplanes which do not exhibit speed stability characteristics. CCA: Test in **n**~~N~~ormal OR **n**~~N~~on-normal **c**~~C~~ontrol state as applicable.
(8) Stall **c**~~C~~haracteristics.	± 3 kts airspeed for initial buffet, stall warning, and stall speeds. For aeroplanes with reversible flight control systems (for FS only): ± 10% or ± 2·2 daN (5 lb) column force (prior to g-break only.)	2nd **s**~~S~~egment **c**~~C~~limb and **a**~~A~~pproach or **l**~~L~~anding	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Wings-level (1 g) stall entry with thrust at or near idle power. Time history data should be shown to include full stall and initiation of recovery. Stall warning signal should be recorded and should occur in the proper relation to stall. FSTDs for aeroplanes exhibiting a sudden pitch attitude change or 'g break' should demonstrate this characteristic. CCA: Test in **n**~~N~~ormal AND **n**~~N~~on-normal **c**~~C~~ontrol state. FNPT and BITD: Test ~~need only~~**should** determine the actuation of the stall warning device only.
(9) Phugoid **d**~~D~~ynamics.	± 10% period. ± 10% time to ½ or double amplitude or ± 0·02 of damping ratio.	Cruise	✓	✓	✓	✓				✓	✓		Test should include ~~3~~ **three** full cycles or that necessary to determine time to ½ or double amplitude, whichever is less. CCA: Test in **n**~~N~~on-normal **c**~~C~~ontrol state.
	± 10% Period with representative damping	Cruise							✓			✓	Test should include at least ~~3~~ **three** full cycles. Time history recommended.
(10) Short **p**~~P~~eriod **d**~~D~~ynamics.	± 1·5º pitch angle or ± 2º/s pitch rate. ± 0·1 g normal acceleration.	Cruise	✓	✓	✓	✓				✓	✓		CCA: Test in **n**~~N~~ormal AND **n**~~N~~on-normal **c**~~C~~ontrol state.
d. LATERAL DIRECTIONAL													Power setting may be that required for level flight unless otherwise specified.
(1) Minimum **c**~~C~~ontrol **s**~~S~~peed, **a**~~A~~ir (V_{MCA} or V_{MCL}), per **a**~~A~~pplicable	± 3 kts airspeed ~~± 61m (200 ft)~~	Take-off or **l**~~L~~anding (whichever is most critical in the aeroplane)~~t~~	**C T & M**	✓	✓	✓	**C T & M**	✓	✓~~**C T & M**~~	✓~~**C T & M**~~	✓~~**C T & M**~~	✓~~**C T & M**~~	Minimum speed may be defined by a performance or control limit which prevents demonstration of V_{MC}or V_{MCL}in the conventional manner. Take-off thrust should be set on the operating engine(s). Time history or

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
a~~A~~irworthiness **s**~~S~~tandard – or – Low **s**~~S~~peed **e**~~E~~ngine **i**~~I~~noperative **h**~~H~~andling **c**~~C~~har-acteristics in the **a**~~A~~ir.	~~± 20% of~~												snapshot data may be used CCA: Test in **n**~~N~~ormal OR **n**~~N~~on-normal **c**~~C~~ontrol state. FNPT and BITD: It is important that there exists a realistic speed relationship between V_{mca} and V_s for all configurations and in particular the most critical full-power engine-out take-off configurations.
(2) Roll **r**~~R~~esponse (**r**~~R~~ate).	± 10% or ± 2º/~~sec~~ roll rate FS only: For aeroplanes with reversible flight control systems: ± 10% or ± 1·3 daN (3 lb) roll controller force.	Cruise and **a**~~A~~pproach or **l**~~L~~anding	✓	✓	✓	✓	**C T & M**	✓	✓	✓	✓	✓	Test with normal roll control displacement (about 30% of maximum control wheel). May be combined with step input of flight deck roll controller test (2d3).
(3) Step **i**~~I~~nput of **c**~~C~~ockpit **r**~~R~~oll **c**~~C~~ontroller (or **r**~~R~~oll **o**~~O~~vershoot).	± 10% or ± 2º bank angle	Approach or **l**~~L~~anding	✓	✓	✓	✓				✓	✓		With wings level, apply a step roll control input using approximately one-third of roll controller travel. At approximately 20° to 30° bank, abruptly return the roll controller to neutral and allow at least 10 se~~conds~~ of aeroplane free response. May be combined with roll response (rate) test (2d2). CCA: Test in **n**~~N~~ormal AND **n**~~N~~on-normal **c**~~C~~ontrol state.
(4) Spiral **s**~~S~~tability.	Correct trend and ± 2º or ± 10% bank angle in 20 se~~conds~~ If alternate test is used: correct trend and ± 2° aileron.	Cruise and **a**~~A~~pproach or **l**~~L~~anding **Cruise**	✓	✓	✓	✓	~~**C T & M**~~ **C T & M**	~~✓~~ ✓	~~**C T & M**~~ ✓	~~✓~~ ✓	~~✓~~ ✓	~~✓~~ ✓	Aeroplane data averaged from multiple tests may be used. Test for both directions. As an alternative test, show lateral control required to maintain a steady turn with a bank angle of approximately 30°. CCA: Test in **n**~~N~~on-normal **c**~~C~~ontrol state.
(5) Engine **i**~~I~~noperative **t**~~T~~rim.	± 1º rudder angle or ± 1º tab angle or equivalent pedal. ± 2º sideslip angle.	2nd **s**~~S~~egment **c**~~C~~limb and **a**~~A~~pproach or **l**~~L~~anding	✓	✓	✓	✓	**C T & M**	✓		✓	✓		Test should be performed in a manner similar to that for which a pilot is trained to trim an engine failure condition. 2nd segment climb test should be at take-off thrust. Approach or landing test should be at

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
													thrust for level flight. May be snapshot tests.
(6) Rudder **r**~~R~~esponse.	± ~~2º~~**2deg**/s or ± 10% yaw rate ~~± 2 deg/sec or~~ ~~± 10% yaw rate or heading change~~	Approach or **l**~~L~~anding	✓	✓	✓	✓							Test with stability augmentation ON and OFF. **For FNPT and BITD: test with stability augmentation OFF only.** Test with a step input at approximately 25% of full rudder pedal throw. CCA: Test in **n**~~N~~ormal AND **n**~~N~~on-normal **c**~~C~~ontrol state.
	± 2 deg/s or **± 10% yaw rate or** **± 10% heading change**								✓~~CT&M~~	✓	✓	✓	
(7) Dutch **r**~~R~~oll (**y**~~Y~~aw **d**~~D~~amper OFF).	± 0·5 s or ± 10% of period. ± 10% of time to ½ or double amplitude or ± 0·02 of damping ratio. ± 20% or ± 1 s of time difference between peaks of bank and sideslip	Cruise and **a**~~A~~pproach or **l**~~L~~anding	✓	✓	✓	✓			✓~~CT&M~~	✓~~CT&M~~	✓~~CT&M~~		Test for at least ~~6~~ **six** cycles with stability augmentation OFF. CCA: Test in **n**~~N~~on-normal **c**~~C~~ontrol state.
(8) Steady **s**~~S~~tate **s**~~S~~ideslip.	For a given rudder position: ± 2º bank angle ± 1º sideslip angle ± 10% or ± 2º aileron ± 10% or ± 5º spoiler or equivalent roll controller position or force For FFSs representing aircraft with reversible flight control systems: ±10% or ±1·3 daN	Approach or **l**~~L~~anding	✓	✓	✓	✓			✓~~CT&M~~	✓	✓	✓	May be a series of snapshot tests using at least two rudder positions (in each direction for propeller driven aeroplanes) one of which should be near maximum allowable rudder. For FNPT and BITD a roll controller position tolerance of ± 10% or ± 5º applies instead of the aileron tolerance. For a BITD the force tolerance ~~shall~~**should** be CT&M.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
	(3 lb) wheel force ±10% or ±2·2 daN (5 lb) rudder pedal force.												
e. LANDINGS													
(1) Normal l~~L~~anding	± 3 kts airspeed ± 1·5º pitch angle ± 1·5º AOA ± 3 m (10 ft) or ± 10% of height For aeroplanes with reversible flight control systems: ± 10% or ± 2·2 daN (5 lb) column force	Landing	C T & M	✓	✓	✓							Test from a minimum of 61 m (200 ft) AGL to nosewheel touch- down. Two tests should be shown, including two normal landing flaps (if applicable) one of which should be near maximum certificated landing weight, the other at light or medium weight CCA: Test in Normal AND Non-normal Control state if applicable.
(2) Minimum f~~F~~lap l~~L~~anding.	± 3 kts airspeed ± 1·5º pitch angle ± 1·5º AOA ± 3 m (10 ft) or ± 10% of height For aeroplanes with reversible flight control systems: ± 10% or ± 2·2 daN (5 lb) column force	Minimum c~~C~~ertified l~~L~~anding f~~F~~lap c~~C~~onfiguration		✓	✓	✓							Test from a minimum of 61 m (200 ft) AGL to nosewheel touchdown. Test at near maximum landing weight.
(3) Crosswind l~~L~~anding.	± 3 kts airspeed ± 1·5º pitch angle ± 1·5º AOA ± 3 m (10 ft) or ± 10% height ± 2º bank angle ± 2º sideslip angle ± 3° heading angle For aeroplanes with reversible flight control systems: ± 10% or ± 2·2 daN	Landing		✓	✓	✓							Test from a minimum of 61 m (200 ft) AGL to a 50% decrease in main landing gear touchdown speed. Requires test data, including wind profile, for a crosswind component of at least 60% of AFM value measured at 10 m (33 ft) above the runway.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
	(5 lb) column force ± 10% or ± 1·3 daN (3 lb) wheel force ± 10% or ± 2·2 daN (5 lb) rudder pedal force.												
(4) One **e**~~E~~ngine **i**~~I~~noperative **l**~~L~~anding.	± 3 kts airspeed ± 1·5º pitch angle ± 1·5º AOA ± 3 m (10 ft) or ± 10% height ± 2º bank angle ± 2º sideslip angle ± 3° heading angle	Landing		✓	✓	✓							Test from a minimum of 61 m (200 ft) AGL to a 50% decrease in main landing gear touchdown speed.
(5) Autopilot **l**~~L~~anding (if applicable).	± 1·5 m (5 ft) flare height. ± 0·5 s or ± 10%T_f. ± 0·7 m/s (140 ft/min) R/D at touchdown. ± 3 m (10 ft) lateral deviation during rollout.	Landing		✓	✓	✓							If autopilot provides rollout guidance, record lateral deviation from touchdown to a 50% decrease in main landing gear touchdown speed. Time of autopilot flare mode engage and main gear touchdown should be noted. This test <u>is not</u> a substitute for the ground effects test requirement. T_f = Duration of **f**~~F~~lare.
(6) All engine autopilot **g**~~G~~o **a**~~A~~round.	± 3 kts airspeed ± 1·5° pitch angle ± 1·5° AOA	As per AFM		✓	✓	✓							Normal all engine autopilot go around should be demonstrated (if applicable) at medium weight. CCA: Test in **n**~~N~~ormal AND **n**~~N~~on-normal
(7) One-**e**~~E~~ngine-inoperative **g**~~G~~o-around	± 3 kts airspeed ±1·5° pitch angle ±1·5° AOA ± 2° bank angle ± 2° sideslip angle	As per AFM		✓	✓	✓							Engine inoperative go-around required near maximum certificated landing weight with critical engine(s) inoperative. Provide one test with autopilot (if applicable) and one without autopilot. CCA: Non-autopilot test to be conducted in **n**~~N~~on-normal mode.
(8) Directional **c**~~C~~ontrol (**r**~~R~~udder **e**~~E~~ffectiveness	± 5 kts airspeed ± 2°/s yaw rate	Landing		✓	✓	✓							Apply rudder pedal input in both directions using full reverse thrust until reaching full thrust reverser minimum operating speed.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
) with **r**~~R~~everse **t**~~T~~hrust symmetric).													
(9) Directional **c**~~C~~ontrol (**r**~~R~~udder **e**~~E~~ffectiveness) with **r**~~R~~everser **t**~~T~~hrust (asymmetric)	± 5 kts airspeed ± 3° heading angle	Landing		✓	✓	✓							With full reverse thrust on the operating engine(s), maintain heading with rudder pedal input until maximum rudder pedal input or thrust reverser minimum operating speed is reached.
f. GROUND EFFECT													
(1) A Test to demonstrate **g**~~G~~round **e**~~E~~ffect.	± 1º elevator ± 0·5º stabilizer angle. ± 5% net thrust or equivalent. ± 1º AOA ± 1·5 m (5 ft) or ± 10% height ± 3 kts airspeed ± 1º pitch angle	Landing		✓	✓	✓							See ~~Paragraph~~ **AMC1-CS-FSTD(A).300** 2.4.2. A rationale should be provided with justification of results. CCA: Test in **n**~~N~~ormal OR **n**~~N~~on-normal control state.
g. WIND SHEAR													
(1) Four Tests, two take-off and two landing with one of each conducted in still air and the other with Wind Shear active to demonstrate **w**~~W~~ind **s**~~S~~hear models.	None	Take-off and **l**~~L~~anding			✓	✓							Wind shear models are required which provide training in the specific skills required for recognition of wind shear phenomena and execution of recovery manoeuvres. Wind shear models should be representative of measured or accident derived winds, but may be simplifications which ensure repeatable encounters. For example, models may consist of independent variable winds in multiple simultaneous components. Wind models should be available for the following critical phases of flight: (1) **p**~~P~~rior to take-off rotation (2) **a**~~A~~t lift-off (3) **d**~~D~~uring initial climb

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
													(4) **s**~~S~~hort final approach The United States Federal Aviation Administration (FAA) Wind shear Training Aid, wind models from the Royal Aerospace Establishment (RAE), the United States ~~Joint Aerodrome Weather studies (~~JAWS~~)~~ Project or other recognised sources may be implemented and should be supported and properly referenced in the QTG. Wind models from alternate sources may also be used if supported by aeroplane**-**related data and such data are properly supported and referenced in the QTG. Use of alternate data should be co–ordinated with the **competent** **a**~~A~~uthority prior to submittal of the QTG for approval.
h. FLIGHT AND MANOEUVRE ENVELOPE PROTECTION FUNCTIONS													This paragraph is only applicable to computer-controlled aeroplanes. Time history results of response to control inputs during entry into each envelope protection function (i.e., with normal and degraded control states if function is different) are required. Set thrust as required to reach the envelope protection function.
(1) Overspeed.	± 5 kts airspeed	Cruise	✓	✓	✓	✓	✓	✓					
(2) Minimum **s**~~S~~peed.	± 3 kts airspeed	Take-off, **c**~~C~~ruise and **a**~~A~~pproach or **l**~~L~~anding	✓	✓	✓	✓	✓	✓					
(3) Load **f**~~F~~actor.	± 0·1 g	Take-off, **c**~~C~~ruise	✓	✓	✓	✓	✓	✓					
(4) Pitch **a**~~A~~ngle.	± 1·5º pitch angle	Cruise, **a**~~A~~pproach	✓	✓	✓	✓	✓	✓					
(5) Bank **a**~~A~~ngle.	± 2º or ± 10% bank angle	Approach	✓	✓	✓	✓	✓	✓					
(6) Angle of **a**~~A~~ttack.	± 1·5º AOA	Second **s**~~S~~egment **c**~~C~~limb and	✓	✓	✓	✓	✓	✓					

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~**FFS**				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
		a~~A~~pproach or **l**~~L~~anding											
3. MOTION SYSTEM													
a. Frequency response	As specified by the applicant for ~~flight simulator~~ **FFS** qualification.	~~Not Applicable~~**n / a**	✓	✓	✓	✓							Appropriate test to demonstrate frequency response required. See also AMC~~ No.~~ 1**-**~~ to~~ CS**-**FSTD(A).300 ~~para~~ 2.4.3.2
b. Leg **b**~~B~~alance	As specified by the applicant for ~~flight simulator~~**FFS** qualification.	**n / a**~~Not Applicable~~	✓	✓	✓	✓							Appropriate test to demonstrate leg balance required See also AMC~~ No.~~ 1**-**~~ to~~ CS**-**FSTD(A).300 ~~para~~ 2.4.3.2
c. Turn-around check	As specified by the applicant for ~~flight simulator~~**FFS** qualification.	**n / a**~~Not Applicable~~	✓	✓	✓	✓							Appropriate test to demonstrate turn-around required. See also AMC ~~No.~~ 1**-**~~ to~~ CS**-**FSTD(A).300 ~~para~~ 2.4.3.2
d. Motion effects													Refer to AMC~~ No~~ 1**-**~~ to~~ CS**-**FSTD(A).300 ~~para~~ 3.3(n) subjective testing
e. Motion **s**~~S~~ystem repeatability	± 0·05g actual platform linear accelerations	None			✓	✓							Ensure that motion system hardware and software (in normal flight simulator operating mode) continue to perform as originally qualified. Performance changes from the original baseline can be readily identified with this information. See AMC~~ No.~~ 1**-**~~ to~~ CS**-**FSTD(A).300 ~~para~~ 2.4.3.4
f. Motion cueing performance signature.	None	Ground and flight	✓	✓	✓	✓							For a given set of flight simulation critical manoeuvres record the relevant motion variables. These tests should be run with the motion buffet module disabled. See AMC~~ No.~~ 1**-**~~ to JAR~~**CS-**~~-~~FSTD(A).300 ~~para~~ 2.4.3.3
g. Characteristic motion vibrations	None	Ground and flight											The recorded test results for characteristic buffets should allow the comparison of relative amplitude versus frequency. For atmospheric disturbance testing, general purpose disturbance models that approximate demonstrable flight test data are acceptable.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
													Principally, the flight simulator results should exhibit the overall appearance and trends of the aeroplane plots, with at least some of the frequency "spikes" being present within 1 or 2 Hz of the aeroplane data. See AMC ~~No.~~ 1 ~~to JAR~~**CS**-~~–~~ FSTD(A).300 ~~para~~ 2.4.3.5
The following tests with recorded results and an SOC are required for characteristic motion vibrations, which can be sensed at the flight deck where applicable by aeroplane type:													
(1) Thrust effects with brakes set	n/a	Ground				✓							Test should be conducted at maximum possible thrust with brakes set.
(2) Landing gear extended buffet	n/a	Flight				✓							Test condition should be for a normal operational speed and not at the gear limiting speed.
(3) Flaps extended buffet	n/a	Flight				✓							Test condition should be for a normal operational speed and not at the flap limiting speed.
(4) Speedbrake deployed buffet	n/a	Flight				✓							
(5) Approach-to-stall buffet	n/a	Flight				✓							Test condition should be approach-to-stall. Post-stall characteristics are not required.
(6) High speed or Mach buffet	n/a	Flight				✓							Test condition should be for high speed manoeuvre buffet/wind-up-turn or alternatively Mach buffet.
(7) In-flight vibrations	n/a	Flight (clean configuration)				✓							Test should be conducted to be representative of in-flight vibrations for propeller driven aeroplanes.
4. VISUAL SYSTEM													

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
a. SYSTEM RESPONSE TIME													
(1) Transport **d**~~D~~elay.	150 mi~~lliseconds~~s or less after controller movement. 300 mi~~lliseconds~~s or less after controller movement.	Pitch, roll and yaw	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	One separate test is required in each axis. See Appendix 5 to ~~ACJ FSTD A.030~~**AMC1-CS-FSTD(A).300** **For** FNPT I and BITD only the instrument response time applies.
-- or --													
(2) Latency	- 150 mi~~lliseconds~~s or less after controller movement. - 300 mi~~lliseconds~~s or less after controller movement.	Take-off, **c**~~C~~ruise, and **a**~~A~~pproach or **l**~~L~~anding	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	One test is required in each axis (pitch, roll, yaw) for each of the ~~3~~ **three** conditions compared with aeroplane data for a similar input. The visual scene or test pattern used during the response testing ~~shall~~**should** be representative of the required system capacities to meet the daylight, twilight (dusk/dawn) and night visual capability as applicable. ~~FS~~ **FFS** only: Response tests should be confirmed in daylight, twilight and night settings as applicable. **For** FNPT I and BITD only the instrument response time applies.
b. DISPLAY SYSTEM TESTS													
(1) (a) Continuous collimated cross-cockpit visual field of view	Continuous, cross-cockpit, minimum collimated visual field of view providing each pilot with 180 degrees horizontal and 40 degrees vertical field of view. Horizontal FOV: Not less than a total of	**n/a**~~Not Applicable~~			✓	✓							Field of view should be measured using a visual test pattern filling the entire visual scene (all channels) consisting of a matrix of black and white 5° squares. Installed alignment should be confirmed in a **s**~~S~~tatement of ~~C~~**c**ompliance.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD		
			A	B	C	D	Init	Rec	I	II	MCC	Rec		
	176 measured degrees (including not less than ±88 measured degrees either side of the centre of the design eye point). Vertical FOV: Not less than a total of 36 measured degrees from the pilot's and co-pilot's eye point.													
(b) Continuous collimated visual field of view	Continuous, minimum collimated visual field of view providing each pilot with 45 degrees horizontal and 30 degrees vertical field of view	**n / a**~~Not Applicable~~	✓	✓										30 degrees vertical field of view may be insufficient to meet AMC~~ No. 1 - to~~ CS-FSTD(A) .300 Table 2.3 ~~paragraph~~ 4.c**.** (visual ground segment)
(2) System geometry	5° even angular spacing within ± 1° as measured from either pilot eye-point, and within 1·5° for adjacent squares.	**n / a**~~Not Applicable~~	✓	✓	✓	✓								System geometry should be measured using a visual test pattern filling the entire visual scene (all channels) consisting of a matrix of black and white 5° squares with light points at the intersections. The operator should demonstrate that the angular spacing of any chosen 5° square and the relative spacing of adjacent squares are within the stated tolerances. The intent of this test is to demonstrate local linearity of the displayed image at either pilot eye-point.
(3) Surface **c**~~C~~ontrast **r**~~R~~atio	Not less than 5:1	**n / a**~~Not Applicable~~			✓	✓								Surface contrast ratio should be measured using a raster drawn test pattern filling the entire visual scene (all channels). The test pattern should consist of black and white squares, **five**~~5~~ per square with a white square in the centre of each channel. Measurement should be made on the

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
													centre bright square for each channel using a 1° spot photometer. This value should have a minimum brightness of 7 cd/m2 (2 foot-lamberts). Measure any adjacent dark squares. The contrast ratio is the bright square value divided by the dark square value. Note. During contrast ratio testing, simulator aft-cab and flight deck ambient light levels should be zero.
(4) Highlight **b**~~B~~rightness	Not less than 20 cd/m^2 (6 ft-lamberts) on the display	**n/a**~~Not Applicable~~			✓	✓							Highlight brightness should be measured by maintaining the full test pattern described in ~~paragraph~~ **AMC1-CS-FSTD(A) .300 Table 2.3** 4.b.**(**3) above, superimposing a highlight on the centre white square of each channel and measuring the brightness using the 1° spot photometer. Lightpoints are not acceptable. Use of calligraphic capabilities to enhance raster brightness is acceptable.
(5) Vernier **r**~~R~~esolution	Not greater than 2 arc minutes	**n/a**~~Not Applicable~~			✓	✓							Vernier resolution should be demonstrated by a test of objects shown to occupy the required visual angle in each visual display used on a scene from the pilot's eye-point. The eye will subtend two arc minutes (arc tan (4/6 876)x60) when positioned on a 3 degree glideslope, 6 876 ft slant range from the centrally located threshold of a black runway surface painted with white threshold bars that are 16 ft wide with 4-ft gaps in-between. This should be confirmed by calculations in a statement of compliance.
(6) Lightpoint **s**~~S~~ize	Not greater than 5 arc minutes.	**n/a**~~Not Applicable~~			✓	✓							Lightpoint size should be measured using a test pattern consisting of a centrally located single row of lightpoints reduced in length until modulation is just discernible in each visual channel. A row of 48 lights will form a 4° angle or less.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
(7) Lightpoint c~~C~~ontrast r~~R~~atio.	Not less than 10:1	**n / a**~~Not Applicable~~	✓	✓									Lightpoint contrast ratio should be measured using a test pattern demonstrating a 1° area filled with lightpoints (i.e. lightpoint modulation just discernible) and should be compared to the adjacent background.
	Not less than 25:1				✓	✓							Note. During contrast ratio testing, simulator aft-cab and flight deck ambient light levels should be zero.
c. VISUAL GROUND SEGMENT	Near end. The lights computed to be visible should be visible in the FSTD. Far end: ± 20% of the computed VGS	Trimmed in the landing configuration at 30 m (100 ft) wheel height above touchdown zone elevation on glide slope at a RVR setting of 300 m (1 000 ft) or 350m (1 200ft)	✓	✓	✓	✓				✓	✓		Visual Ground Segment. This test is designed to assess items impacting the accuracy of the visual scene presented to a pilot at DH on an ILS approach. Those items include - RVR, - glideslope (G/S) and localiser modelling accuracy (location and slope) for an ILS, - for a given weight, configuration and speed representative of a point within the aeroplane's operational envelope for a normal approach and landing. If non-homogenous fog is used, the vertical variation in horizontal visibility should be described and be included in the slant range visibility calculation used in the VGS computation. FNPT: If a generic aeroplane is used as the basic model, a generic cut-off angle of 15 deg. is assumed as an ideal.
5. SOUND SYSTEMS													All tests in this section should be presented using an unweighted 1/3-octave band format from band 17 to 42 (50 Hz to 16 kHz). A minimum 20 s~~econd~~ average should be taken at the location corresponding to the aeroplane data set. The aeroplane and flight simulator results should be produced using comparable data

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
													analysis techniques. See AMC ~~No.1 - to~~CS-FSTD(A).300 ~~para~~ 2.4.5
a. TURBO-JET AEROPLANES													
(1) Ready for engine start	± 5 dB per 1/3 octave band	Ground				✓							Normal condition prior to engine start. The APU should be on if appropriate.
(2) All engines at idle	± 5 dB per 1/3 octave band	Ground				✓							Normal condition prior to take-off.
(3) All engines at maximum allowable thrust with brakes set	± 5 dB per 1/3 octave band	Ground				✓							Normal condition prior to take-off.
(4) Climb	± 5 dB per 1/3 octave band	En-route climb				✓							Medium altitude.
(5) Cruise	± 5 dB per 1/3 octave band	Cruise				✓							Normal cruise configuration.
(6) Speedbrake / spoilers extended (as appropriate)	± 5 dB per 1/3 octave band	Cruise				✓							Normal and constant speedbrake deflection for descent at a constant airspeed and power setting.
(7) Initial approach	± 5 dB per 1/3 octave band	Approach				✓							Constant airspeed, gear up, flaps/slats as appropriate.
(8) Final approach	± 5 dB per 1/3 octave band	Landing				✓							Constant airspeed, gear down, full flaps.
b. PROPELLER AEROPLANES													
(1) Ready for engine start	± 5 dB per 1/3 octave band	Ground				✓							Normal condition prior to engine start. The APU should be on if appropriate.
(2) All propellers feathered	± 5 dB per 1/3 octave band	Ground				✓							Normal condition prior to take-off.
(3) Ground idle or equivalent	± 5 dB per 1/3 octave band	Ground				✓							Normal condition prior to take-off.
(4) Flight idle or equivalent	± 5 dB per 1/3 octave band	Ground				✓							Normal condition prior to take-off.
(5) All engines at maximum allowable	± 5 dB per 1/3 octave band	Ground				✓							Normal condition prior to take-off.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL										COMMENTS
			~~FS~~FFS				FTD		FNPT			BITD	
			A	B	C	D	Init	Rec	I	II	MCC	Rec	
power with brakes set													
(6) Climb	± 5 dB per 1/3 octave band	En-route climb				✓							Medium altitude.
(7) Cruise	± 5 dB per 1/3 octave band	Cruise				✓							Normal cruise configuration.
(8) Initial approach	± 5 dB per 1/3 octave band	Approach				✓							Constant airspeed, gear up, flaps extended as appropriate, RPM as per ~~operating~~ **operations** manual.
(9) Final approach	± 5 dB per 1/3 octave band	Landing				✓							Constant airspeed, gear down, full flaps, RPM as per ~~operating~~ **operations** manual.
c. SPECIAL CASES	± 5 dB per 1/3 octave band					✓							Special cases identified as particularly significant to the pilot, important in training, or unique to a specific aeroplane type or variant.
d. ~~FLIGHT SIMULATOR~~**FFS**~~**FSTD**~~ BACKGROUND NOISE	Initial evaluation: not applicable. Recurrent evaluation: ± 3dB per 1/3 octave band compared to initial evaluation					✓							Results of the background noise at initial qualification should be included in the QTG document and approved by the qualifying authority. The simulated sound will be evaluated to ensure that the background noise does not interfere with training. Refer to AMC~~ No.~~1**-**~~ to ~~CS**-**FSTD(A).300 ~~para ~~2.4.5.6. The measurements **should**~~are to~~ be made with the simulation running, the sound muted and a dead cockpit.
e. FREQUENCY RESPONSE	Initial evaluation: not applicable. Recurrent evaluation: cannot exceed ± 5 dB on three consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.				✓	✓							Only required if the results are to be used during recurrent evaluations according to AMC~~ No.~~1**-**~~ to ~~CS**-**FSTD(A.).300~~ para ~~2.4.5.7. The results ~~shall~~**should** be acknowledged by the ~~au~~**competent au**thority at initial qualification.

2.4 Information for **v**~~V~~alidation **t**~~T~~ests

2.4.1 Control **d**~~D~~ynamics

2.4.1.1 General

The characteristics of an aircraft flight control system have a major effect on handling qualities. A significant consideration in pilot acceptability of an aircraft is the 'feel' provided through the flight controls. Considerable effort is expended on aircraft feel system design so that pilots will be comfortable and will consider the aircraft desirable to fly. In order for a**n** FSTD to be representative, it too should present the pilot with the proper feel – that of the aircraft being simulated. Compliance with this requirement should be determined by comparing a recording of the control feel dynamics of the FSTD to actual aircraft measurements in the relevant configurations.

a. Recordings such as free response to a pulse or step function are classically used to estimate the dynamic properties of electromechanical systems. In any case, the dynamic properties can only be estimated since the true inputs and responses are also only estimated. Therefore, it is imperative that the best possible data be collected since close matching of the FSTD control loading system to the aircraft systems is essential. The required dynamic control checks are indicated in ~~paragraph~~ 2.3–2b(1) to (3) of the table of FSTD validation tests.

b. For initial and upgrade evaluations, ~~it is required that~~ control dynamics characteristics **should** be measured at and recorded directly from the flight controls. This procedure is usually accomplished by measuring the free response of the controls using a step input or pulse input to excite the system. The procedure should be accomplished in relevant flight conditions and configurations.

c. For aeroplanes with irreversible control systems, measurements may be obtained on the ground if proper pitot-static inputs (if applicable) are provided to represent airspeeds typical of those encountered in flight. Likewise, it may be shown that for some aeroplanes, take-off, cruise, and landing configurations have like effects. Thus, one may suffice for another. If either or both considerations apply, engineering validation or aeroplane manufacturer rationale should be submitted as justification for ground tests or for eliminating a configuration. For FSTDs requiring static and dynamic tests at the controls, special test fixtures ~~will~~ **should** not be required during initial and upgrade evaluations if the MQTG shows both test fixture results and the results of an alternate approach, such as computer plots which were produced concurrently and show satisfactory agreement. Repeat of the alternate method during the initial evaluation would then satisfy this test requirement.

2.4.1.2 Control dynamics evaluation.

The dynamic properties of control systems are often stated in terms of frequency, damping, and a number of other classical measurements which can be found in texts on control systems. In order to establish a consistent means of validating test results for FSTD control loading, criteria are needed that ~~will~~ clearly define the interpretation of the measurements and the tolerances to be applied. Criteria are needed for underdamped, critically damped, and overdamped systems. In the case of an underdamped system with very light damping, the system may be quantified in terms of frequency and damping. In critically damped or overdamped systems, the frequency and damping are not readily measured from a response time history. Therefore, some other measurement should be used.

Tests to verify that control feel dynamics represent the aeroplane should show that the dynamic damping cycles (free response of the controls) match that of the aeroplane within specified tolerances. The method of evaluating the response and the tolerance to be applied is described in the underdamped and critically damped cases are as follows:

a. Underdamped **r**~~R~~esponse.

1. Two measurements are required for the period, the time to first zero crossing (in case a rate limit is present) and the subsequent frequency of oscillation. It is necessary to measure cycles on an individual basis in case there are non-uniform periods in the response. Each period ~~will~~ **should** be independently compared with the respective period of the aeroplane control system and, consequently, **should**~~will~~ enjoy the full tolerance specified for that period.

2. The damping tolerance should be applied to overshoots on an individual basis. Care should be taken when applying the tolerance to small overshoots since the significance of such overshoots becomes questionable. Only those overshoots larger than 5% of the total initial displacement should be considered. The residual band, labelled T(Ad) in Figure 1 is ± 5% of the initial displacement amplitude Ad from the steady state value of the oscillation. Only oscillations outside the residual band are considered significant. When comparing FSTD data to aeroplane data, the process should begin by overlaying or aligning the FSTD and aeroplane steady state values and then comparing amplitudes of oscillation peaks, the time of the first zero crossing, and individual periods of oscillation. The FSTD should show the same number of significant overshoots to within one when compared against the aeroplane data. This procedure for evaluating the response is illustrated in Figure 1 below.

b. Critically damped and overdamped response. Due to the nature of critically damped and overdamped responses (no overshoots), the time to reach 90% of the steady state (neutral point) value should be the same as the aeroplane within ± 10%. Figure 2 illustrates the procedure.

c. Special considerations. Control systems~~, which~~ **that** exhibit characteristics other than classical overdamped or underdamped responses should meet specified tolerances. In addition, special consideration should be given to ensure that significant trends are maintained.

2.4.1.3. Tolerances. The following table summarises the tolerances, T. See figures 1 and 2 for an illustration of the referenced measurements.

$T(P_0)$	± 10% of P_0
$T(P_1)$	± 20% of P_1
$T(P_2)$	± 30% of P_2
$T(P_n)$	± 10(n+1)% of P_n
$T(A_n)$	± 10% of A_1
$T(A_d)$	± 5% of A_d = residual band
Significant overshoots	**f**~~F~~irst overshoot and ± 1 subsequent overshoots

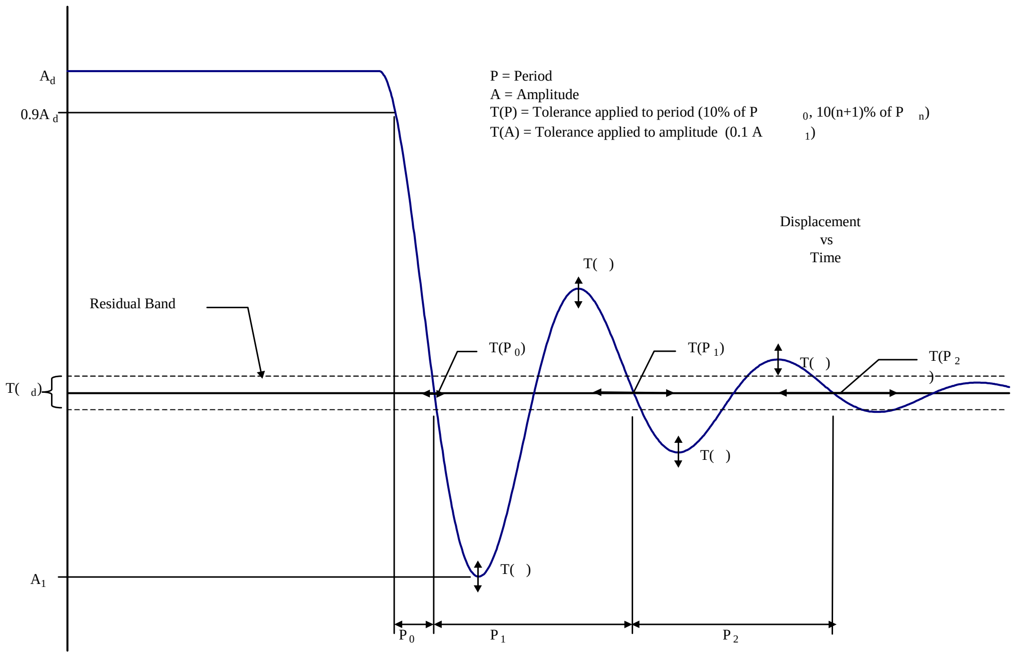

Figure 1: Underdamped step response

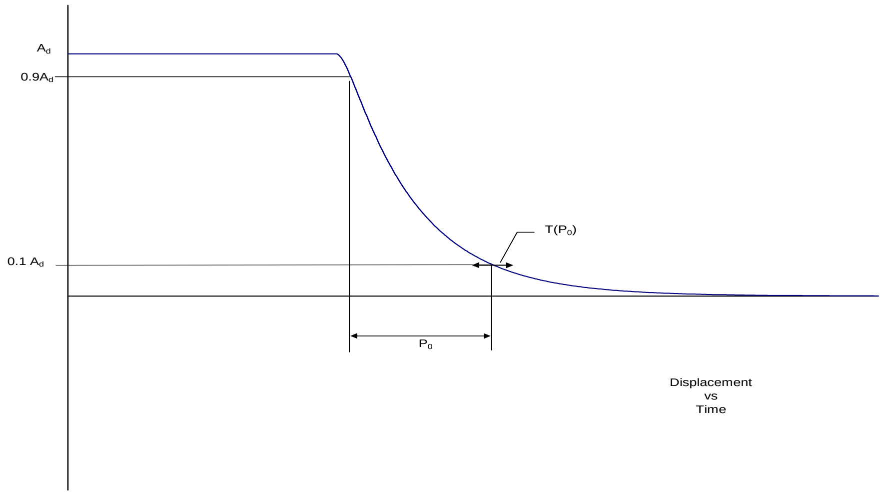

Figure 2: Critically damped step response

2.4.1.4 Alternate method for control dynamics evaluation~~.~~

An alternate means for validating control dynamics for aircraft with hydraulically powered flight controls and artificial feel systems is by the measurement of control force and rate of movement. For each axis of pitch, roll, and yaw, the control should be forced to its maximum extreme position for the following distinct rates. These tests should be conducted at typical flight and ground conditions.

a. Static test**:**~~—~~ **s**~~S~~lowly move the control such that approximately 100 seconds are required to achieve a full sweep. A full sweep is defined as movement of the controller from neutral to the stop, usually aft or right stop, then to the opposite stop, then to the neutral position.

b. Slow dynamic test**:**~~—~~ **a**~~A~~chieve a full sweep in approximately 10 s~~econds~~.

c. Fast dynamic test**:** ~~—A~~**a**chieve a full sweep in approximately 4 s~~econds~~.

Note: **d**~~D~~ynamic sweeps may be limited to forces not exceeding 44.5 daN (100 lbs).

2.4.1.5 Tolerances

a. Static test**:**~~ ,~~ see ~~paragraph~~ 2.3 – 2.a(1), (2), and (3) of ~~the~~ **t**~~T~~able of FSTD validation tests.

b. Dynamic test**:**~~—~~ ± 0.9 daN (2 lbs) or ± 10% on dynamic increment above static test.

The ~~Au~~**competent au**thority ~~is~~ **should**~~open to~~ **consider** alternative means such as the one described above. Such alternatives should, however, be justified and appropriate to the application. For example, the method described here may not apply to all manufacturers' systems and certainly not to aeroplanes with reversible control systems. Hence, each case should be considered on its own merit on an *ad hoc* basis. Should the ~~Au~~**competent au**thority find that alternative methods do not result in satisfactory performance, then more conventionally accepted methods should be used.

2.4.2 Ground **e**~~E~~ffect

2.4.2.1 For a**n** FSTD to be used for take-off and landing it should faithfully reproduce the aerodynamic changes which occur in ground effect. The parameters chosen for FSTD validation should be indicative of these changes.

A dedicated test should be provided ~~which will~~**to** validate the aerodynamic ground effect characteristics.

The selection of the test method and procedures to validate ground effect is at the option of the organisation performing the flight tests; however, the flight test should be performed with enough duration near the ground to validate sufficiently the ground-effect model.

2.4.2.2 Acceptable tests for validation of ground effect include **the following**:

a. Level fly-bys**:**~~.~~ ~~The level fly-bys~~**these** should be conducted at a minimum of three altitudes within the ground effect, including one at no more than 10% of the wingspan above the ground, one each at approximately 30% and 50% of the wingspan where height refers to main gear tyre above the ground. In addition, one level-flight trim condition should be conducted out of ground effect, e.g. at 150% of wingspan.

b. Shallow approach landing**:**~~.~~ ~~The shallow approach landing~~**this** should be performed at a glide slope of approximately one degree with negligible pilot activity until flare.

If other methods are proposed, a rationale should be provided to conclude that the tests performed validate the ground-effect model.

2.4.2.3 The lateral-directional characteristics are also altered by ground effect. For example, because of changes in lift, roll damping is affected. The change in roll damping will affect other dynamic modes usually evaluated for FSTD validation. ~~In fact,~~ Dutch roll dynamics, spiral stability, and roll-rate for a given lateral control input are altered by ground effect. Steady heading sideslips will also be affected. These effects should be accounted for in the FSTD modelling. Several tests such as 'crosswind landing', 'one engine inoperative landing', and 'engine failure on take-off' serve to validate lateral-directional ground effect since portions of them are accomplished whilst transiting heights at which ground effect is an important factor.

2.4.3 Motion **s**~~S~~ystem

2.4.3.1 General

a. Pilots use continuous information signals to regulate the state of the aeroplane. In concert with the instruments and outside-world visual information, whole-body motion feedback is essential in assisting the pilot to control the aeroplane's dynamics, particularly in the presence of external disturbances. The motion system should therefore meet basic objective performance criteria, as well as being subjectively tuned at the pilot's seat position to represent the linear and angular accelerations of the aeroplane during a prescribed minimum set of manoeuvres and conditions. Moreover, the response of the motion cueing system should be repeatable.

b. The objective validation tests presented **here** in ~~this paragraph~~ **2.4.3** are intended to qualify the FSTD motion cueing system from a mechanical performance standpoint. Additionally, the list of motion effects provides a representative sample of dynamic conditions that should be present in the FSTD. A list of representative training-critical manoeuvres that should be recorded during initial qualification (but without tolerance) to indicate the FSTD motion cueing performance signature has been added to this document **(see Table 1 and Table 2)**. These are intended to help to improve the overall standard of FSTD motion cueing.

2.4.3.2 Motion **s**~~S~~ystem **c**~~C~~hecks.

The intent of tests as described in the table of FSTD validation tests **(2.3)**, ~~paragraph 2.3 -~~ **–points** 3.a.~~,~~ frequency response, 3.b**.** leg balance, and 3.c.~~,~~ turn-around check, is to demonstrate the performance of the motion system hardware, and to check the integrity of the motion set-up with regard to calibration and wear. These tests are independent of the motion cueing software and should be considered as robotic tests.

2.4.3.3 Motion **c**~~C~~ueing **p**~~P~~erformance **s**~~S~~ignature

a. Background. The intent of this test is to provide quantitative time history records of motion system response to a selected set of automated QTG manoeuvres during initial qualification. This is not intended to be a comparison of the motion platform accelerations against the flight test recorded accelerations (i.e. not to be compared against aeroplane cueing). This information describes a minimum set of manoeuvres and a guideline for determining the FSTD's motion footprint. If over time there is a change to the initially certified motion software load or motion hardware then these baseline tests should be rerun.

b. List of tests. Table ~~1~~ ~~3~~**1**delineates those tests that are important to pilot motion cueing and are general tests applicable to all types of aeroplanes and thus the motion cueing performance signature should be run for initial qualification. These tests can be run at any time deemed acceptable to the ~~Au~~**competent au**thority prior to or during the initial qualification. The tests in table ~~2~~ ~~4~~**2**are also significant to pilot motion cues but are provided for information only. These tests are not required to be run.

c. Priority. A priority (X) is given to each of these manoeuvres, with the intent of placing greater importance on those manoeuvres that directly influence pilot perception and control of the aeroplane motions. For the manoeuvres designated with a priority in the tables below, the FSTD motion cueing system should have a high tilt co-ordination gain, high rotational gain, and high correlation with respect to the aeroplane simulation model.

d. Data **r**~~R~~ecording. The minimum list of parameters provided should allow for the determination of the FSTD's motion cueing performance signature for the initial qualification. The following parameters are recommended as being acceptable to perform such a function:

1. flight model acceleration and rotational rate commands at the pilot reference point;
2. motion actuators position;
3. actual platform position; **and**
4. actual platform acceleration at pilot reference point.

2.4.3.4 Motion **s**~~S~~ystem **r**~~R~~epeatability.

The intent of this test is to ensure that the motion system software and motion system hardware have not degraded or changed over time. This diagnostic test should be run during recurrent checks in lieu of the robotic tests. This **test** ~~will~~ allow**s** an improved ability to determine changes in the software or determine degradation in the hardware that have adversely affected the training value of the motion as was accepted during the initial qualification. The following information delineates the methodology that should be used for this test.

a. Conditions:

1. **o**~~O~~ne test case on-ground: to be determined by the operator; **and**
2. **o**~~O~~ne test case **i**~~I~~n-flight: to be determined by the operator.

b. Input: **t**~~T~~he inputs should be such that both rotational accelerations/rates and linear accelerations are inserted before the transfer from aeroplane centre of gravity to pilot reference point with a minimum amplitude of 5deg/s~~ec~~/s~~ec~~, 10deg/s~~ec~~ and 0·3g respectively to provide adequate analysis of the output.

c. Recommended output:

1. actual platform linear accelerations**:**~~;~~ the output will comprise accelerations due to both the linear and rotational motion acceleration; **and**
2. motion actuators position**.**

No.	Associated validation test	Manoeuvre	Priority	Comments
1	1b4	Take-off rotation (Vr to V2)	X	Pitch attitude due to initial climb should dominate over cab tilt due to longitudinal acceleration.
2	1b5	Engine failure between V1 and Vr	X	
3	2e6	Pitch change during go-around	X	
4	2c2 & 2c4	Configuration changes	X	
5	2c1	Power change dynamics	X	Resulting effects of power changes
6	2e1	Landing flare	X	
7	2e1	Touchdown bump		

Table 1~~3~~**:**~~—~~Tests required for initial qualification

No.	Associated validation test	Manoeuvre	Priority	Comments
8	1a2	Taxi (including acceleration, turns, braking), with presence of ground rumble	X	

9	1b4	Brake release and initial acceleration	X	
10	1b1 & 3g	Ground rumble on runway, acceleration during take off, scuffing, runway lights and surface discontinuities	X	Scuffing and velocity cues are given priority
11	1b2 & 1b7	Engine failure prior to V1 (RTO)	X	Lateral and directional cues are given priority
12	1c1	Steady-state climb	X	
13	1d1& 1d2	Level flight acceleration and deceleration		
14	2c6	Turns	X	
15	1b8	Engine failures		
16	2c8	Stall characteristics	X	
17		System failures	X	Priority depending on the type of system failure and aeroplane type (e.g. flight controls failures, rapid decompression, inadvertent thrust reverser deployment)
18	2g1 & 2e3	Wind shear/crosswind landing	X	Influence on vibrations and on attitude control
19	1e1	Deceleration on runway		Including contamination effects

Table ~~4: 22~~ ~~—~~Tests that are significant but are not required to be run

2.4.3.5 Motion vibrations

a. Presentation of results. The characteristic motion vibrations are a means to verify that the FSTD can reproduce the frequency content of the aeroplane when flown in specific conditions. The test results should be presented as a **p**~~P~~ower **s**~~S~~pectral **d**~~D~~ensity (PSD) plot with frequencies on the horizontal axis and amplitude on the vertical axis. The aeroplane data and FSTD data should be presented in the same format with the same scaling. The algorithms used for generating the FSTD data should be the same as those used for the aeroplane data. If they are not the same then the algorithms used for the FSTD data should be proven to be sufficiently comparable. As a minimum the results along the dominant axes should be presented and a rationale for not presenting the other axes should be provided.

b. Interpretation of results. The overall trend of the PSD plot should be considered while focusing on the dominant frequencies. Less emphasis should be placed on the differences at the high frequency and low amplitude portions of the PSD plot. During the analysis it should be considered that certain structural components of the FSTD have resonant frequencies that are filtered and thus may not appear in the PSD plot. If such filtering is required the notch filter bandwidth should be limited to 1 Hz to ensure that the buffet feel is not adversely affected. In addition, a rationale should be provided to explain that the characteristic motion vibration is not being adversely affected by the filtering. The amplitude should match aeroplane data as per the description below**.**~~;~~ **H**~~h~~owever, if for subjective reasons the PSD plot was altered a rationale should be provided to justify the change. If the plot is on a logarithmic scale it may be difficult to interpret the amplitude of the buffet in terms of acceleration. A 1x10-3 grms2/Hz would describe a heavy buffet. On the other hand, a 1x10-6 grms2/Hz buffet is ~~almost~~ **barely**~~not~~ perceivable~~;~~ but may represent a buffet at low speed. The previous two examples could differ in magnitude by 1 000. On a PSD plot this represents three decades (one decade is a change in order of magnitude of 10; two decades is a change in order of magnitude of 100, etc.).

2.4.4 Visual **s**~~S~~ystem

2.4.4.1 Visual **d**~~D~~isplay **s**~~S~~ystem

a. Contrast ratio (daylight systems). **This s**~~S~~hould be demonstrated using a raster-drawn test pattern filling the entire visual scene (three or more channels) consisting of a matrix of black and white squares no larger than ~~5~~ **five** degrees per square with a white square in the centre of each channel. Measurement should be made on the centre bright square for each channel using a ~~1~~ **one** degree spot photometer. Measure any adjacent dark squares. The contrast ratio is the bright square value divided by the dark square value. Lightpoint contrast ratio is measured when lightpoint modulation is just discernable compared to the adjacent background. See ~~paragraph~~ 2.3.4.b.(3) and ~~paragraph~~ 2.3.4.b.(7).

b. Highlight brightness test (daylight systems). **This s**~~S~~hould be demonstrated by maintaining the full test pattern described above, ~~the~~ superimposing a highlight on the centre white square of each channel and measure the brightness using the ~~1~~ **one** degree spot photometer. Lightpoints are not acceptable. Use of calligraphic capabilities to enhance raster brightness is acceptable. See ~~paragraph~~ 2.3.4.b.(4).

c. Resolution (daylight systems) should be demonstrated by a test of objects shown to occupy a visual angle of not greater than the specified value in arc minutes in the visual scene from the pilot's eyepoint. This should be confirmed by calculations in the statement of compliance. See ~~paragraph~~ 2.3.4.b.(5).

d. Lightpoint size (daylight systems) ~~–~~should be measured in a test pattern consisting of a single row of lightpoints reduced in length until modulation is just discernible. See ~~paragraph~~ 2.3.4.b.(6).

e. Lightpoint size (twilight and night systems)~~—~~ **should be** of sufficient resolution so as to enable achievement of visual feature recognition tests according to ~~paragraph~~ 2.3.4.b.(6).

2.4.4.2 Visual ground segment

(a) Altitude and RVR for the assessment have been selected in order to produce a visual scene that can be readily assessed for accuracy (RVR calibration) and where spatial accuracy (centreline and G/S) of the simulated aeroplane can be readily determined using approach/runway lighting and flight deck instruments.

(b) The QTG should indicate the source of data, i.e. airport and runway used, ILS G/S antenna location (airport and aeroplane), pilot eye reference point, flight deck cut-off angle, etc., used to make accurate~~ly~~ visual ground segment (VGS) scene content calculations.

(c) Automatic positioning of the simulated aeroplane on the ILS is encouraged. If such positioning is accomplished, diligent care should be taken to ensure the correct spatial position and aeroplane attitude is achieved. Flying the approach manually or with an installed autopilot should also produce acceptable results.

2.4.5 Sound **s**~~S~~ystem

2.4.5.1 General. The total sound environment in the aeroplane is very complex, and changes with atmospheric conditions, aeroplane configuration, airspeed, altitude, power settings, etc. Thus, flight deck sounds are an important component of the flight deck operational environment and as such provide valuable information to the flight crew. These aural cues can either assist the crew, as an indication of an abnormal situation, or hinder the crew, as a distraction or nuisance. For effective training, the FSTD should provide flight deck sounds that are perceptible to the pilot during normal and abnormal operations, and that are comparable to those of the aeroplane. Accordingly, the FSTD operator should carefully evaluate background noises in the location being considered. To demonstrate compliance with the sound requirements, the objective or validation tests ~~in this paragraph~~~~**2.4.5**~~have been selected to provide a representative sample of normal static conditions typical of those experienced by a pilot.

2.4.5.2 Alternate engine fits. For FSTDs with multiple propulsion configurations**,** any condition listed in ~~paragraph 2.3, the table of FSTD validation tests,~~~~**Table 1 of this AMC**~~**the table of validation tests (2.3)** that is identified by the aeroplane manufacturer as significantly different~~,~~ due to a change in engine model, should be presented for evaluation as part of the QTG.

2.4.5.3 Data and **d**~~D~~ata **c**~~C~~ollection **s**~~S~~ystem

(a) Information provided to the FSTD manufacturer should comply with **the IATA document entitled *Flight Simulation Training Device Design & Performance Data Requirements*, *7th edition***~~"*IATA Flight Simulator Design & Performance Data Requirements*", 6th Edition, 2000~~. This information should contain calibration and frequency response data.

(b) The system used to perform the tests listed in~~ para.~~2.3.5, within the table~~**table 1**~~ of FSTD validation tests, should comply with the following standards:

(**i**~~1~~) ANSI S1.11-1986 - Specification for octave, half octave and third octave band filter sets; **and**

(**ii**~~2~~) IEC 1094-4 - 1995 - measurement microphones - type WS2 or better.

2.4.5.4 Headsets. If headsets are used during normal operation of the aeroplane they should also be used during the FSTD evaluation.

2.4.5.5 Playback equipment. Recordings of the QTG conditions according to ~~paragraph~~ 2.3~~, table of~~~~**table 1**~~**in the table of** FSTD validation tests, should be provided during initial evaluations.

2.4.5.6 Background noise

(a) Background noise is the noise in the FSTD due to the FSTD's cooling and hydraulic systems that is not associated with the aeroplane, and the extraneous noise from other locations in the building. Background noise can seriously impact the correct simulation of aeroplane sounds, so the goal should be to keep the background noise below the aeroplane sounds. In some cases, the sound level of the simulation can be increased to compensate for the background noise. However, this approach is limited by the specified tolerances and by the subjective acceptability of the sound environment to the evaluation pilot.

(b) The acceptability of the background noise levels is dependent upon the normal sound levels in the aeroplane being represented. Background noise levels that fall below the lines defined by the following points, may be acceptable (refer to figure 3 **below**):

(1) 70 dB **at**~~@~~ 50 Hz;

(2) 55 dB ~~@ ~~**at** 1 000 Hz;

(3) 30 dB **at**~~@~~ 16 kHz.

These limits are for unweighted 1/3 octave band sound levels. Meeting these limits for background noise does not ensure an acceptable FSTD. Aeroplane sounds, which fall below this limit require careful review and may require lower limits on the background noise.

(c) The background noise measurement may be rerun at the recurrent evaluation as stated in ~~paragraph~~ 2.4.5.8. The tolerances to be applied are that recurrent 1/3 octave band amplitudes cannot exceed ± 3 dB when compared to the initial results.

2.4.5.7 Frequency response**.**~~—~~ Frequency response plots for each channel should be provided at initial evaluation. These plots may be rerun at the recurrent evaluation as per ~~paragraph~~ 2.4.5.8. The tolerances to be applied are as follows:

(a) recurrent 1/3 octave band amplitudes cannot exceed ± 5 dB for three consecutive bands when compared to initial results**; and**~~.~~

(b) the average of the sum of the absolute differences between initial and recurrent results cannot exceed 2 dB (refer table ~~35~~**3 below**).

2.4.5.8 Initial and recurrent evaluations. If recurrent frequency response and FSTD background noise results are within tolerance, respective to initial evaluation results, and the operator can prove that no software or hardware changes have occurred that will affect the aeroplane cases, then it is not required to rerun those cases during recurrent evaluations.

If aeroplane cases are rerun during recurrent evaluations then the results may be compared against initial evaluation results rather than aeroplane master data.

2.4.5.9 Validation testing. Deficiencies in aeroplane recordings should be considered when applying the specified tolerances to ensure that the simulation is representative of the aeroplane. Examples of typical deficiencies are:

(a) variation of data between tail numbers;

(b) frequency response of microphones;

(c) repeatability of the measurements; **and**

(d) extraneous sounds during recordings.

Fi

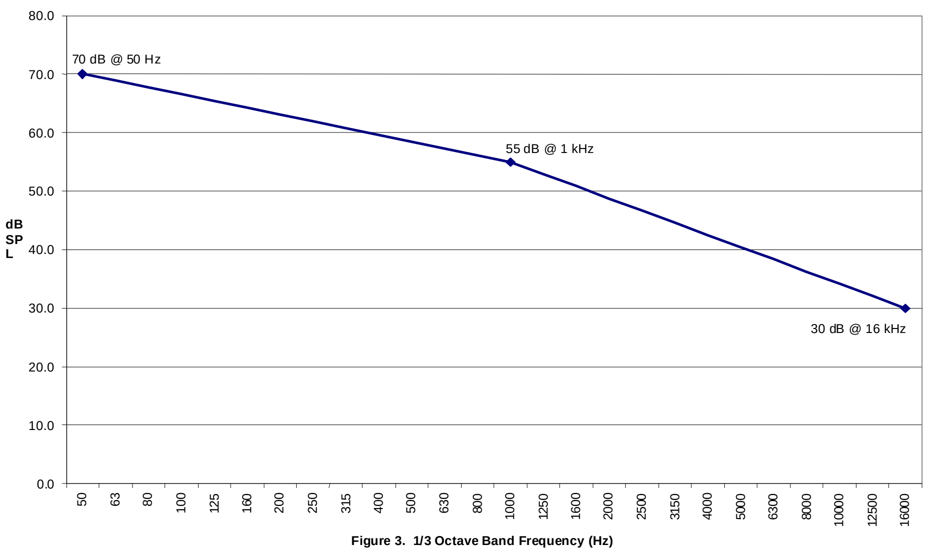

Figure 3: 1/3 octave band frequency (Hz)

Band Centre Freq.	Initial Results (dBSPL)	Recurrent Results (dBSPL)	Absolute Difference
50	75.0	73.8	1.2
63	75.9	75.6	0.3
80	77.1	76.5	0.6
100	78.0	78.3	0.3
125	81.9	81.3	0.6
160	79.8	80.1	0.3
200	83.1	84.9	1.8
250	78.6	78.9	0.3
315	79.5	78.3	1.2
400	80.1	79.5	0.6
500	80.7	79.8	0.9
630	81.9	80.4	1.5
800	73.2	74.1	0.9
1000	79.2	80.1	0.9
1250	80.7	82.8	2.1
1600	81.6	78.6	3.0
2000	76.2	74.4	1.8
2500	79.5	80.7	1.2
3150	80.1	77.1	3.0
4000	78.9	78.6	0.3
5000	80.1	77.1	3.0
6300	80.7	80.4	0.3
8000	84.3	85.5	1.2
10000	81.3	79.8	1.5
12500	80.7	80.1	0.6
16000	71.1	71.1	0.0
		Average	1.1

Table 3: Example of recurrent frequency response test tolerance

3 Functions and **s**~~S~~ubjective **t**~~T~~ests

3.1 Discussion

3.1.1 Accurate replication of aeroplane systems functions **should**~~will~~ be checked at each flight crewmember position. This includes procedures using the operator's approved manuals, aeroplane manufacturer's approved manuals and checklists. A useful source of guidance for conducting the tests required to establish that the criteria set out in this ~~document~~ **CS** are complied with by the ~~flight simulator~~**FSTD** under evaluation are published in the RAeS ~~*Airplane Flight Simulator Evaluation Handbook*~~***Aeroplane Flight Simulator Evaluation Handbook*, *3rd edition*, *2005***. Handling qualities, performance, and FSTD systems operation **should**~~will~~ be subjectively assessed. In order to assure the functions tests are conducted in an efficient and timely manner, operators are encouraged to coordinate with the appropriate ~~Au~~**competent au**thority responsible for the evaluation so that any skills, experience or expertise needed by the ~~Au~~**competent au**thority in charge of the evaluation team are available.

3.1.2 The necessity of functions and subjective tests arises from the need to confirm that the simulation has produced a totally integrated and acceptable replication of the aeroplane. Unlike the objective tests listed in ~~paragraph~~ 2 above, the subjective testing should cover those areas of the flight envelope which may reasonably be reached by a trainee, even though the FSTD has not been approved for training in that area. Thus it is prudent to examine, for example, the normal and abnormal FSTD performance to ensure that the simulation is representative even though it may not be a requirement for the level of qualification being sought. (Any such subjective assessment of the simulation should include reference to ~~paragraph~~ 2 and 3 above in which the minimum objective standards acceptable for that **q**~~Q~~ualification **l**~~L~~evel are defined. In this way it is possible to determine whether simulation is an absolute requirement or just one where an approximation, if provided, has to be checked to confirm that it does not contribute to negative training.)

3.1.3 At the request of the ~~Au~~**competent au**thority, the FSTD may be assessed for a special aspect of an operator's training programme during the functions and subjective portion of an evaluation. Such an assessment may include a portion of a **l**~~L~~ine **o**~~O~~riented **f**~~F~~light **t**~~T~~raining (LOFT) scenario or special emphasis items in the operator's training programme. Unless directly related to a requirement for the current **q**~~Q~~ualification **l**~~L~~evel, the results of such an evaluation would not affect the FSTD's current status.

3.1.4 Functions tests **should**~~will~~ be run in a logical flight sequence at the same time as performance and handling assessments. This also permits real time FSTD running for ~~2~~ **two** to **three**~~3~~ hours, without repositioning or flight or position freeze, thereby permitting proof of reliability.

3.2 Test requirements

3.2.1 The ground and flight tests and other checks required for qualification are listed in ~~the~~ table ~~**6,** of~~ functions and subjective tests. The table includes manoeuvres and procedures to assure that the FSTD functions and performs appropriately for use in pilot training, testing and checking in the manoeuvres and procedures normally required of a training, testing and checking programme.

3.2.2 Manoeuvres and procedures are included to address some features of advanced technology aeroplanes and innovative training programmes. For example, 'high angle of attack manoeuvring' is included to provide an alternative to 'approach to stalls'. Such an alternative is necessary for aeroplanes employing flight envelope limiting technology.

3.2.3 All systems functions **should**~~will~~ be assessed for normal and, where appropriate, alternate operations. Normal, abnormal, and emergency procedures associated with a flight phase **should**~~will~~ be assessed during the evaluation of manoeuvres or events within that flight phase. Systems are listed separately under 'any flight phase' to assure appropriate attention to systems checks.

3.2.4 When evaluating functions and subjective tests, the fidelity of simulation required for the highest level of qualification should be very close to the aeroplane. However, for the lower levels of qualification the degree of fidelity may be reduced in accordance with the criteria contained in paragraph 2 above.

3.2.5 Evaluation of the lower orders of FSTD should be tailored only to the systems and flight conditions which have been simulated. Similarly, many tests **should**~~will~~ be applicable for automatic flight. Where automatic flight is not possible and pilot manual handling is required, the FSTD ~~shall~~**should** be at least controllable to permit the conduct of the flight.

3.2.6 Any additional capability provided in excess of the minimum required standards for a particular **q**~~Q~~ualification **l**~~L~~evel should be assessed to ensure the absence of any negative impact on the intended training and testing manoeuvres.

Functions and subjective tests

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
a PREPARATION FOR FLIGHT										
(1) Preflight. Accomplish a functions check of all switches, indicators, systems, and equipment at all ~~crewmember~~**crew member**s' and instructors' stations and determine that;										
(a) the flight deck design and functions are identical to that of the aeroplane or class of aeroplane simulated	✓	✓	✓	✓	✓	✓	✓	✓	✓	
(b) design and functions represent those of the simulated class of aeroplane										✓
b SURFACE OPERATIONS (PRE-TAKE-OFF)										
(1) Engine **s**~~S~~tart										
(a) Normal start	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(b) Alternate start procedures	✓	✓	✓	✓	✓	✓				
(c) Abnormal starts and shutdowns (hot start, hung start, tail pipe fire, etc.)	✓	✓	✓	✓	✓	✓				
(2) Pushback/Powerback	✓	✓	✓	✓						
(3) Taxi										
(a) Thrust response	✓	✓	✓	✓			✓	✓	✓	
(b) Power lever friction	✓	✓	✓	✓			✓	✓	✓	
(c) Ground handling	✓	✓	✓	✓			✓	✓	✓	
(d) Nosewheel scuffing	✓	✓	✓	✓						
(e) Brake operation (normal and alternate/emergency)							✓	✓	✓	
A. Brake fade (if applicable)	✓	✓	✓	✓						
B. Other	✓	✓	✓	✓						
c TAKE-OFF										
(1) Normal										✓(1)
(a) Aeroplane/engine parameter relationships	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(b) Acceleration characteristics (motion)	✓	✓	✓	✓						
(c) Acceleration characteristics (not associated with motion)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(d) Nosewheel and rudder steering	✓	✓	✓	✓	✓	✓	✓	✓	✓	
(e) Crosswind (maximum demonstrated)	✓	✓	✓	✓				✓	✓	

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(f) Special performance (e.g. reduced V_1, max de-rate, short field operations)	✓	✓	✓	✓						
(g) Low visibility take-off	✓	✓	✓	✓				✓	✓	
(h) Landing gear, wing flap leading edge device operation	✓	✓	✓	✓			✓	✓	✓	✓
(i) Contaminated runway operation	✓	✓	✓	✓						
(j) Other	✓	✓	✓	✓						
(2) Abnormal/emergency										
(a) Rejected	✓	✓	✓	✓					✓	
(b) Rejected special performance (e.g. reduced V1, max de-rate, short field operations)	✓	✓	✓	✓						
(c) With failure of most critical engine at most critical point, continued take-off	✓	✓	✓	✓						
(d) With wind shear	✓	✓	✓	✓						
(e) Flight control system failures, reconfiguration modes, manual reversion and associated handling	✓	✓	✓	✓						
(f) Rejected, brake fade	✓	✓	✓	✓						
(g) Rejected, contaminated runway	✓	✓	✓	✓						
(h) Other	✓	✓	✓	✓						
d CLIMB										
(1) Normal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(2) One or more engines inoperative	✓	✓	✓	✓	✓	✓	✓(2)	✓	✓	✓(2)
(3) Other	✓	✓	✓	✓	✓	✓				
e CRUISE										
(1) Performance characteristics (speed vs. power)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(2) High altitude handling	✓	✓	✓	✓	✓	✓		✓	✓	
(3) High Mach number handling (Mach tuck, Mach buffet) and recovery (trim change)	✓	✓	✓	✓	✓	✓		✓(3)	✓(3)	
(4) Overspeed warning (in excess of V_{mo} or M_{mo})	✓	✓	✓	✓						
(5) High IAS handling	✓	✓	✓	✓	✓	✓		✓	✓	
f MANOEUVRES										
(1) High angle of attack, approach to stalls, stall warning, buffet, and g-break (take-off, cruise, approach, and landing configuration)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(2) Flight envelope protection (high angle of attack, bank limit, overspeed, etc)	✓	✓	✓	✓	✓	✓				

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(3) Turns with/without speedbrake/spoilers deployed	✓	✓	✓	✓	✓	✓	✓	✓	✓	
(4) Normal and standard rate turns	✓	✓	✓	✓						✓
(5) Steep turns	✓	✓	✓	✓						✓
(6) Performance turn	✓	✓	✓	✓						
(7) In-flight engine shutdown and restart (assisted and windmill)	✓	✓	✓	✓	✓	✓			✓	
(8) Manoeuvring with one or more engines inoperative, as appropriate	✓	✓	✓	✓	✓	✓	✓(2)	✓	✓	✓(2)
(9) Specific flight characteristics (e.g. direct lift control)	✓	✓	✓	✓	✓	✓				
(10) Flight control system failures, reconfiguration modes, manual reversion and associated handling	✓	✓	✓	✓	✓	✓			✓	
(11) Other	✓	✓	✓	✓	✓	✓				
g DESCENT										
(1) Normal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(2) Maximum rate (clean and with speedbrake, etc)	✓	✓	✓	✓	✓	✓	✓	✓	✓	
(3) With autopilot	✓	✓	✓	✓					✓	
(4) Flight control system failures, reconfiguration modes, manual reversion and associated handling	✓	✓	✓	✓	✓	✓			✓	
(5) Other	✓	✓	✓	✓	✓	✓				
h INSTRUMENT APPROACHES AND LANDING										
Only those instrument approach and landing tests relevant to the simulated aeroplane type or class should be selected from the following list, where tests should be made with limiting wind velocities, wind shear and with relevant system failures, including the use of **f**~~F~~light **d**~~D~~irector.										
(1) Precision										
(a) PAR	✓	✓	✓	✓			✓	✓	✓	✓
(b) CAT I/GBAS (ILS/MLS) published approaches										
A. Manual approach with/without flight director including landing	✓	✓	✓	✓	✓	✓		✓	✓	
B. Autopilot/autothrottle coupled approach and manual landing	✓	✓	✓	✓	✓	✓			✓	
C. Manual approach to DH and G/A all engines	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	**FFS**				**FTD**		**FNPT**			**BITD**
	A	**B**	**C**	**D**	**1**	**2**	**I**	**II**	**MCC**	
D. Manual one engine out approach to DH and G/A	✓	✓	✓	✓	✓	✓	✓(2)	✓	✓	✓(2)
E Manual approach controlled with and without flight director to 30 m (100 ft) below CAT I minima	✓	✓	✓	✓						
(i) with cross–wind (maximum demonstrated)										
(ii) with wind shear	✓	✓	✓	✓						
F. Autopilot/autothrottle coupled approach, one engine out to DH and G/A	✓	✓	✓	✓	✓	✓			✓	
G. Approach and landing with minimum/standby electrical power	✓	✓	✓	✓	✓	✓			✓	
(c) CAT II/GBAS (ILS/MLS) published approaches	✓	✓	✓	✓	✓	✓				
A. Autopilot/autothrottle coupled approach to DH and landing										
B. Autopilot/autothrottle coupled approach to DH and G/A	✓	✓	✓	✓	✓	✓				
C. Autocoupled approach to DH and manual G/A	✓	✓	✓	✓	✓	✓				
D. Autocoupled/autothrottle Category II published approach	✓	✓	✓	✓						
(d) CAT III/GBAS (ILS/MLS) published approaches	✓	✓	✓	✓	✓	✓				
A. Autopilot/autothrottle coupled approach to land and rollout										
B. Autopilot/autothrottle coupled approach to DH/Alert Height and G/A	✓	✓	✓	✓	✓	✓				
C. Autopilot/autothrottle coupled approach to land and rollout with one engine out	✓	✓	✓	✓	✓	✓				
D. Autopilot/autothrottle coupled approach to DH/Alert Height and G/A with one engine out	✓	✓	✓	✓	✓	✓				
E. Autopilot/autothrottle coupled approach (to land or to go around)	✓	✓	✓	✓						
(i) with generator failure										
(ii) with 10 ~~knot~~ **kts** tail wind	✓	✓	✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(iii) with 10 ~~knot~~ **kts** crosswind	✓	✓	✓	✓						
(2) Non-precision										
(a) NDB	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(b) VOR, VOR/DME, VOR/TAC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(c) RNAV (GNSS)	✓	✓	✓	✓	✓	✓			✓	
(d) ILS LLZ (LOC), LLZ(LOC)/BC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(e) ILS offset localizer	✓	✓	✓	✓						
(f) direction finding facility	✓	✓	✓	✓						
(g) surveillance radar	✓	✓	✓	✓						
NOTE: If Standard **o**~~O~~perating **p**~~P~~rocedures are to use autopilot for non-precision approaches then these should be evaluated.										
i VISUAL APPROACHES (SEGMENT) AND LANDINGS										
(1) Manoeuvring, normal approach and landing all engines operating with and without visual approach aid guidance	✓	✓	✓	✓				✓	✓	
(2) Approach and landing with one or more engines inoperative	✓	✓	✓	✓				✓	✓	
(3) Operation of landing gear, flap/slats and speedbrakes (normal and abnormal)	✓	✓	✓	✓						
(4) Approach and landing with crosswind (max. demonstrated for **FFS**~~Flight simulator~~)	✓	✓	✓	✓				✓	✓	
(5) Approach to land with wind shear on approach	✓	✓	✓	✓						
(6) Approach and landing with flight control system failures,(for ~~Flight simulator~~**FFS** - reconfiguration modes, manual reversion and associated handling (most significant degradation which is probable))	✓	✓	✓	✓					✓	
(7) Approach and landing with trim malfunctions										
(a) longitudinal trim malfunction	✓	✓	✓	✓						
(b) lateral-directional trim malfunction	✓	✓	✓	✓						
(8) Approach and landing with standby (minimum) electrical/hydraulic power	✓	✓	✓	✓						
(9) Approach and landing from circling conditions (circling approach)	✓	✓	✓	✓						
(10) Approach and landing from visual traffic pattern	✓	✓	✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	**FFS**				**FTD**		**FNPT**			**BITD**
	A	**B**	**C**	**D**	**1**	**2**	**I**	**II**	**MCC**	
(11) Approach and landing from non-precision approach	✓	✓	✓	✓						
(12) Approach and landing from precision approach	✓	✓	✓	✓						
(13) Approach procedures with vertical guidance (APV), e.g., SBAS	✓	✓	✓	✓						
(14) Other	✓	✓	✓	✓						
NOTE: FSTD with visual systems, which permit completing a special approach procedure in accordance with applicable regulations, may be approved for that particular approach procedure.										
j MISSED APPROACH										
(1) All engines	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(2) One or more engine(s) out	✓	✓	✓	✓	✓	✓	✓(2)	✓	✓	✓(2)
(3) With flight control system failures, reconfiguration modes, manual reversion and for ~~flight simulator~~**FFS** - associated handling	✓	✓	✓	✓	✓	✓			✓	
k SURFACE OPERATIONS (POST LANDING)										
(1) Landing roll and taxi										
(a) Spoiler operation	✓	✓	✓	✓	✓	✓		✓	✓	
(b) Reverse thrust operation	✓	✓	✓	✓	✓	✓		✓	✓	
(c) Directional control and ground handling, both with and without reverse thrust	✓	✓	✓	✓	✓	✓				
(d) Reduction of rudder effectiveness with i	✓	✓	✓	✓						
(e) Brake and anti-skid operation with dry, wet, and icy condition	✓	✓	✓	✓						
(f) Brake operation, to include auto-braking system where applicable	✓	✓	✓	✓	✓	✓	✓	✓	✓	
(g) Other	✓	✓	✓	✓	✓	✓				
l ANY FLIGHT PHASE										
(1) Aeroplane and powerplant systems operation										
(a) Air conditioning and pressurisation (ECS)	✓	✓	✓	✓	✓	✓			✓	
(b) De-icing/anti-icing	✓	✓	✓	✓	✓	✓		✓	✓	
(c) Auxiliary powerplant/auxiliary power unit (APU)	✓	✓	✓	✓	✓	✓				
(d) Communications	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(e) Electrical	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(f) Fire and smoke detection and suppression	✓	✓	✓	✓	✓	✓			✓	
(g) Flight controls (primary and secondary)	✓	✓	✓	✓	✓	✓			✓	
(h) Fuel and oil, hydraulic and pneumatic	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(i) Landing gear	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(j) Oxygen	✓	✓	✓	✓	✓	✓			✓	
(k) Powerplant	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(l) Airborne radar	✓	✓	✓	✓	✓	✓				
(m) Autopilot and **f**~~F~~light **d**~~D~~irector	✓	✓	✓	✓	✓	✓			✓	
(n) Collision avoidance systems. (e.g. GPWS, TCAS)	✓	✓	✓	✓	✓	✓				
(o) Flight control computers including stability and control augmentation	✓	✓	✓	✓	✓	✓				
(p) Flight display systems	✓	✓	✓	✓	✓	✓				
(q) Flight management computers	✓	✓	✓	✓	✓	✓				
(r) Head-up guidance, head-up displays	✓	✓	✓	✓	✓	✓				
(s) Navigation systems	✓	✓	✓	✓			✓	✓	✓	✓
(t) Stall warning/avoidance	✓	✓	✓	✓			✓	✓	✓	
(u) Wind shear avoidance equipment	✓	✓	✓	✓						
(v) Automatic landing aids	✓	✓	✓	✓						
(2) Airborne procedures										
(a) Holding	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(b) Air hazard avoidance. (traffic, –weather)			✓	✓	✓	✓				
(c) Wind shear			✓	✓	✓	✓				
(3) Engine shutdown and parking										
(a) Engine and systems operation	✓	✓	✓	✓	✓	✓	✓	✓	✓	
(b) Parking brake operation	✓	✓	✓	✓	✓	✓	✓	✓	✓	
(4) Other as appropriate including effects of wind	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
m VISUAL SYSTEM										

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(1) Functional test content requirements (**l**~~L~~evels C and D)										
NOTE: The following is the minimum airport model content requirement to satisfy visual capability tests, and provides suitable visual cues to allow completion of all functions and subjective tests described in this appendix. FSTD operators are encouraged to use the model content described below for the functions and subjective tests. If all of the elements cannot be found at a single real world airport, then additional real world airports may be used. The intent of this visual scene content requirement description is to identify that content required to aid the pilot in making appropriate, timely decisions.										
(a) two parallel runways and one crossing runway displayed simultaneously; at least two runways should be lit simultaneously			✓	✓						
(b) runway threshold elevations and locations ~~shall~~**should** be modelled to provide sufficient correlation with aeroplane systems (e.g., HGS, GPS, altimeter); slopes in runways, taxiways, and ramp areas should not cause distracting or unrealistic effects, including pilot eye-point height variation			✓	✓						
(c) representative airport buildings, structures and lighting			✓	✓						
(d) one useable gate, set at the appropriate height, for those aeroplanes that typically operate from terminal gates			✓	✓						
(e) representative moving and static gate clutter (e.g., other aeroplanes, power carts, tugs, fuel trucks, additional gates)			✓	✓						
(f) representative gate/apron markings (e.g., hazard markings, lead-in lines, gate numbering) and lighting			✓	✓						
(g) representative runway markings, lighting, and signage, including a wind sock that gives appropriate wind cues			✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(h) representative taxiway markings, lighting, and signage necessary for position identification, and to taxi from parking to a designated runway and return to parking; representative, visible taxi route signage ~~shall~~**should** be provided; a low visibility taxi route (e.g. **s**~~S~~urface **m**~~M~~ovement **g**~~G~~uidance **c**~~C~~ontrol **s**~~S~~ystem, follow-me truck, daylight taxi lights) should also be demonstrated			✓	✓						
(i) representative moving and static ground traffic (e.g., vehicular and aeroplane)			✓	✓						
(j) representative depiction of terrain and obstacles within 25 NM of the reference airport			✓	✓						
(k) representative depiction of significant and identifiable natural and cultural features within 25 NM of the reference airport			✓	✓						
NOTE: This refers to natural and cultural features that are typically used for pilot orientation in flight. Outlying airports not intended for landing need only provide a reasonable facsimile of runway orientation.										
(l) representative moving airborne traffic			✓	✓						
(m) appropriate approach lighting systems and airfield lighting for a VFR circuit and landing, non-precision approaches and landings, and Category I, II and III precision approaches and landings			✓	✓						
(n) representative gate docking aids or a marshaller			✓	✓						
(2) Functional test content requirements (**l**~~L~~evels A and B)										
NOTE: The following is the minimum airport model content requirement to satisfy visual capability tests, and provides suitable visual cues to allow completion of all functions and subjective tests described in this appendix. FSTD operators are encouraged to use the model content described below for the functions and subjective tests.										
(a) representative airport runways and taxiways	✓	✓					✓	✓	✓	

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(b) runway definition	✓	✓					✓	✓	✓	
(c) runway surface and markings	✓	✓					✓	✓	✓	
(d) lighting for the runway in use including runway edge and centreline lighting, visual approach aids and approach lighting of appropriate colours	✓	✓					✓	✓	✓	
(e) representative taxiway lights	✓	✓								
(3) Visual scene management										
(a) Runway and approach lighting intensity for any approach should be set at an intensity representative of that used in training for the visibility set; all visual scene light points should fade into view appropriately	✓	✓	✓	✓						
	✓	✓	✓	✓						
(b) The directionality of strobe lights, approach lights, runway edge lights, visual landing aids, runway centre line lights, threshold lights, and touchdown zone lights on the runway of intended landing should be realistically replicated										
(4) Visual feature recognition										
NOTE: Tests 4(a) through 4(g) below contain the minimum distances at which runway features should be visible. Distances are measured from runway threshold to an aeroplane aligned with the runway on an extended 3-degree glide slope in suitable simulated meteorological conditions. For circling approaches, all tests below apply both to the runway used for the initial approach and to the runway of intended landing										
(a) Runway definition, strobe lights, approach lights, and runway edge white lights from 8 km 5 sm) of the runway threshold	✓	✓	✓	✓				✓	✓	
(b) Visual **a**~~A~~pproach **a**~~A~~ids lights from 8 km (5 sm) of the runway threshold			✓	✓						
(c) Visual **a**~~A~~pproach **a**~~A~~ids lights from 5 km (3 sm) of the runway threshold	✓	✓						✓	✓	
(d) Runway centreline lights and taxiway definition from 5 km (3 sm)	✓	✓	✓	✓				✓	✓	
(e) Threshold lights and touchdown zone lights from 3 km (2 sm)	✓	✓	✓	✓				✓	✓	

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(f) Runway markings within range of landing lights for night scenes as required by the surface resolution test on day scenes	✓	✓	✓	✓				✓	✓	
(g) For circling approaches, the runway of intended landing and associated lighting should fade into view in a non-distracting manner	✓	✓	✓	✓						
(5) Airport model content										
Minimum of three specific airport scenes as defined below;										
(a) terminal approach area										
A. accurate portrayal of airport features is to be consistent with published data used for aeroplane operations			✓	✓						
B. all depicted lights should be checked for appropriate colours, directionality, behaviour and spacing (e.g., obstruction lights, edge lights, centre line, touchdown zone, VASI, PAPI, REIL and strobes)			✓	✓						
C. depicted airport lighting should be selectable via controls at the instructor station as required for aeroplane operation			✓	✓						
D. selectable airport visual scene capability at each model demonstrated for:			✓	✓						
(i) night										
(ii) twilight										
(iii) day										
E. (i) – ramps and terminal buildings which –correspond to an –operator's LOFT and LOS –scenarios			✓	✓						
(ii) terrain- appropriate terrain, geographic and cultural features			✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(iii) dynamic effects - the capability to present multiple ground and air hazards such as another aeroplane crossing the active runway or converging airborne traffic; hazards should be selectable via controls at the instructor station			✓	✓						
(iv) illusions - operational visual scenes which portray representative physical relationships known to cause landing illusions, for example short runways, landing approaches over water, uphill or downhill runways, rising terrain on the approach path and unique topographic features			✓	✓						
NOTE: Illusions may be demonstrated at a generic airport or specific aerodrome.										
(6) Correlation with aeroplane and associated equipment										
(a) visual system compatibility with aerodynamic programming	✓	✓	✓	✓				✓	✓	
(b) visual cues to assess sink rate and depth perception during landings. Visual cueing sufficient to support changes in approach path by using runway perspective. Changes in visual cues during take-off and approach should not distract the pilot		✓	✓	✓				✓	✓	
(c) accurate portrayal of environment relating to **FSTD**~~flight simulator~~ attitudes	✓	✓	✓	✓				✓	✓	
(d) the visual scene should correlate with integrated aeroplane systems, where fitted (e.g. terrain, traffic and weather avoidance systems and **h**~~H~~ead-up **g**~~G~~uidance **s**~~S~~ystem (HGS))			✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	**FFS**				**FTD**		**FNPT**			**BITD**
	A	**B**	**C**	**D**	**1**	**2**	**I**	**II**	**MCC**	
(e) representative visual effects for each visible, ownship, aeroplane external light		✓	✓	✓						
(f) the effect of rain removal devices should be provided			✓	✓						
(7) Scene quality										
(a) surfaces and textural cues should be free from apparent quanti**s**~~z~~ation (aliasing)			✓	✓						
(b) system capable of portraying full colour realistic textural cues			✓	✓						
(c) the system light points should be free from distracting jitter, smearing or streaking	✓	✓	✓	✓						
(d) demonstration of occulting through each channel of the system in an operational scene	✓	✓								
(e) demonstration of a minimum of ~~ten~~ **10** levels of occulting through each channel of the system in an operational scene			✓	✓						
(f) system capable of providing focus effects that simulate rain and light point perspective growth			✓	✓						
(g) system capable of six discrete light step controls (0-5)	✓	✓	✓	✓						
(8) Environmental effects										
(a) the displayed scene should correspond to the appropriate surface contaminants and include runway lighting reflections for wet, partially obscured lights for snow, or suitable alternative effects			✓	✓						
(b) Special weather representations which include the sound, motion and visual effects of light, medium and heavy precipitation near a thunderstorm on take-off, approach and landings at and below an altitude of 600 m (2 000 ft) above the aerodrome surface and within a radius of 16 km (10 sm) from the aerodrome			✓	✓						
(c) in-cloud effects such as variable cloud density, speed cues and ambient changes should be provided			✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(d) the effect of multiple cloud layers representing few, scattered, broken and overcast conditions giving partial or complete obstruction of the ground scene			✓	✓						
(e) gradual break-out to ambient visibility/RVR, defined as up to 10% of the respective cloud base or top, 20 ft ≤ transition layer ≤200 ft; cloud effects should be checked at and below a height of 600 m (2 000 ft) above the aerodrome and within a radius of 16 km (10 sm) from the airport			✓	✓						
(f) visibility and RVR measured in terms of distance. Visibility/RVR should be checked at and below a height of 600 m (2 000 ft) above the aerodrome and within a radius of 16 km (10 sm~~.~~) from the airport	✓	✓	✓	✓						
(g) patchy fog giving the effect of variable RVR**.** Note – Patchy fog is sometimes referred to as patchy RVR.			✓	✓						
(h) effects of fog on aerodrome lighting such as halos and defocus			✓	✓						
(i) effect of ownship lighting in reduced visibility, such as reflected glare, to include landing lights, strobes, and beacons			✓	✓						
(j) wind cues to provide the effect of blowing snow or sand across a dry runway or taxiway should be selectable from the instructor station			✓	✓						
(9) Instructor controls of:										
(a) Environmental effects, e.g. cloud base, cloud effects, cloud density, visibility in kilometres/statute miles and RVR in metres **or** ~~/~~feet	✓	✓	✓	✓				✓	✓	
(b) Airport/aerodrome selection	✓	✓	✓	✓			✓	✓	✓	
(c) Airport/aerodrome lighting including variable intensity where appropriate	✓	✓	✓	✓				✓(4)	✓(4)	
(d) Dynamic effects including ground and flight traffic	✓	✓	✓	✓						
(10) Night visual scene capability	✓	✓	✓	✓						
(11) Twilight visual scene capability			✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(12) Daylight visual scene capability			✓	✓						
n MOTION EFFECTS										
The following specific motion effects are required to indicate the threshold at which a flight ~~crewmember~~**crew member** should recognise an event or situation. Where applicable below, **FFS**~~flight simulator~~ pitch, side loading and directional control characteristics should be representative of the aeroplane as a function of aeroplane type: (1) Effects of runway rumble, oleo deflections, ground speed, uneven runway, runway centreline lights and taxiway characteristics (a) After the aeroplane has been pre-set to the takeoff position and then released, taxi at various speeds, first with a smooth runway, and note the general characteristics of the simulated runway rumble effects of oleo deflections. Next repeat the manoeuvre with a runway roughness of 50%, then finally with maximum roughness. The associated motion vibrations should be affected by ground speed and runway roughness. If time permits, different gross weights can also be selected as this may also affect the associated vibrations depending on aeroplane type. The associated motion effects for the above tests should also include an assessment of the effects of centreline lights, surface discontinuities of uneven runways, and various taxiway characteristics.	*	✓	✓	✓						
(2) Buffets on the ground due to spoiler/speedbrake extension and thrust (a) Perform a normal landing and use ground spoilers and reverse thrust – either individually or in combination with each other – to decelerate the simulated aeroplane. Do not use wheel braking so that only the buffet due to the ground spoilers and thrust reversers is felt.	*	✓	✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(3) Bumps associated with the landing gear (a) Perform a normal take-off paying special attention to the bumps that could be perceptible due to maximum oleo extension after lift-off. When the landing gear is extended or retracted, motion bumps could be felt when the gear locks into position	*	✓	✓	✓						
(4) Buffet during extension and retraction of landing gear (a) Operate the landing gear. Check that the motion cues of the buffet experienced are reasonably representative of the actual aeroplane	*	✓	✓	✓						
(5) Buffet in the air due to flap and spoiler/speedbrake extension and approach to stall buffet (a) First perform an approach and extend the flaps and slats, especially with airspeeds deliberately in excess of the normal approach speeds. In cruise configuration verify the buffets associated with the spoiler/speedbrake extension. The above effects could also be verified with different combinations of speedbrake/flap/gear settings to assess the interaction effects	*	✓	✓	✓						
(6) Approach to stall buffet (a) Conduct an approach-to-stall with engines at idle and a deceleration of 1 k~~not~~/~~second~~. Check that the motion cues of the buffet, including the level of buffet increase with decreasing speed, are reasonably representative of the actual aeroplane	*	✓	✓	✓						
(7) Touchdown cues for main and nose gear (a) Fly several normal approaches with various rates of descent. Check that the motion cues of the touchdown bump for each descent rate are reasonably representative of the actual aeroplane	*	✓	✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(8) Nose wheel scuffing (a) Taxi the simulated aeroplane at various ground speeds and manipulate the nose wheel steering to cause yaw rates to develop which cause the nose wheel to vibrate against the ground ("scuffing"). Evaluate the speed/nose wheel combination needed to produce scuffing and check that the resultant vibrations are reasonably representative of the actual aeroplane	*	✓	✓	✓						
(9) Thrust effect with brakes set (a) With the simulated aeroplane set with the brakes on at the take-off point, increase the engine power until buffet is experienced and evaluate its characteristics. This effect is most discernible with wing mounted engines. Confirm that the buffet increases appropriately with increasing engine thrust	*	✓	✓	✓						
(10) Mach and manoeuvre buffet (a) With the simulated aeroplane trimmed in 1 g flight while at high altitude, increase the engine power such that the Mach number exceeds the documented value at which Mach buffet is experienced. Check that the buffet begins at the same Mach number as it does in the aeroplane (for the same configuration) and that buffet levels are a reasonable representation of the actual aeroplane. In the case of some aeroplanes, manoeuvre buffet could also be verified for the same effects. Manoeuvre buffet can occur during turning flight at conditions greater than 1 g, particularly at higher altitudes	*	✓	✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(11) Tyre failure dynamics			✓	✓						
(a) Dependent on aeroplane type, a single ty~~i~~re failure may not necessarily be noticed by the pilot and therefore there should not be any special motion effect. There may possibly be some sound and/or vibration associated with the actual ~~tiyre~~**tyre** losing pressure. With a multiple ty~~i~~re failure selected on the same side the pilot may notice some yawing which should require the use of the rudder to maintain control of the aeroplane										
(12) Engine malfunction and engine damage	*	✓	✓	✓						
(a) The characteristics of an engine malfunction as stipulated in the malfunction definition document for the particular FSTD should describe the special motion effects felt by the pilot. The associated engine instruments should also vary according to the nature of the malfunction										
(13) Tail strikes and pod strikes	*	✓	✓	✓						
(a) Tail-strikes can be checked by over-rotation of the aeroplane at a speed below Vr whilst performing a takeoff. The effects can also be verified during a landing. The motion effect should be felt as a noticeable bump. If the tail strike affects the aeroplane's angular rates, the cueing provided by the motion system should have an associated effect.										
(b) Excessive banking of the aeroplane during its take-off/landing roll can cause a pod strike. The motion effect should be felt as a noticeable bump. If the pod strike affects the aeroplane's angular rates, the cueing provided by the motion system should have an associated effect	*	✓	✓	✓						
o SOUND SYSTEM										
(1) The following checks should be performed during a normal flight profile with motion			✓	✓						
(a) precipitation										

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	**FFS**				**FTD**		**FNPT**			**BITD**
	A	**B**	**C**	**D**	**1**	**2**	**I**	**II**	**MCC**	
(b) rain removal equipment			✓	✓						
(c) significant aeroplane noises perceptible to the pilot during normal operations, such as engine, flaps, gear, spoiler extension/retraction, thrust reverser to a comparable level of that found in the aeroplane	✓	✓	✓	✓	✓	✓		✓	✓	
(d) abnormal operations for which there are associated sound cues including, but not limited to, engine malfunctions, landing gear/tire malfunctions, tail and engine pod strike and pressurization malfunction			✓	✓						
(e) sound of a crash when the ~~**FSTD**~~~~flight simulator~~**FFS** is landed in excess of limitations			✓	✓						
(f) significant engine/propeller noise perceptible to pilot during normal operations							✓	✓	✓	✓
p SPECIAL EFFECTS										
(1) Braking Dynamics			✓	✓						
(a) representative brake failure dynamics (including antiskid) and decreased brake efficiency due to high brake temperatures based on aeroplane related data. These representations should be realistic enough to cause pilot identification of the problem and implementation of appropriate procedures. FSTD pitch, side-loading and directional control characteristics should be representative of the aeroplane										
(2) Effects of Airframe and Engine Icing			✓	✓						
(a) See Appendix 1 to CS-FSTD(A).300 2.1(t).										
NOTE: For **l**~~L~~evel 'A', an asterisk (*****) denotes that the appropriate effect is required to be present.										

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
NOTE: It is accepted that tests will only apply to FTD **l**~~L~~evel 1 if that system and flight condition is simulated. It is intended that the tests listed below should be conducted in automatic flight. Where automatic flight is not possible and pilot manual handling is required, the FTD ~~shall~~**should** be at least controllable to permit the conduct of the flight.										

NOTES:

General: **m**~~M~~otion and buffet cues will only be applicable to FSTD equipped with an appropriate motion system~~:~~

(1) **t**~~T~~ake**-**off characteristics sufficient to commence the airborne exercises**;**

(2) **f**~~F~~or FNPT 1 and BITD only if multi-engine~~d~~**;**

(3) **o**~~O~~nly trim change **is** required**; and**

(4) **f**~~F~~or FNPT, variable intensity airport lighting **is** not required**.**

Appendix 1 to AMC ~~No.~~1 ~~- to~~ CS-FSTD(A).300 Validation t~~T~~est t~~T~~olerances

1 Background

1.1 The tolerances listed in AMC ~~No.~~ 1 ~~- to~~ CS-FSTD(A).300 are designed to be a measure of quality of match using flight test data as a reference.

1.2 There are many reasons, however, why a particular test may not fully comply with the prescribed tolerances:

(a) **f**~~F~~light –test is subject to many sources of potential error, e.g. instrumentation errors and atmospheric disturbance during data collection;

(b) **d**~~D~~ata that exhibit rapid variation or noise may also be difficult to match; **or**

(c) **e**~~E~~ngineering simulator data and other calculated data may exhibit errors due to a variety of potential differences discussed below.

1.3 When applying tolerances to any test, good engineering judgement should be applied. Where a test clearly falls outside the prescribed tolerance(s) for no apparent reason~~s~~, then it should be judged to have failed.

~~1.4 The use of non-flight-test data as reference data was in the past quite small, and thus these tolerances were used for all tests. The inclusion of this type of data as a validation source has rapidly expanded, and will probably continue to expand.~~

1.~~5~~**4** When engineering simulator data are used, the basis for their use is that the reference data are produced using the same simulation models as used in the equivalent ~~flight training simulator~~**FSTD**; i.e., the two sets of results should be 'essentially' similar. The use of flight test**-**based tolerances may undermine the basis for using engineering simulator data, because an essential match is needed to demonstrate proper implementation of the data package.

1.~~6~~**5** There are, of course, reasons why the results from the two sources can be expected to differ:

(a) **h**~~H~~ardware (avionics units and flight controls);

(b) **i**~~I~~teration rates;

(c) **e**~~E~~xecution order;

(d) **i**~~I~~ntegration methods;

(e) **p**~~P~~rocessor architecture;

(f) **d**~~D~~igital drift:

(**i**~~1~~) **i**~~I~~nterpolation methods;

(**ii**~~2~~) **d**~~D~~ata handling differences; **or**

(**iii**~~3~~) **a**~~A~~uto-test trim tolerances, etc.

1.~~7~~**6** Any differences should, however, be small and the reasons for any differences, other than those listed above, should be clearly explained.

1.~~8~~**7** Historically, engineering simulation data were used only to demonstrate compliance with certain extra modelling features:

(a) **f**~~F~~light test data could not reasonably be made available;

(b) **d**~~D~~ata from engineering simulations made up only a small portion of the overall validation data set; **or**

(c) **k**~~K~~ey areas were validated against ~~flight-test~~**flight test** data.

1.~~9~~**8** The current rapid increase in the use and projected use of engineering simulation data is an important issue because:

(a) flight test data are often not available due to sound technical reasons;

(b) **a**~~A~~lternative technical solutions are being advanced; **and**

(c) **c**~~C~~ost is an ever-present issue.

1.~~10~~**9** Guidelines are therefore needed for the application of tolerances to engineering**-**~~-~~simulator-generated validation data.

2 Non-**f**~~F~~light~~-~~**t**~~T~~est **t**~~T~~olerances

2.1 Where engineering simulator data or other non-flight test data are used as an allowable form of reference validation data for the objective tests listed in the table of validation tests, the match obtained between the reference data and the FSTD results should be very close. It is not possible to define a precise set of tolerances as the reasons for other than an exact match will vary depending upon a number of factors discussed in paragraph ~~one~~ **1** of this appendix.

2.2 As guidance, unless a rationale justifies a significant variation between the reference data and the FSTD results, 20% of the corresponding 'flight test' tolerances would be appropriate.

2.3 For this guideline (20% of flight test tolerances) to be applicable, the data provider should supply a well-documented mathematical model and testing procedure that enables an exact replication of their engineering simulation results.

Appendix 2 to AMC ~~No.~~1~~-~~ ~~to~~ CS-FSTD(A).300 Validation d~~D~~ata r~~R~~oadmap

1 General

1.1 Aeroplane manufacturers or other sources of data should supply a validation data roadmap (VDR) document as part of the data package. A VDR document contains guidance material from the aeroplane validation data supplier recommending the best possible sources of data to be used as validation data in the QTG. A VDR is of special value in the cases of requests for 'interim' qualification, requests for qualification of simulations of aeroplanes certificated prior to 1992, and for qualification of alternate engine or avionics fits (see Appendices 3 and 4 of this AMC). A VDR should be submitted to the ~~au~~**competent au**thority as early as possible in the planning stages for any FSTD planned for qualification to the standards contained herein. The respective **Member** State**'s** civil aviation authority is the final authority to approve the data to be used as validation material for the QTG.

1.2 The validation data roadmap should clearly identify (in matrix format) sources of data for all required tests. It should also provide guidance regarding the validity of these data for a specific engine type and thrust rating configuration and the revision levels of all avionics affecting aeroplane handling qualities and performance. The document should include rationale or explanation in cases where data or parameters are missing, engineering simulation data are to be used, flight test methods require explanation, etc., together with a brief narrative describing the cause/effect of any deviation from data requirements. Additionally, the document should make reference to other appropriate sources of validation data (e.g., sound and vibration data documents).

1.3 Table 1~~,~~ below~~,~~ depicts a generic roadmap matrix identifying sources of validation data for an abbreviated list of tests. A complete matrix should address all test conditions.

1.4 Additionally, two examples of 'rationale pages' are presented in Appendix F of ~~the IATA *Flight Simulator Design & Performance Data Requirements* document~~**the IATA document *Flight Simulation Training Device Design & Performance Data Requirements*, *7th edition***. These illustrate the type of ~~aeroplane~~ **aircraft** and avionics configuration information and descriptive engineering rationale used to describe data anomalies, provide alternative data, or provide an acceptable basis to the ~~au~~**competent au**thority for obtaining deviations from QTG validation requirements.

ICAO or IATA #	Test Description	CCA Mode[1]	Validation Source: Aircraft Flight Test Data [2]	Validation Source: Engineering Simulator Data (DEF-73 Engines)	Validation Document: Aerodynamics POM Doc. # xxx123, Rev. A	Validation Document: Flight Controls POM Doc. # xxx456, NEW	Validation Document: Ground Handling POM Doc. # xxx789, Rev. B	Validation Document: Propulsion POM Doc. # xxx321, Rev. C	Validation Document: Integrated POM Doc. # xxx654, Rev. A	Validation Document: Appendix to this VDR Doc. # xxx987, NEW	Comments
	Notes: 1. Only one page is shown; and some test conditions were deleted for brevity; 2. Relevant regulatory material should be consulted and all applicable tests addressed; 3. Validation source, document and comments provided herein are for reference only and do not constitute approval for use										D71 = Engine Type: DEF-71, Thrust Rating: 71.5K D73 = Engine Type: DEF-73, Thrust Rating: 73K **BOLD** upper case denotes primary validation source Lower case denotes alternate validation source R = Rationale included in the VDR Appendix
1.a.1	Minimum Radius Turn		X				D71				
1.a.2	Rate of Turn vs. Nosewheel Angle (2 speeds)		X				D71				
1.b.1	Ground Acceleration Time and Distance		X				d73		D73		Primary data contained in IPOM
1.b.2	Minimum Control Speed, Ground (Vmcg)		x	X	d71					D73	See engineering rationale for test data in VDR
1.b.3	Minimum Unstick Speed (Vmu)		X		D71						
1.b.4	Normal Takeoff		X		d73				D73		Primary data contained in IPOM
1.b.5	Critical Engine Failure on Takeoff		X		d71					D73	Alternate engine thrust rating flight test data in VDR
1.b.6	Crosswind Takeoff		X		d71					D73	Alternate engine thrust rating flight test data in VDR
1.b.7	Rejected Takeoff		X		D71					R	Test procedure anomaly; see rationale
1.b.8	Dynamic Engine Failure After Takeoff			X						D73	No flight test data available; see rationale
1.c.1	Normal Climb - All Engine		X		d71				D71		Primary data contained in IPOM
1.c.2	Climb - Engine-Out, Second Segment		X		d71					D73	Alternate engine thrust rating flight test data in VDR
1.c.3	Climb - Engine-Out, Enroute		X		d71					D73	AFM data available (73K)
1.c.4	Engine-Out Approach Climb		X		D71						
1.c.5.a	Level Flight Acceleration		x	X	d73					D73	Eng sim data w/ modified EEC accel rate in VDR
1.c.5.b	Level Flight Deceleration		x	X	d73					D73	Eng sim data w/ modified EEC decel rate in VDR
1.d.1	Cruise Performance		X		D71						
1.e.1.a	Stopping Time & Distance (Wheel Brakes / Light weight)			X	D71					d73	No flight test data available; see rationale
1.e.1.b	Stopping Time & Distance (Wheel Brakes / Med weight)		X	x	D71					d73	
1.e.1.c	Stopping Time & Distance (Wheel Brakes / Heavy weight		X	x	D71					d73	
1.e.2.a	Stopping Time & Distance (Reverse Thrust / Light weight)		X	x	D71					d73	
1.e.2.b	Stopping Time & Distance (Reverse Thrust / Med weight)			X	d71					D73	No flight test data available; see rationale

*[1] CCA mode shall be described for each test condition.
*[2] If more than one aircraft type (e.g., derivative and baseline) are used as validation data more columns may be necessary.

Table 1: generic roadmap matrix

Appendix 3 to AMC~~No.~~1-~~to~~CS-FSTD(A).300 Data r~~R~~equirements for a~~A~~lternate e~~E~~ngines - a~~A~~pproval g~~G~~uidelines (a~~A~~pplicable to ~~FFS~~ full flight simulators only)

1 Background

1.1 For a new aeroplane type, the majority of flight validation data are collected on the first aeroplane configuration with a 'baseline' engine type. These data are then used to validate all ~~FSTDs~~ **FFS** representing that aeroplane type.

1.2 In the case of ~~FSTDs~~ **FFS** representing an aeroplane with engines of a different type than the baseline, or a different thrust rating than that of previously validated configurations, additional flight test validation data may be needed.

1.3 When a~~n~~~~FSTD~~ **FFS** with additional and/or alternate engine fits is to be qualified, the QTG should contain tests against flight test validation data for selected cases where engine differences are expected to be significant.

2 Approval Guidelines for validating alternate Engine Fits

2.1 The following guidelines apply to FSTDs representing aeroplanes with an alternate engine fit~~;~~ or~~,~~ with more than one engine type or thrust rating.

2.2 Validation tests ~~can~~ **should** be segmented into those that are dependent on engine type or thrust rating**,** and those that are not.

2.3 For tests that are independent of engine type or thrust rating, the QTG ~~can~~ **may**be based on validation data from any engine fit. Tests in this category should be clearly identified.

2.4 For tests which are affected by engine type, the QTG should contain selected engine-specific flight test data sufficient to validate that particular aeroplane-engine configuration. These effects may be due to engine dynamic characteristics, thrust levels and/or engine-related aeroplane configuration changes. This category is primarily characterised by differences between different engine manufacturers' products, but also includes differences due to significant engine design changes from a previously flight-validated configuration within a single engine type. See Table 1 below for a list of acceptable tests.

2.5 For those cases where the engine type is the same, but the thrust rating exceeds that of a previously flight-validated configuration by five percent (5%) or more, or is significantly less than the lowest previously validated rating (a decrease of ~~fifteen percent (~~15%~~)~~ or more), the QTG should contain selected engine-specific flight test data sufficient to validate the alternate thrust level. See Table 1 below for a list of acceptable tests. However, if an aeroplane manufacturer, qualified as a validation data supplier under the guidelines of AMC~~No.~~ 1**-CS-FSTD(A).300(c)(1)** and **AMC**2-~~to~~ CS-FSTD(A).300(c)(1), shows that a thrust increase greater than 5% will not significantly change the aeroplane's flight characteristics, ~~and~~ then flight validation data are not needed.

2.6 No additional flight test data are required for thrust ratings which are not significantly different from that of the baseline or other applicable flight-validated engine-airframe configuration (i.e., less than 5% above or 15% below), except as noted in ~~paragraphs~~ 2.7 and 2.8~~,~~ below. As an example, for a configuration validated with 50~~,~~000 pound-thrust-rated engines, no additional flight validation data are required for ratings between 42~~,~~500 **lbs** and 52~~,~~500 lbs. If multiple engine ratings are tested concurrently, only test data for the highest rating are needed.

2.7 Throttle calibration data (i.e., commanded power setting parameter versus throttle position) should be provided to validate all alternate engine types, and engine thrust ratings ~~which~~ **that** are higher or lower than a previously validated engine. Data from a test aeroplane or engineering test bench are acceptable, provided the correct engine controller (both hardware and software) is used.

2.8 The validation data described in ~~paragraphs~~ 2.4 through 2.7 above should be based on flight test data, except as noted ~~in those paragraphs~~**there**, or where other data are specifically allowed within AMC~~No.~~ 1-~~to~~ CS-FSTD(A).300(c)(1). However, if certification of the flight characteristics of the aeroplane with a new thrust rating (regardless of percentage change) does require certification flight testing with a comprehensive stability and control flight instrumentation package, then the conditions in table 1 below should be obtained from flight testing and presented in the QTG. Conversely, flight test data other than throttle calibration as described above are not required if the new thrust rating is certified on the aeroplane without need for a comprehensive stability and control flight instrumentation package.

2.9 As a supplement to the engine-specific flight tests of table 1 below and baseline engine-independent tests, additional engine-specific engineering validation data should be provided in the QTG, as appropriate, to facilitate running the entire QTG with the alternate engine configuration. The specific validation tests to be supported by engineering simulation data should be agreed with the competent authority well in advance of FSTD evaluation.

2.10 A matrix or ~~‘~~roadmap~~’~~ should be provided with the QTG indicating the appropriate validation data source for each test (see Appendix 2 of this AMC).

The following flight test conditions (one per test number) are appropriate and should be sufficient to validate implementation of alternate engine fits in a**n** FSTD.

<table>
<tr><th>TEST NUMBER</th><th colspan="2">TEST DESCRIPTION</th><th>ALTERNATE ENGINE TYPE</th><th>ALTERNATE THRUST RATING [2]</th></tr>
<tr><td>1.b.1, 4</td><td colspan="2">Normal take-off/ground acceleration time & distance</td><td>X</td><td>X</td></tr>
<tr><td>1.b.2</td><td colspan="2">V_{mcg}, if performed for aeroplane certification</td><td>X</td><td>X</td></tr>
<tr><td>1.b.5</td><td>Engine-out take-off</td><td rowspan="2">Either test may be performed.</td><td rowspan="2">X</td><td rowspan="2"></td></tr>
<tr><td>1.b.8</td><td>Dynamic engine failure after take-off</td></tr>
<tr><td>1.b.7</td><td colspan="2">Rejected take-off if performed for aeroplane certification</td><td>X</td><td></td></tr>
<tr><td>1.d.3</td><td colspan="2">Cruise performance</td><td>X</td><td></td></tr>
<tr><td>1.f.1, 2</td><td colspan="2">Engine acceleration and deceleration</td><td>X</td><td>X</td></tr>
<tr><td>2.a.8</td><td colspan="2">Throttle calibration [1]</td><td>X</td><td>X</td></tr>
<tr><td>2.c.1</td><td colspan="2">Power change dynamics (acceleration)</td><td>X</td><td>X</td></tr>
<tr><td>2.d.1</td><td colspan="2">V_{mca} if performed for aeroplane certification</td><td>X</td><td>X</td></tr>
<tr><td>2.d.5</td><td colspan="2">Engine inoperative trim</td><td>X</td><td>X</td></tr>
<tr><td>2.e.1</td><td colspan="2">Normal landing</td><td>X</td><td></td></tr>
</table>

[1] Should be provided for all changes in engine type or thrust rating (see ~~paragraph~~ 2.7~~,~~ above).

[2] See ~~paragraphs~~ 2.5 through 2.8 above for a definition of applicable thrust ratings.

*Note: ~~Tt~~**T**his table does not take into consideration additional configuration settings and control laws.*

Table 1: Alternate **e**~~E~~ngine **v**~~V~~alidation **f**~~F~~light **t**~~T~~ests

Appendix 4 to AMC~~ No.~~1~~ to~~ CS-FSTD(A).300 Data r~~R~~equirements for a~~A~~lternate a~~A~~vionics (f~~F~~light-related c~~C~~omputers &c~~C~~ontrollers) – a~~A~~pproval g~~G~~uidelines

1. Background

1.1 For a new aeroplane type, the majority of flight validation data ~~are~~ **is** collected on the first aeroplane configuration with a ~~‘~~baseline~~’~~ flight-related avionics ship-set (see ~~paragraph~~ 2.2~~,~~ below). These data are then used to validate all FSTDs representing that aeroplane type.

1.2 In the case of FSTDs representing an aeroplane with avionics of a different hardware design than the baseline, or a different software revision than that of previously validated configurations, additional validation data may be required.

1.3 When a**n** FSTD with additional and/or alternate avionics configurations is to be qualified, the **qualification test guide (**QTG**)** should contain tests against validation data for selected cases where avionics differences are expected to be significant.

2. Approval **g**~~G~~uidelines for **v**~~V~~alidating **a**~~A~~lternate **a**~~A~~vionics

2.1 The following guidelines apply to FSTDs representing aeroplanes with a revised, or more than one, avionics configuration.

2.2 The aeroplane avionics ~~can~~ **should** be segmented into those systems or components that can significantly affect the QTG results and those that cannot. The following avionics are examples of those for which hardware design changes or software revision updates may lead to significant differences relative to the baseline avionics configuration: **f**~~F~~light control computers and controllers for engines, autopilot, braking system, nose wheel steering system, high lift system, and landing gear system. Related avionics such as stall warning and augmentation systems should also be considered. The aeroplane manufacturer should identify for each validation test~~,~~ which avionics systems, if changed, could affect test results.

2.3 The baseline validation data should be based on flight test data, except where other data are specifically allowed (see AMC ~~No.~~1**-CS-FSTD(A).300(c)(1)** and **AMC**2**-** ~~to~~ CS**-**FSTD(A).~~.~~300(c)(1)).

2.4 For changes to an avionics system or component that cannot affect **master** ~~M~~QTG **(MQTG)** validation test results, the QTG test can be based on validation data from the previously validated avionics configuration.

2.5 For changes to an avionics system or component that could affect a~~n~~ QTG validation test, but where that test is not affected by this particular change (e.g., the avionics change is ~~a~~ **a built-in test equipment (**BITE**)** update or a modification in a different flight phase), the QTG test can be based on validation data from the previously-validated avionics configuration. The aeroplane manufacturer should clearly state that this avionics change does not affect the test.

2.6 For an avionics change which affects some tests in the QTG, but where no new functionality is added and the impact of the avionics change on aeroplane response is a small, well-understood effect, the QTG may be based on validation data from the previously– validated avionics configuration. This should be supplemented with avionics-specific validation data from the aeroplane manufacturer's engineering simulation, generated with the revised avionics configuration. In such cases, the aeroplane manufacturer should provide a rationale explaining the nature of the change and its effect on the aeroplane response.

2.7 For an avionics change that significantly affects some tests in the QTG, especially where new functionality is added, the QTG should be based on validation data from the previously–validated avionics configuration and supplemental avionics-specific flight test data sufficient to validate the alternate avionics revision. However, additional flight validation data may not be needed if the avionics changes were certified without need for testing with a comprehensive flight instrumentation package. The aeroplane manufacturer should co–ordinate FSTD data requirements in this situation, in advance, with the competent authority.

2.8 A matrix or ~~'~~roadmap~~'~~ should be provided with the QTG indicating the appropriate validation data source for each test (see Appendix 2 to AMC ~~No.~~ 1**-** ~~to~~ CS**-**FSTD(A).300).

Appendix 5 to AMC ~~No.~~1 ~~to~~- CS-FSTD(A).300 Transport d~~D~~elay a~~A~~nd l~~L~~atency t~~T~~esting m~~M~~ethods

1. General

1.1 The purpose of this appendix is to demonstrate how to determine the introduced transport delay through the FSTD system such that it does not exceed a specific time delay. That is, measure the transport delay from control inputs through the interface, through each of the host computer modules and back through the interface to motion, flight instrument and visual systems, and show that it is no more than the tolerances required in the validation test tables. (For **l**~~L~~atency testing methods see ~~para~~ 2).

1.2 Four specific examples of transport delay are described as follows:

(a) simulation of classic non-computer**-**controlled aircraft;

(b) simulation of computer**-**controlled aircraft using real aircraft equipment;

(c) simulation of computer**-**controlled aircraft using software emulation of aircraft equipment; **and**

(d) simulation using software avionics or re–hosted instruments.

1.3 Figure 1 illustrates the total transport delay for a non-computer-controlled aircraft, or the classic transport delay test.

1.4 Since there are no aircraft-induced delays for this case, the total transport delay is equivalent to the introduced delay.

1.5 Figure 2 illustrates the transport delay testing method employed on a**n** FSTD that uses the real aircraft controller system.

1.6 To obtain the induced transport delay for the motion, instrument and visual signal, the delay induced by the aircraft controller should be subtracted from the total transport delay. This difference represents the introduced delay.

1.7 Introduced transport delay is measured from the cockpit control input to the reaction of the instruments, and motion and visual systems (See figure 1).

1.8 Alternatively, the control input may be introduced after the aircraft controller system and the introduced transport delay measured directly from the control input to the reaction of the instruments, and FSTD motion and visual systems (**s**~~S~~ee figure 2).

1.9 Figure 3 illustrates the transport delay testing method employed on a**n** FSTD that uses a software emulated aircraft controller system.

1.10 By using the simulated aircraft controller system architecture for the pitch, roll and yaw axes, it is not possible to measure simply the introduced transport delay. Therefore, the signal should be measured directly from the pilot controller. Since in the real aircraft the controller system has an inherent delay as provided by the aircraft manufacturer, the FSTD manufacturer should measure the total transport delay and subtract the inherent delay of the actual aircraft components and ensure that the introduced delay does not exceed the tolerances required in the validation test tables.

1.11 Special measurements for instrument signals for FSTDs using a real aircraft instrument display system, versus a simulated or re–hosted display. For the case of the flight instrument systems, the total transport delay should be measured, and the inherent delay of the actual aircraft components subtracted to ensure that the introduced delay does not exceed the tolerances required in the validation test tables.

1.11.1 Figure 4A illustrates the transport delay procedure without the simulation of aircraft displays. The introduced delay consists of the delay between the control movement and the instrument change on the data bus.

1.11.2 Figure 4B illustrates the modified testing method required to correctly measure introduced delay due to software avionics or re–hosted instruments. The total simulated instrument transport delay is measured and the aircraft delay should be subtracted from this total. This difference represents the introduced delay and ~~shall~~**should** not exceed the tolerances required in the validation test tables. The inherent delay of the aircraft between the data bus and the displays is indicated as XX mse~~c~~ (**s**~~S~~ee figure 4A). The display manufacturer ~~shall~~**should** provide this delay time.

1.12 Recorded signals. The signals recorded to conduct the transport delay calculations should be explained on a schematic block diagram. The FSTD manufacturer should also provide an explanation of why each signal was selected and how they relate to the above descriptions.

1.13 Interpretation of results. It is normal that FSTD results vary over time from test to test. This can easily be explained by a simple factor called 'sampling uncertainty'. All FSTDs run at a specific rate where all modules are executed sequentially in the host computer. The flight controls input can occur at any time in the iteration, but these data will not be processed before the start of the new iteration. For a**n** FSTD running at 60 Hz a worst-case difference of 16·67 mse~~c~~ can be expected. Moreover, in some conditions, the host computer and the visual system do not run at the same iteration rate, therefore the output of the host computer to the visual will not always be synchronised.

1.14 The transport delay test should account for ~~the worst case mode~~**daylight, twilight (dusk, dawn) and night modes (as applicable)** of operation of the visual system. The tolerance is as required in the validation test tables and motion response ~~shall~~ **should** occur before the end of the first video scan containing new information.

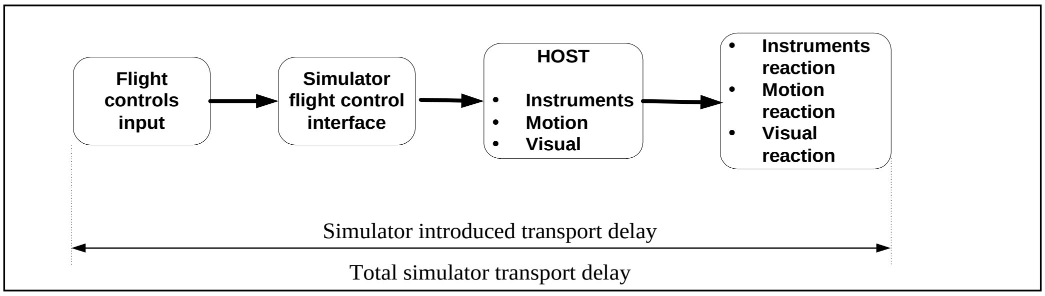

Figure 1: Transport **d**~~D~~elay for simulation of classic non-computer-controlled aircraft

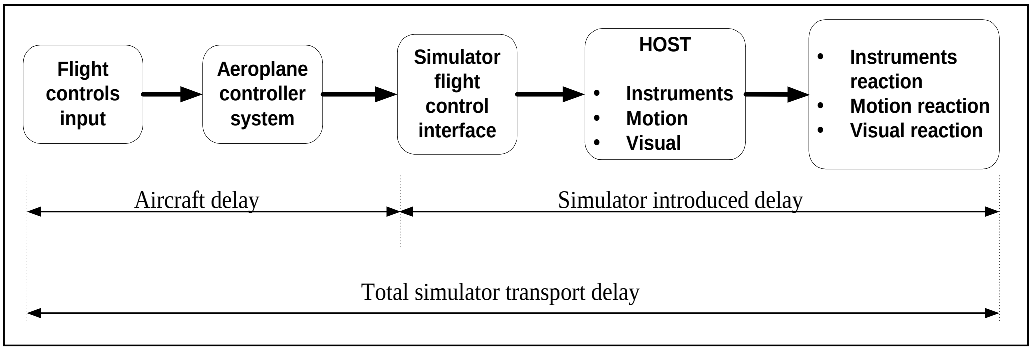

Figure 2: Transport **d**~~D~~elay for simulation of computer-controlled aircraft using real aircraft equipment ~~computercontrolled aircraft~~

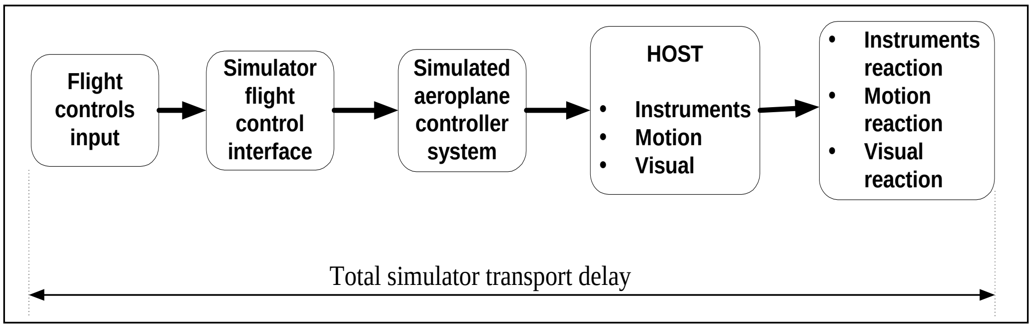

Figure 3: Transport **d**~~D~~elay for simulation of computer-controlled aircraft using software emulation of aircraft equipment

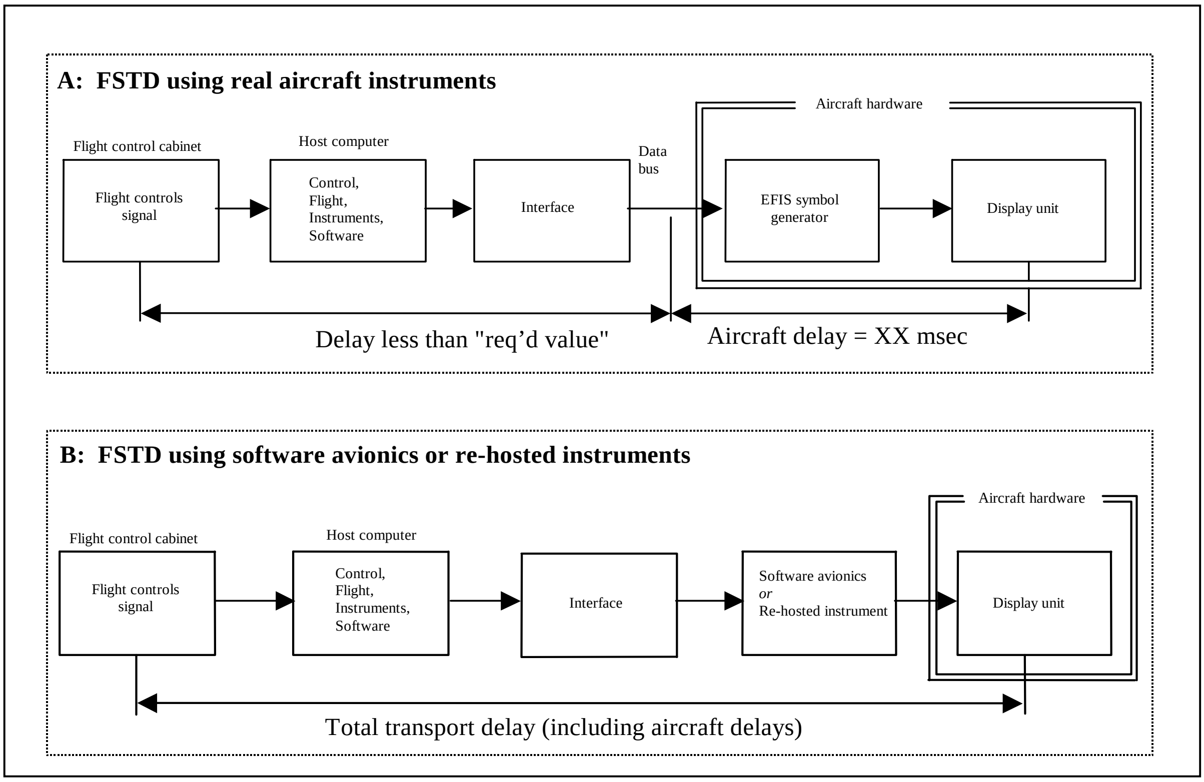

Figure 4A and 4B: Transport delay for simulation of aircraft using real or re~~-~~hosted instrument drivers

2 Latency Test Methods

2.1 The visual system, flight deck instruments and initial motion system response ~~shall~~ **should** respond to abrupt pitch, roll and yaw inputs from the pilot's position within the specified time, but not before the time, when the aeroplane would respond under the same conditions. The objective of the test is to compare the recorded response of the FSTD to that of the actual aeroplane data in the take-off, cruise and landing configuration for rapid control inputs in all three rotational axes. The intent is to verify that the FSTD system response does not exceed the specified time (this does not include aeroplane response time as per the manufacturer's data) and that the motion and visual cues relate to actual aeroplane responses. For **the** aeroplane response, acceleration in the appropriate corresponding rotational axis is preferred.

2.2 Interpretation of results. It is normal that FSTD results vary over time from test to test. This can easily be explained by a simple factor called 'sampling uncertainty.' All FSTDs run at a specific rate where all modules are executed sequentially in the host computer. The flight controls input can occur at any time in the iteration, but these data will not be processed before the start of the new iteration. For a**n** FSTD running at 60 Hz a worst-case difference of 16·67 ms~~ec~~ can be expected. Moreover, in some conditions, the host computer and the visual system do not run at the same iteration rate**;**~~,~~ therefore the output of the host computer to the visual will not always be synchronised.

Appendix 6 to AMC~~ No.~~1~~-~~ ~~to~~ CS-FSTD(A).300 Recurrent e~~E~~valuations - v~~V~~alidation t~~T~~est d~~D~~ata p~~P~~resentation

1. Background

1.1 During the initial evaluation of a**n** FSTD the **master qualification test guide (**MQTG**)** is created. This is the master document, as amended, to which FSTD recurrent evaluation test results are compared.

1.2 The currently accepted method of presenting recurrent evaluation test results is to provide FSTD results over–plotted with reference data. Test results are carefully reviewed to determine if the test is within the specified tolerances. This can be a time consuming process, particularly when reference data exhibits rapid variations or an apparent anomaly requiring engineering judgement in the application of the tolerances. In these cases the solution is to compare the results to the MQTG. If the recurrent results are the same as those in the MQTG, the test is accepted. Both the FSTD operator and the ~~au~~**competent au**thority are looking for any change in the FSTD performance since initial qualification.

2. Recurrent **e**~~E~~valuation **t**~~T~~est **r**~~R~~esults **p**~~P~~resentation

2.1 To promote a more efficient recurrent evaluation, FSTD operators are encouraged to over–plot recurrent validation test results with MQTG FSTD results recorded during the initial evaluation and as amended. Any change in a validation test will be readily apparent. In addition to plotting recurrent validation test and MQTG results, operators may elect to plot reference data as well.

2.2 ~~There~~ **For full flight simulators (FFSs) and flight training devices (FTDs:** ~~(FTD:~~ **when tests are not based on CT&M) there** are no suggested tolerances between ~~FSTD~~ **the** recurrent **test results** and **the** MQTG validation test results **of the initial evaluation**. Investigation of any discrepancy between the MQTG and recurrent ~~FSTD~~ **FFS/FTD** performance is left to the discretion of the FSTD operator and the **competent** authority.

For devices where CT&M is used for the in~~t~~itial evaluation, the test results for the recurrent evaluation should be acceptable if they are within the tolerances to the MQTG test results as given in AMC~~ No.~~ 1~~-~~ ~~to~~ CS-FSTD(A).300 ~~paragraph~~ 2.3.

2.3 Differences between the two sets of results, other than minor variations attributable to repeatability issues (see Appendix 1 of this AMC), ~~which~~ **that** cannot easily be explained, may require investigation.

2.4 The FSTD should still retain the capability to over–plot both automatic and manual validation test results with reference data.

Appendix 7 to AMC~~ No.~~1~~-~~ ~~to~~ CS-FSTD(A).300 Applicability of CS-FSTD a~~A~~mendments to FSTD d~~D~~ata p~~P~~ackages for e~~E~~xisting a~~A~~eroplanes

Except where specifically indicated otherwise ~~within~~ **in** AMC~~ No~~ 1~~-~~ ~~to JAR~~**CS**-FSTD(A).300 ~~Para~~ 2.3, validation data for **qualification test guide (**QTG**)** objective tests are expected to be derived from aeroplane ~~flight test~~**flight test**ing.

Ideally, data packages for all new FSTDs ~~will~~ **should** fully comply with the current standards for qualifying FSTDs.

For types of aeroplanes first entering into service after the publication of a new amendment of CS-FSTD(A), the provision of acceptable data to support the FSTD qualification process is a matter of planning and regulatory agreement.

For aeroplanes certificated prior to the release of the current amendment of CS-FSTD(A), it may not always be possible to provide the required data for any new or revised objective test cases compared to the previous amendments. After certification, manufacturers do not normally keep flight test aeroplanes available with the required instrumentation to gather additional data. In the case of flight test data gathered by independent data providers, it is most unlikely that the test aeroplane will still be available.

Notwithstanding the above discussion, except where other types of data are already acceptable (see, for example, AMC~~ No.~~ 1**-CS-FSTD(A).300(c)(1)** and **AMC**2**-**~~ to~~ CS**-**FSTD(A).300(c)(1)), the preferred source of validation data is flight test**ing**. It is expected that best endeavours will be made by data suppliers to provide the required flight test data. If any flight test data exist (flown during the certification or any other flight test campaigns) that addresses~~es~~ the requirement, these test data should be provided. If any possibility exists to do this flight test during the occasion of a new flight test campaign, this should be done and provided in the data package at the next issue. Where these flight test data are genuinely not available, alternative sources of data may be acceptable using the following hierarchy of preferences:

first: as defined in **f**~~F~~light test**ing** at an alternate but near equivalent condition/configuration.

second: **d**~~D~~ata from an audited engineering simulation **as defined in**AMC**1-** ~~to~~ CS**-**FSTD(A).200 ~~para~~ 1.1.e from an acceptable source (for example meets the guidelines laid out in AMC ~~No.~~ 1**-** ~~to~~ CS**-**FSTD(A).300(c)(1) ~~para~~ 2.**)**, or as used for aircraft certification.

third: **d**~~D~~ata as defined in AMC to CS FSTD(A).200 ~~para 1.1.b~~ or other **a**~~A~~eroplane **p**~~P~~erformance approved published sources (e.g., **p**~~P~~roduction flight test schedule) for the following tests:

i. 1c1 **n**~~N~~ormal climb, all engines**;**

ii. 1c2 one engine inoperative 2nd segment climb**;**

iii. 1c3 one engine inoperative en-route climb**;**

iv. 1c4 one engine inoperative approach climb for aeroplanes with icing accountability**;**

v. 1e3 stopping distance, wheel brakes, wet runway, and test**; and**

vi. 1e4 stopping distance, wheel brakes, icy runway**.**

fourth: Where no other data ~~is~~ **are** available ~~then~~, in exceptional circumstances only, the following sources may be acceptable subject to a case-by-case review with the competent authorities concerned taking into consideration the level of qualification sought for the FSTD**:**

i. unpublished but acceptable sources e.g., calculations, simulations, video or other simple means of flight test analysis or recording**; or**

ii. footprint test data from the actual training FSTD requiring qualification validated by ~~NAA appointed pilot~~ subjective assessment **by a pilot appointed by the competent authority**.

In certain cases, it may make good engineering sense to provide more than one test to support a particular objective test requirement. An example ~~might be~~**is** a **minimum control speed (ground) test(**V~~MCG~~$_{\mathbf{mcg}}$**)** test, where the flight test engine and thrust profile do not match the simulated engine. The VMCG test could be run twice, once with the flight test thrust profile as an input and a second time with a fully integrated response to a fuel cut on the simulated engine.

For aeroplanes certified prior to the date of issue of an amendment, an operator may, after reasonable attempts have failed to obtain suitable flight test data, indicate in the MQTG where flight test data are unavailable or unsuitable for a specific test. For each case, where the preferred data are not available, a rationale should be provided laying out the reasons for the non-compliance and justifying the alternate data and or test(s).

These rationales should be clearly recorded within the **v**~~V~~alidation **d**~~D~~ata **r**~~R~~oadmap (VDR) in accordance with and as defined in Appendix 2 to AMC ~~No.~~ 1**-** ~~to~~ CS**-**FSTD(A).300.

It should be recognised that there may come a time when there are so little compatible flight test data available that new flight test**ing** may be required ~~to be gathered~~.

Appendix 8 to AMC ~~No.~~ 1- ~~to~~ CS-FSTD(A).300 General technical requirements for FSTD q~~Q~~ualification l~~L~~evels

This **a**~~A~~ppendix summarises the general technical requirements for ~~Flight Simulators~~**full flight simulators** level~~s~~ A, B, C and D, **flight training devices**~~FTD~~ level~~s~~ 1 and 2, **flight navigation procedures trainers** ~~FNPT~~ level~~s~~ I, II and IIMCC, and **basic instrument training devices** ~~(BITDs)~~.

Table 1:~~–~~General technical requirements for **l**~~L~~evel A, B, C and D **f**~~F~~ull **f**~~F~~light **s**~~S~~imulators**(FFS)**

Qualification Level	General technical requirements
A	The lowest level of ~~flight simulator~~**FFS** technical complexity. An enclosed full-scale replica of the aeroplane cockpit/flight deck including simulation of all systems, instruments, navigational equipment, communications and caution and warning systems. An instructor's station with seat ~~shall~~ **should** be provided. Seats for the flight ~~crewmember~~**crew member**s and two seats for inspectors/observers ~~shall~~ **should** also be provided. Control forces and displacement characteristics ~~shall~~ **should** correspond to that of the replicated aeroplane and they ~~shall~~ **should** respond in the same manner as the aeroplane under the same flight conditions. The use of class specific data tailored to the specific aeroplane type with fidelity sufficient to meet the objective tests, functions and subjective tests is allowed. Generic ground effect and ground handling models are permitted. Motion, visual and sound systems sufficient to support the training, testing and checking credits sought are required. The visual system ~~shall~~ **should** provide at least 45 degrees horizontal and 30 degrees vertical field of view per pilot. The response to control inputs ~~shall~~ **should** not be greater than 300 m~~illisecond~~s more than that experienced on the aircraft.
B	As for **l**~~L~~evel A plus: Validation flight test data ~~shall~~ **should** be used as the basis for flight and performance and systems characteristics. Additionally ground handling and aerodynamics programming to include ground effect reaction and handling characteristics ~~shall~~ **should** be derived from validation flight test data.
C	The second highest level of ~~flight simulator~~**FFS** fidelity. As for **l**~~L~~evel B plus: A daylight/twilight/night visual system is required with a continuous, cross-cockpit, minimum collimated visual field of view providing each pilot with 180 degrees horizontal and 40 degrees vertical field of view. A six**-**degrees**-**of**-**freedom motion system ~~shall~~ **should** be provided. The sound simulation **should**~~shall~~ include the sounds of precipitation and other significant aeroplane noises perceptible to the pilot and ~~shall~~ **should** be able to reproduce the sounds of a crash landing. The response to control inputs **should**~~shall~~ not be greater than 150 m~~illisecond~~s more than that experienced on the airplane. Windshear simulation ~~shall~~ **should** be provided.
D	The highest level of ~~flight simulator~~**FFS** fidelity. As for **l**~~L~~evel C plus: There **should**~~shall~~ be complete fidelity of sounds and motion buffets **validated through objective tests**.

Table 2 – General technical requirements for **l**~~L~~evel 1 and 2 FTDs

Qualification Level	**General technical requirements**
1	Type specific with at least ~~1~~ **one** system fully represented. Enclosed or open flight deck. Choice of systems simulated is the responsibility of the organisation seeking approval or re-approval for the course. The aeroplane system simulated **should**~~shall~~ comply with the relevant subjective and objective tests relevant to that system.
2	Type specific device with all applicable systems fully represented. An enclosed flight deck with an onboard instructor station. Type specific or generic flight dynamics (but **should**~~shall~~ be representative of aircraft performance). Primary flight controls ~~which~~ **that** control the flight path and ~~be~~ **are** broadly representative of airplane control characteristics. Significant sounds. Control of atmospheric conditions. Navigation **d**~~D~~ata**b**~~B~~ase sufficient to support simulated aeroplane systems.

Table 3A - General technical requirements for **t**~~T~~ype I FNPTs

Qualification Level	**General technical requirements**
FNPT Type I	A cockpit/flight deck sufficiently enclosed to exclude distraction, which will replicate that of the aeroplane or class of aeroplane simulated and in which the navigation equipment, switches and the controls will operate as, and represent those in, that aeroplane or class of aeroplane. An instructor's station with seat ~~shall~~**should** be provided and ~~shall~~**should** provide an adequate view of the ~~crewmember~~**crew member**s**'** panels and station. Effects of aerodynamic changes for various combinations of drag and thrust normally encountered in flight, including the effect of change in aeroplane attitude, sideslip, altitude, temperature, gross mass, centre of gravity location and configuration. Complete navigational data for at least ~~5~~ **five** different European airports with corresponding precision and non-precision approach procedures including current updating within a period of ~~3~~ **three** months. Stall recognition device corresponding to that of the replicated aeroplane or class of aeroplane.

Table 3B - General technical requirements for **t**~~T~~ype II FNPTs

Qualification Level	General technical requirements
FNPT Type II	As for **t**~~T~~ype I with the following additions or amendments: An enclosed flight deck, including the instructor's station. Crew members' seats **should**~~shall~~ be provided with sufficient adjustment to allow the occupant to achieve the design eye reference position appropriate to the aeroplane or class of aeroplane and for the visual system to be installed to align with that eye position. Control forces and control travels which respond in the same manner under the same flight conditions as in the aeroplane or class of aeroplane being simulated. Circuit breakers **should**~~shall~~ function accurately when involved in procedures or malfunctions requiring or involving flight crew response. Aerodynamic modelling **should**~~shall~~ reflect: (a) the effects of airframe icing; (b) the rolling moment due to yawing. A generic ground handling model ~~shall~~**should** be provided to enable representative flare and touch down effects to be produced by the sound and visual systems. Systems **should**~~shall~~ be operative to the extent that it ~~shall be~~**is** possible to perform all normal, abnormal and emergency operations as may be appropriate to the aeroplane or class of aeroplanes being simulated and as required for the training. Significant cockpit/flight deck sounds. A visual system (night/dusk or day) capable of providing a field-of-view of a minimum of 45 degrees horizontally and 30 degrees vertically, unless restricted by the type of aeroplane, simultaneously for each pilot. The visual system need not be collimated. The responses of the visual system and the flight deck instruments to control inputs **should**~~shall~~ be closely coupled to provide the integration of the necessary cues.

Table 3C - General technical requirements for **t**~~T~~ype II MCC FNPTs

Qualification Level	General technical requirements
FNPT Type II MCC	For use in **m**~~M~~ulti-**c**~~C~~rew **c**~~C~~o~~-~~operation (MCC) training - as for **t**~~T~~ype II with additional instrumentation and indicators as required. for MCC training and operation. Reference AMC ~~no.~~ 3**-** ~~to~~CS FSTD (A).300.

Table 4 - General technical requirements for BITDs

Qualification Level	General technical requirements
BITD	A student pilot's station that represents a class of aeroplane sufficiently enclosed to exclude distraction. The switches and all the controls **should**~~shall~~ be of a representative size, shape, location and **should**~~shall~~ operate as and represent those as in the simulated class of aeroplane. In addition to the pilot's seat, suitable viewing arrangements for the instructor **should**~~shall~~ be provided allowing an adequate view of the pilot's panels. The **c**~~C~~ontrol forces, control travel and aeroplane performance **should**~~shall~~ be representative of the simulated class of aeroplane. Navigation equipment for flights under IFR with representative tolerances. This **should**~~shall~~ include communication equipment. Complete navigation database for at least ~~3~~ **three** airports with corresponding precision and non-precision approach procedures including regular updates. Engine sound **should**~~shall~~ be available. Instructor controls of atmospheric conditions and to set and reset malfunctions relating to flight instruments, navigation aids, flight controls, engine out operations (for multi engine aeroplanes only). Stall recognition device corresponding to that of the simulated class of aeroplane.

~~**NOTES:**~~

~~General: Motion and buffet cues will only be applicable to FSTD equipped with an appropriate motion system~~

~~(1) Takeoff characteristics sufficient to commence the airborne exercises~~

~~(2) For FNPT 1 and BITD only if multi-engine~~

~~(3) Only trim change required~~

~~(4) For FNPT, variable intensity airport lighting not required~~

AMC ~~No.~~ 2 ~~- to~~ CS-FSTD(A).300 Guidance on d~~D~~esign and q~~Q~~ualification of l~~L~~evel 'A' a~~A~~eroplane ~~FFSs~~full flight simulators (FFSs)

1 Background

1.1 When determining the cost-effectiveness of any FSTD many factors should be taken into account such as:

(a) **e**~~E~~nvironmental

(b) **s**~~S~~afety

(c) **a**~~A~~ccuracy

(d) **r**~~R~~epeatability

(e) **q**~~Q~~uality and depth of training

(f) **w**~~W~~eather and crowded airspace~~.~~

1.2 The requirements as laid down by the various regulatory bodies for the lowest level of FFS do not appear to have been promoting the anticipated interest in the acquisition of lower cost FFS for the smaller aeroplanes used by the general aviation community.

1.3 The significant cost drivers associated with the production of any FSTD are:

(a) **t**~~T~~ype specific data package~~,~~

(b) QTG flight test data~~,~~

(c) **m**~~M~~otion system~~,~~

(d) **v**~~V~~isual system~~,~~

(e) **f**~~F~~light controls~~ and~~

(f) **a**~~A~~ircraft parts~~.~~

*Note: To attempt to reduce the cost of ownership of a **l**~~L~~evel A FFS, each element has been examined in turn and with a view to relaxing the requirements where possible whilst recognising the training, checking and testing credits allowed on such a device.*

2 Data package

2.1 The cost of collecting specific flight test data sufficient to provide a complete model of the aerodynamics, engines and flight controls can be significant. The use of a class specific data package ~~which~~ **that** could be tailored to represent a specific type of aeroplane (e.g. PA34 to PA31) is encouraged. This may enable a well-engineered light twin baseline data package to be carefully tuned to adequately represent any one of a range of similar aeroplanes. Such work including justification and the rationale for the changes ~~would have to~~**should** be carefully documented and made available for consideration by the Agency as part of the qualification process. Note that for this lower level of FFS, the use of generic ground handling and generic ground effect models is allowed.

2.2 However**,** specific flight test data to meet the needs of each relevant test within the QTG ~~will~~ **should** be required. Recognising the cost of gathering such data, ~~two~~ **the following** points should be borne in mind:

(a) For this class of FFS, much of the flight test information could be gathered by simple means e.g. stopwatch, pencil and paper or video. However**,** comprehensive details of test methods and initial conditions should be presented.

(b) A number of tests within the QTG have had their tolerances reduced to **c**~~'C~~orrect **t**~~T~~rend and **m**~~M~~agnitude~~'~~ (CT&M)**,** thereby avoiding the need for specific flight test data.

(c) The use of CT&M is not to be taken as an indication that certain areas of simulation can be ignored. Indeed in the class of aeroplane envisaged~~,~~ that might take advantage of **l**~~L~~evel A, it is imperative that the specific characteristics are present, and incorrect effects would be unacceptable (e.g. if the aeroplane has a weak positive spiral stability, it would not be acceptable for the FFS to exhibit neutral or negative spiral stability).

(d) Where CT&M is used~~ as a tolerance~~, it is strongly recommended that an automatic recording system be used to ~~'~~footprint~~'~~ the baseline results**,** thereby avoiding the effects of possible divergent subjective opinions on recurrent evaluations.

3 Motion

3.1 For **l**~~L~~evel A FFS, the requirements for both the primary cueing and buffet simulation have been not specified in detail. Traditionally, for primary cueing, emphasis has been laid on the numbers of axes available on the motion system. For this level of FFS, ~~it is felt appropriate that~~ the FFS manufacturer should be allowed to decide on the complexity of the motion system. However, during the evaluation, the motion system ~~will~~ **should** be assessed subjectively to ensure that it ~~is supporting~~**supports** the piloting task, including engine failures, and ~~is~~**never**, ~~under no circumstances,~~ provid**es**~~ing~~ negative cueing.

3.2 Buffet simulation is important to add realism to the overall simulation; for **l**~~L~~evel A, the effects can be simple but they should be appropriate, in harmony with the sound cues and ~~,under no circumstances,~~**never** provide negative training.

4 Visual

4.1 Other than field of view (FOV), specific technical criteria for the visual systems are not specified. The emergence of lower cost 'raster only' daylight systems is recognised. The adequacy of the performance of the visual system ~~will~~ **should** be determined by its ability to support the flying tasks. e.g. 'visual cueing sufficient to support changes in approach path by using runway perspective'.

4.2 The ~~need for~~ collimated visual optics may not always be ~~necessary~~**needed**. A single channel direct viewing system ~~would~~ **should** be acceptable for a**n** FFS of a single crew aeroplane. (The risk here is that, should the aeroplane be subsequently upgraded to multi-crew, the non-collimated visual system may be unacceptable.)

4.3 The vertical FOV specified (30°) may be insufficient for certain tasks. Some smaller aeroplane have large downward viewing angles which cannot be accommodated by the +/– 15° vertical FOV. This can lead to two limitations:

(a) **a**~~A~~t the CAT I all weather operations **d**~~D~~ecision **h**~~H~~eight, the appropriate visual ground segment may not be ~~'~~seen~~'~~; and

(b) ~~D~~**d**uring an approach, where the aeroplane goes below the ideal approach path, during the subsequent pitch-up to recover, adequate visual reference to make a landing on the runway may be lost**.**

5 Flight **c**~~C~~ontrols

The specific requirements for flight controls remain unchanged. Because the handling qualities of smaller aeroplanes are inextricably intertwined with their flight controls, there is little scope for relaxation of the tests and tolerances. It could be argued that with reversible control systems that the on the ground static sweep should in fact be replaced by more representative 'in air' testing. It is hoped that lower cost control loading systems would be adequate to fulfil the needs of this level of simulation (i.e. electric).

6 Aeroplane **p**~~P~~arts

As with any level of FSTD, the components used within the flight deck ~~area~~ need not be aeroplane parts; however, any parts used should be robust enough to endure the training tasks. Moreover, the **l**~~L~~evel A FFS is type specific, thus all relevant switches, instruments, controls etc. within the simulated area ~~will be required to~~**should** look and feel 'as aeroplane'.

AMC ~~No.~~ 3 - ~~to~~ CS-FSTD(A).300 Guidance on d~~D~~esign and q~~Q~~ualification of flight and navigation procedures trainers (FNPTs)

1 Background

1.1 Traditionally training devices used by the *ab-initio* professional pilot schools have been relatively simple instrument flight-only aids. These devices were loosely based on the particular school's aeroplane. The performance would be approximately correct in a small number of standard configurations, however the handling characteristics could range from rudimentary to loosely representative. The instrumentation and avionics fit varied between basic and very close to the target aeroplane. The approval to use such devices as part of a training course was based on a regular subjective evaluation of the equipment and its operator by an **inspector of the competent** authority ~~inspector~~.

1.2 CS-FSTD(A) introduces two new devices: FNPT I & FNPT II. The FNPT I device is essentially a replacement for the traditional instrument flight ground training device taking advantage of recent technologies and having a more objective design basis. The FNPT II device is the more advanced of the two defined standards and fulfils the wider requirements of the various Part**-**FCL professional pilot training modules up to and including (optionally with additional features) multi-crew co–operation (MCC) training.

1.3 The currently available technologies enable such new devices to have much greater fidelity and lower life-cycle costs than was previously possible. A more objective design basis encourages better understanding and therefore modelling of the aeroplane systems, handling and performance. These advances combined with the ever upwardly spiralling costs of flying and with the environmental pressures all point towards the need for revised standards.

1.4 The FNPT II device essentially bridges the gap in design complexity between the traditional subjectively created device and the objectively based **l**~~L~~evel A **full flight simulator (**FFS**)**.

1.5 These new standards are designed to replace the highly subjective design standards and qualification methods with new objective and subjective methods, which ensure that the devices fulfil their intended goals throughout their service lives.

2 Design **s**~~S~~tandards

~~There are two~~**Two** sets of design standards **are** specified within CS-FSTD(A)**:**~~,~~ FNPT I and FNPT II, the more demanding ~~one~~ of which is FNPT II.

2.1 Simulated **a**~~A~~eroplane **c**~~C~~onfiguration

Unlike FFS devices, FNPT I and FNPT II devices are intended to be representative of a class of aeroplane (although they may in fact be type specific ~~if desired~~).

The configuration chosen should sensibly represent the aeroplane or aeroplanes likely to be used as part of the overall training package. Areas such as general layout, seating, instruments and avionics, control type, control force and position, performance and handling and powerplant configuration should be representative of the class of aeroplane or the aeroplane itself.

It ~~would be~~**is** in the interest of all parties to engage in early discussions with the ~~Au~~**competent au**thority to broadly agree a suitable configuration (known as the ~~"~~designated aeroplane configuration~~"~~). Ideally any such discussion ~~would~~ **should** take place in time to avoid any hold-ups in the design/build/acceptance process thereby ensuring a smooth entry into service.

2.2 The **c**~~C~~ockpit/**f**~~F~~light **d**~~D~~eck

The cockpit/flight deck should be representative of the designated aeroplane configuration. For good training ambiance the cockpit/flight deck should be sufficiently enclosed for FNPT I to exclude any distractions. For an FNPT II the cockpit/flight deck should be fully enclosed. The controls, instruments and avionics controllers should be representative: touch, feel, layout, colour and lighting to create a positive learning environment and good transfer of training to the aeroplane.

2.3 Cockpit/**f**~~F~~light **d**~~D~~eck **c**~~C~~omponents

As with any training device, the components used within the cockpit/flight deck area do not need to be aircraft parts: however, any parts used should be representative of typical training aeroplanes and should be robust enough to endure the training tasks. With the current state of technology the use of simple **cathode ray tube (**CRT**)** monitor**-**based representations and touch screen controls would not be acceptable. The training tasks envisaged for these devices are such that appropriate layout and feel is very important: i.e. the altimeter sub-scale knob needs to be physically located ~~on the altimeter~~**where it is in the represented class of aeroplane either equipped with glass cockpit avionics or classic instruments**. The use of CRTs with physical overlays incorporating operational switches/knobs/buttons replicating an aeroplane instrument panel may be acceptable **to the competent authority**.

2.4 Data

The data used to model the aerodynamics flight controls and engines should be soundly based on the "designated aeroplane configuration". It is not acceptable and would not give good training if the models merely represented a few key configurations bearing in mind the extent of the credits available.

Validation data may be derived from a specific aeroplane within a set of aeroplanes that the FNPT is intended to represent, or it may be based on information from several aeroplanes within a set/group/range (**the** ~~"~~designated aeroplane configuration~~"~~). It is recommended that the intended validation data together with a substantiation report be submitted to the ~~Au~~**competent au**thority for evaluation and approval prior to the commencement of the manufacturing process.

2.4.1 Data **c**~~C~~ollection and **m**~~M~~odel **d**~~D~~evelopment

Recogni**s**~~z~~ing the cost of and complexity of flight simulation models, it should be possible to generate generic class ~~"~~typical~~"~~ models. Such models should be continuous and vary sensibly throughout the required training flight envelope. A basic requirement for any modelling is the integrity of the mathematical equations and models used to represent the flying qualities and performance of the class of aeroplane simulated. Data to tune the generic model to represent a more specific aeroplane can be obtained from many sources without recourse to expensive flight test:

(a) **a**~~A~~eroplane design data**;**

(b) **f**~~F~~light and **m**~~M~~aintenance **m**~~M~~anuals**; or**

(c) **o**~~O~~bservations on ground and in **the** air**.**

Data obtained on the ground and in flight can be measured and recorded using a range of simple means such as:

(a) **v**~~V~~ideo

(b) **p**~~P~~encil and paper

(c) **s**~~S~~topwatch

(d) **n**~~N~~ew technologies (i.e. GPS)**.**

Any such data gathering should take place at representative masses and centres of gravity. Development of such a data package including justification and the rationale for the design and intended performance, the measurement methods and recorded parameters (e.g. mass, c of g, atmospheric conditions) should be carefully documented and available for inspection by the ~~Au~~**competent au**thority as part of the qualification process.

2.5 Limitations

A further possible complication is the strong interaction between the flight control forces and the effects of both the engines and the aerodynamic configuration. For this reason a simple force cueing system in which forces vary not only with position but with configuration (speed, flaps, trim) will be necessary for the FNPT II device. For an FNPT I device a force cueing system may be spring-loaded, but it should be remembered that it is vitally important that negative characteristics would not be acceptable.

It should be remembered however that whilst a simple model may be sufficient for the task, it is vitally important that negative characteristics are not present.

3 Visual

Unless otherwise stated **below**, the visual requirements are as specified for a **l**~~L~~evel A FFS.

3.1 Other than **f**~~F~~ield-of-**v**~~V~~iew (FoV) specific technical criteria for the visual systems are not specified. The emergence of lower cost raster**-**only daylight systems is recognised. The adequacy of the performance of the visual system will be determined by its ability to support the flying tasks. e.g. "visual cueing sufficient to support changes in approach path by using runway perspective".

3.2 The need for collimated visual optics is probably not necessary. A single channel direct viewing system (single projector or a monitor for each pilot) would probably be acceptable as no training credits for landing ~~will be~~**are** available. Distortions due to non-collimation would only become significant during on ground or near to the ground operations.

3.3 The minimum specified vertical FoV of 30 deg may not be sufficient for certain tasks.

Where the FNPT does not simulate a particular aeroplane type, then the design of the out-of-cockpit/flight deck view should be matched to the visual system such that the pilot has a FoV sufficient for the training tasks.

For example during an instrument approach the pilot should be able to see the appropriate visual segment at **d**~~D~~ecision **h**~~H~~eight. Additionally**,** where the aeroplane deviates from the permitted approach path, undue loss of visual reference should not occur during the subsequent correction in pitch.

3.4 There are two methods of establishing latency, which is the relative response of the visual system, cockpit/flight deck instruments and initial motion system response. These should be coupled closely to provide integrated sensory cues.

For a generic FNPT, a **t**~~T~~ransport **d**~~D~~elay test is the only suitable test that demonstrates that the FNPT system does not exceed the permissible delay. If the FNPT is based upon a particular aeroplane type, either Transport Delay or Latency tests are acceptable. Response time tests check response to abrupt pitch, roll, and yaw inputs at the pilot's position is within the permissible delay, but not before the time when the aeroplane would respond under the same conditions. Visual scene changes from steady state disturbance should occur within the system dynamic response limit but not before the resultant motion onset.

The test to determine compliance with these requirements should include simultaneously recording the analogue output from the pilot's control column, wheel, ~~and~~ pedals, the output from the accelerometer attached to the motion system platform located at an acceptable location near the pilots' seats, the output signal to the visual system display (including visual system analogue delays), and the output signal to the pilot's attitude indicator or an equivalent test approved by the ~~Au~~**competent au**thority. The test results in a comparison of a recording of the simulator's response with actual aeroplane response data in the take-off, cruise, and landing configuration.

The intent is to verify that the FNPT system **t**~~T~~ransport **d**~~D~~elays or time lags are less than the permissible delay and that the motion and visual cues relate to actual aeroplane responses. For **the** aeroplane response, acceleration in the appropriate rotational axis is preferred.

The **t**~~T~~ransport **d**~~D~~elay test should measure all the delay encountered by a step signal migrating from the pilot's control through the control loading electronics and interfacing through all the simulation software modules in the correct order, using a handshaking protocol, finally through the normal output interfaces to the motion system, to the visual system and instrument displays. A recordable start time for the test should be provided by a pilot flight control input. The test mode should permit normal computation time to be consumed and should not alter the flow of information through the hardware/software system.

The **t**~~T~~ransport **d**~~D~~elay of the system is ~~then~~ **therefore** the time between control input and the individual hardware responses. It need only be measured once in each axis

3.5 Care should be taken when using the limited processing power of the lower cost visual systems to concentrate on the key areas which support the intended uses**,** thereby avoiding compromising the visual model by including unnecessary features e.g. moving ground traffic, marshallers. The capacity of the visual model should be directed towards:

(a) **r**~~R~~unway surface**,**

(b) **r**~~R~~unway lighting systems**,**

(c) PAPI/ VASI approach guidance aids**,**

(d) **a**~~A~~pproach lighting systems**,**

(e) **s**~~S~~imple taxiway**,**

(f) **s**~~S~~imple large-scale ground features e.g. large bodies of water, big hills**; and,**

(g) ~~B~~**b**asic environmental lighting (night/dusk)**.**

4 Motion

Although motion is not a requirement for either an FNPT I or II, should the operator choose to have one fitted, it will be evaluated to ensure that its contribution to the overall fidelity of the device is positive. Unless otherwise stated in **these certification specifications** ~~this document~~, the motion requirements are as specified for a **l**~~L~~evel A FFS, see AMC ~~No~~ 2**-** ~~to~~ CSFSTD(A).300

5 Testing / **e**~~E~~valuation

To ensure that any device meets its design criteria initially and periodically throughout its life a system of objective and subjective testing will be used. The subjective testing may be similar to that in use in the recent past. The objective testing methodology is drawn from that used currently on FSTD.

The validation tests specified **in** ~~(~~AMC ~~No~~ 1**-** ~~to~~ CS**-**FSTD(A).300 ~~par.~~ 2.3~~)can~~ **should**be "flown" by a suitably skilled person and the results recorded manually. Bearing in mind the cost implications, the use of automatic recording (and testing) is encouraged thereby increasing the repeatability of the achieved results.

The tolerances specified are designed to ensure that the device meets its original target criteria year after year. It is therefore important that such target data ~~is~~ **are** carefully derived and values are agreed with the appropriate inspecting authority in advance of any formal qualification process. For initial qualification, it is highly desirable that the device should meet its design criteria within the listed tolerances**.** ~~,~~**H**~~h~~owever**,** unlike the tolerances specified for FSTDs, the tolerances contained within ~~this document~~**these certification specifications** are specifically intended to be used to ensure repeatability during the life of the device and in particular at each recurrent regulatory inspection.

A number of tests within the QTG have had their tolerances reduced to **c**~~"C~~orrect **t**~~T~~rend and **m**~~M~~agnitude~~"~~ (CT&M) thereby avoiding the need for specific validation data. The use of CT&M is not to be taken as an indication that certain areas of simulation can be ignored. For such tests, the performance of the device should be appropriate and representative of the simulated designated aeroplane and should ~~under no circumstances~~**never** exhibit negative characteristics. Where CT&M is used ~~as a tolerance~~, it is strongly recommended that an automatic recording system be used to ~~"~~footprint~~"~~ the baseline results**,** thereby avoiding the effects of possible divergent subjective opinions during recurrent evaluations.

The subjective tests listed under "Functions and Manoeuvres" (AMC ~~No~~ 1 ~~to~~**-** CS **-**FSTD(A).300 ~~para.~~ 3) should be flown out by a suitably qualified and experienced pilot.

Subjective testing will review not only the interaction of all of the systems but the integration of the FNPT with **the following**:

(a) **t**~~T~~raining environment

(b) **f**~~F~~reezes and repositions

(c) **n**~~N~~avaid environment

(d) **c**~~C~~ommunications

(e) **w**~~W~~eather and visual scene contents**.**

In parallel with this objective/subjective testing process**,**~~it is envisaged that~~ suitable maintenance arrangements as part of a **c**~~C~~ompliance **m**~~M~~onitoring **p**~~P~~rogramme ~~shall~~ **should** be in place. Such arrangements ~~will~~ **should** cover routine maintenance, the provision of satisfactory spares holdings and personnel.

6 FNPT **t**~~T~~ype I

The design standards, testing and evaluation requirements for the FNPT Type I device are less demanding than those required for a FNPT Type II device. This difference in standard is in line with the reduced Part**-**FCL credits available for this type of device.

7 Additional features

Any additional features in excess of the minimum design requirements added to an FNPT **t**~~T~~ype I & II ~~will~~ **should** be subject to evaluation and should meet the appropriate standards in CS-FSTD(A).

AMC ~~No.~~ 4 ~~to~~ CS-FSTD(A).300 Guidance on d~~D~~esign and q~~Q~~ualification of basic instrument training devices (BITDs)

1 Background

1.1 Traditionally**,** ~~training devices~~ **FSTDs** used by the *ab-initio* pilot schools have been relatively simple instrument flight-only aids. These devices were loosely based on the particular school's aeroplane. The performance would be approximately correct in a small number of standard configurations**.** ~~,~~**H**~~h~~owever**,** the handling characteristics could range from rudimentary to loosely representative. The instrumentation and avionics fit varied between basic and very close to the target aeroplane. The approval to use such devices as part of a training course was based on a regular subjective evaluation of the equipment and its operator by a~~n~~~~Au~~ **competent au**thority inspector.

1.2 CS-FSTD(A) introduces two new devices, **flight and navigation procedures trainer (**FNPT**)** type I and FNPT type II, where the FNPT I device is essentially a replacement for the traditional instrument flight ground training device taking advantage of recent technologies and having a more objective design basis.

1.3 CS-FSTD(A) sets also the requirements and guidelines for the lowest level of FSTDs by introducing BITDs. It should be clearly understood that a BITD **can** never ~~can~~ replace an FNPT I. The main purpose of a BITD is to replace an old instrument training device that cannot be longer approved either due to poor fidelity or system reliability.

2 Design **s**~~S~~tandards

2.1 Unlike FFS devices, a BITD is intended to be representative of a class of aeroplane. The configuration chosen should broadly represent the aeroplane likely to be used as part of the overall training package. It would be in the interest of all parties to engage in early discussions with the ~~Au~~**competent au**thority to broadly agree a suitable configuration, known as the 'designated aeroplane configuration'.

2.2 The student pilot station should be broadly representative of the designated aeroplane configuration and should be sufficiently enclosed to exclude any distractions.

2.3 The main instrument panel in a BITD may be displayed on a **cathode ray tube (**CRT**)**. Touch screen or mouse and keyboard operation by the student pilot would not be acceptable for any instrument or system.

2.4 The standards for BITDs were developed for low cost devices and therefore were kept as simple as possible. With advances in technology the higher standards defined for ~~FFSs~~ ~~**full flight simulators (FFSs)**~~ and FNPTs should be used where economically possible.

3 Validation Data

3.1 The data used to model the aerodynamics and engine(s) should be soundly based on the designated aeroplane configuration. It is not acceptable if the models merely represent a few key configurations.

3.2 Recognising the cost and complexity of flight simulation models, it should be possible to generate a generic class typical model. Such models should be continuous and vary sensibly throughout the required training flight envelope. A basic principal for any modelling is the integrity of the mathematical equations and models used to represent the flying qualities and performance of the class of aeroplane simulated. Data to tune the generic model to represent a more specific aeroplane can be obtained from many sources without recourse to expensive flight test**, including**:

(a) **a**~~A~~eroplane design date**;**

(b) **f**~~F~~light and **m**~~M~~aintenance **m**~~M~~anuals**; and**

(c) **o**~~O~~bservations on ground and during flight**.**

Data obtained on ground or in flight can be measured and recorded using a range of simple means such as:

(a) **v**~~V~~ideo

(b) **p**~~P~~encil and paper

(c) **s**~~S~~topwatch

(d) **n**~~N~~ew technologies like GPS etc.

Any such data gathering should take place at representative masses and centres of gravity. Development of such a data package including justification and the rationale for the design and intended performance, the measurement methods and recorded parameters should be carefully documented and available for inspection by the ~~Au~~**competent au**thority as part of the qualification process.

4 Limitations

A force cueing system may be spring-loaded. But it should be remembered that it is vitally important that negative characteristics ~~would not be~~**are not** acceptable.

5 Testing and **e**~~E~~valuation

To ensure that any device meets its design criteria initially and periodically throughout its ~~'~~life**,**~~'~~ a system of objective and subjective testing will be used. The subjective testing may be similar to that in use in the recent past. The objective testing methodology is drawn from that used currently on higher level training devices.

The validation tests specified in AMC~~ No ~~1**-**~~ to ~~CS**-**FSTD(A).300,~~ para.~~ 2.3 ~~can~~ **should** be flown by a suitably skilled person and the results recorded manually. However**,** a print**-**out of the parameters of interest is highly recommended, thereby increasing the repeatability of the achieved results.

The tolerances specified are designated to ensure that the device meets its original target criteria year after year. It is therefore important that such target data ~~is~~ **are** carefully derived and values are agreed with the ~~inspecting Au~~**competent au**thority in advance of any formal qualification process. For initial qualification, it is highly desirable that the device meets its design criteria within the listed tolerances**.** ~~,~~**H**~~h~~owever the tolerances contained in this ~~document~~ **CS** are specifically intended to be used to ensure repeatability during the ~~'~~life~~'~~ of the device and in particular at each recurrent ~~Au~~**competent au**thority evaluation.

Most of the tests within the **qualification test guide (**QTG**)** had their tolerances reduced to **c**~~C~~orrect **t**~~T~~rend and **m**~~M~~agnitude (CT&M). The use of CT&M is not to be taken as an indication that certain areas of simulation can be ignored. For such tests, the performance of the device should be approximate and representative of the simulated class of aeroplane and should under no circumstances exhibit negative characteristics. In all these cases it is strongly recommended to print out the baseline results during initial evaluation thereby avoiding the effects of possible divergent subjective opinions during recurrent evaluations.

The subjective tests listed under AMC~~ No ~~1**-**~~ to ~~CS**-**FSTD(A).300~~, para.~~ 3, functions and manoeuvres, should be flown out by a suitably qualified and experienced pilot. Subjective testing ~~will~~ **should** not only review the interaction of all the applicable systems but the integration of the BITD within a training syllabus, including:

(a) **the t**~~T~~raining environment**;**

(b) **f**~~F~~reezes and repositions**; and**

(c) **the n**~~N~~avaid environment**.**

In parallel with this objective and subjective testing process**,** it is envisaged that suitable maintenance arrangements as part of a **c**~~C~~ompliance **m**~~M~~onitoring ~~sSystem~~**programme** are in place. Such arrangements ~~will~~ **should** cover routine maintenance, the provision of satisfactory spares supply and personnel.

6 Guidelines for an **i**~~I~~nstrument **p**~~P~~anel displayed on a **s**~~S~~creen

a. The basic flight instruments ~~shall~~**should** be displayed and arranged in the usual "T-layout". Instruments ~~shall~~**should** be displayed very nearly full-size as in the simulated class of aeroplane. The following instruments ~~shall~~**should** be displayed so as to be representative for the simulated class of aeroplane:

An attitude indicator with at least 5° and 10° pitch markings, and bank angle markings for 10°, 20°, 30° and 60°.

Adjustable altimeter(s) with 20 ft markings. Controls to adjust the QNH ~~shall~~**should** be located spatially correct at the respective instrument.

An airspeed indicator with at least 5 kts markings within a representative speed range and colour coding.

An HSI or heading indicator with incremental markings each of at least 5°, displayed on a 360° circle. The heading figures ~~shall~~**should** be radially aligned. Controls to adjust the course or heading bugs ~~shall~~**should** be located spatially correct at the respective instrument.

A vertical speed indicator with 100 fpm markings up to 1 000 fpm and 500 fpm thereafter within a representative range.

A turn and bank indicator with incremental markings for a rate of 3° per second turn for left and right turns. The 3° per second rate index ~~shall~~**should** be inside of the maximum deflection of the indicator.

A slip indicator representative of the simulated class of aeroplane, where a coordinated flight condition is indicated with the ball in centre position. A triangle slip indicator is acceptable if applicable for the simulated class of aeroplane

A magnetic compass with incremental markings each 10°.

Engine instruments as applicable to the simulated class of aeroplane, with markings for normal ranges, minimum and maximum limits.

A suction gauge or instrument pressure gauge, as applicable, with a display as applicable for the simulated class of aeroplane.

A flap position indicator, which displays the current flap setting. This indicator ~~shall~~**should** be representative of the simulated class of aeroplane.

A pitch trim indicator with a display that shows zero trim and appropriate indices of aeroplane nose down and nose up trim.

A stop watch or digital timer, which allows the readout of seconds and minutes.

b. A communication and navigation panel ~~shall~~**should** be displayed ~~in a manner~~**such** that the frequency in use is shown. Controls to select the frequencies and other functions may be located on a central COM/NAV panel or on a separate ergonomically located panel. The NAV equipment ~~shall~~**should** include ADF, VOR, DME and ILS indicators with the following incremental markings:

1. **o**~~O~~ne-half dot or less for course and glide slope indications on the VOR and ILS display**; and**~~.~~
2. 5° or less of bearing deviation for ADF and RMI, as applicable.

All NAV radios ~~shall~~**should** be equipped with an aural identification feature. A marker beacon receiver ~~shall~~**should** also be installed with an optical and aural identification.

c. All instrument displays ~~shall~~**should** be visible during all flight operation. The instrument system ~~shall~~**should** be designed to ensure jumping and stepping is not a distraction and to display all changes within the range of the replicated instruments that are equal or greater than the values stated below:

1. **a**~~A~~ttitude ½° pitch and 1° bank**;**
2. **t**~~T~~urn and bank of ¼ standard rate turn**;**
3. IAS 1 kts**;**
4. VSI 20 fpm**;**
5. **a**~~A~~ltitude 3 ft**;**

6. ~~H~~eading on HSI ½°**;**

7. **c**~~C~~ourse and Heading on OBS and/or RMI 1°**;**

8. ILS ¼°**;**

9. RPM 25**; and**

10. MP ½ inch**.**

d. The update rate of all displays ~~shall~~**should** be proofed by a**n** SOC. The resolution ~~shall~~**should** provide an image of the instruments that:

1. does not appear out of focus**;**~~.~~

2. does not appear to "jump" or "step" to a distracting degree during operation**; and**~~.~~

3. does not appear with distracting jagged lines or edges.

7 Additional Information

Unlike with other FSTDs the manufacturer of a BITD has the responsibility for the initial evaluation of a new BITD model. Because all serial numbers of such a model are automatically qualified, the ~~user approval~~**ATO certificate containing the specification of the device and the extent to which it may be used** at the operator's site becomes more important before the course approval is granted.

~~AMC No. 5 to CS FSTD(A).300 Guidance on Evaluations of Electrical Motion Systems for FFSs~~

~~1 Introduction~~

~~1.1 Pilots use continuous information systems to regulate the state of the aircraft. Whole-body motion feedback is essential in assisting the pilot to control the aircraft dynamics, particularly in the presence of external disturbances.~~

~~1.2 Whilst a full flight simulator can never perfectly represent the six degrees of freedom of the aircraft motion, the standard of realism achieved by current hydraulic motion systems fitted to Level C and D full flight simulators is very high. It is essential that, with the advent of new technologies, no reduction in the current standards of realism be accepted.~~

~~1.3 The existing hydraulic motion systems use hydraulic rams to provide six degrees of freedom motion. The hydraulic power packs used to drive these rams are expensive and have high power consumption.~~

~~1.4 A new method of activating the legs of a simulator by means of electric motors is now being introduced throughout the Member States. Whilst having significant advantages, there are some areas that require special attention when evaluating and certifying such equipped FSTDs, in order to ensure that the existing standards of realism are not compromised.~~

~~2 Types of Electrical Motion Systems~~

~~2.1 At present, a limited number of FSTDs have been equipped with these new electrical motion systems. So far, the following types of devices can be recognised:~~

~~Electro-Mechanical Motion (EMM) Systems~~

~~The EMM systems use electric motors to physically operate the legs of the simulator. The best way to describe this type of system is "direct drive", because the electric motor drives the lead-screw of the motion leg directly.~~

~~(b) Electro-Pneumatic Motion (EPM) Systems~~

~~The EPM system also uses electric motors to drive the lead-screw of the legs directly, but separate (or internal) actuators operated pneumatically are used to balance the weight of the simulator platform itself. Since the electric motors now do not have to carry the weight of the platform, typical electric power consumption is much lower than the EMM system.~~

~~(c) Electro-Hydraulic Motion (EHM) Systems~~

~~The EHM system uses fluid pressure to balance the weight of the simulator platform and electric pumps to displace fluid to actuate the motion legs. Since the electric motors do not sustain the weight of the simulator, typical electric power consumption is much lower than the EMM system.~~

~~3 Experiences so far and recommendations for evaluation~~

~~3.1 A number of simulation devices that use one of the previously described electrically driven motion systems have now been certified by Member States.~~

~~3.2 A number of areas have been identified where specific attention is required due to the different characteristics of the new technology:~~

~~(a) Noise originating in the motion system and being transferred to flight deck level.~~

~~Due to the mechanical construction and the way the electric drive functions, the noise levels generated can be high. To date, the problem has been found to be noise transferred mechanically through to the simulator cab, causing distraction to flight crew, especially when performing demanding yawing manoeuvres such as making turns on ground (taxiing) where all six legs of the motion system are actuated at the same time. Improved noise insulation and different software to drive the electric motors has proven to influence this noise level. The quieter the aircraft aerodynamically and engine wise, the more intrusive this noise might be. Due to the sound level of propeller driven aircraft, this phenomenon might be less noticed in this type of aircraft. The potential impact of high noise levels on other devices located close-by should also be checked.~~

~~(b) Motion cues for certain manoeuvres like flare, touchdown etc.~~

~~The new electrical motion systems have the potential ability to react much faster to steering commands than the existing hydraulic systems. This high onset rate can cause stronger outputs than normally seen with hydraulic systems resulting in motion movements that are perceived as too strong or too sharp. Conversely, examples have been seen, particularly with shorter stroke electric systems, where the motion system has been unable to present acceptable cues in cases where a very high demand was placed on the system, such as at flare and touch down. Tuning of the software driving the motion actuators is required in these cases and the point of acceptability should be a level of performance equal to or better than current hydraulic systems.~~

~~(c) Frequency response for models of runway roughness and turbulence.~~

~~The basic models used in hydraulic motion systems for surface roughness and turbulence have been developed over several years to a very high standard of realism. The different frequency characteristics of the electric actuators require modification to existing models to achieve the same level of realism. The systems evaluated to date have been found to be both lacking in the higher frequency, sharp edged elements of roughness and turbulence motion, but, also, with the electric systems using lead-screws, to feel too harsh. The mechanically transmitted motion is incompressible, unlike the air in which the real aircraft operates, or hydraulic fluids of the existing motion systems.~~

~~(d) Issues of safety and reliability.~~

~~Due to the inherent ability to react very rapidly and very violently to control inputs from the motion software, it is important to verify that the built in protection of the motion system, that will limit the response from the motion actuators, functions correctly and that possible erroneous signals from the flight data software do not result in dangerous motion responses. Especially when operating outside the normal flight envelope or when making non-standard manoeuvres the functioning of this protection is crucial to the safety of the persons inside the flight simulator. Taxiing into buildings or obstacles, stall penetration, steep turns and crash landings are examples of such manoeuvres. It should also be noted that the feature built into hydraulic motion systems to return the platform to a neutral position if power is lost has to be re-created on the new electric motion systems using a variety of energy back-ups schemes best suited to each implementation.~~

~~Whilst the reliability of the new systems cannot be established at initial qualification, it should be noted that some installations have suffered from initial reliability issues. This has been exacerbated by excessive time needed to recover the system after failure, resulting in significant impacts on training. This area should be monitored.~~

AMC ~~No. 6~~ 5-~~to~~CS-FSTD(A).300 Guidance on e~~E~~nhanced v~~V~~isual s~~S~~ystem (EVS) and q~~Q~~ualification of full flight simulators (FFSs)

1 Applicability

1.1 This process applies to all ~~simulators~~ **FFSs** used to comply with EVS training and checking requirements as detailed in the relevant **JOEB or EASA** ~~J~~OEB report**s** for the particular aircraft type. This document represents one means of qualifying a**n**~~full flight simulator~~ **FFS**. Use of any other means requires prior approval by the competent authority.

2 Compliance certificate

2.1 A statement of compliance is required for those ~~full flight simulators~~**FFSs** in which EVS hardware is not fitted as original equipment in the aircraft and has therefore been retrofitted to the aircraft and FFS. The statement of compliance should confirm that the added hardware and software ha**ve**~~s~~ the same functionality as the aircraft equipment. A block diagram showing input and output signal flow as compared to the aircraft ~~will~~ **should** be required.

3 FFS Standards

3.1 The minimum FFS requirements for qualifying an EVS system in a**n** FFS **are as follows**:

(a) **t**~~T~~he FFS should be EASA qualified to **l**~~L~~evel C with a daylight visual display or **l**~~L~~evel D**;**~~.~~

(b) **t**~~T~~he EVS FFS hardware and software, including cockpit displays, should function the same or equivalent to that installed in the aircraft**;**~~.~~

(c) **t**~~T~~he instructor **o**~~O~~perat**ing**~~or~~ **s**~~S~~tation (IOS) should include an EVS display of the representative EVS and HUD scene, as seen through the pilot's **h**~~H~~ead-**u**~~U~~p-**d**~~D~~isplay (HUD) combiner glass or the cockpit flight displays**;**~~.~~ **and**

(d) **a**~~A~~ minimum of one airport should be modelled for EVS. That model should have an ILS and a non-precision approach (**w**~~W~~ith VNAV if required by the ~~AFM~~ **aircraft flight manual** for that type) available. In addition to EVS modelling, the airport model should meet the requirements of CS-FSTD(A).

4 Objective tests

4.1 The ground and flight tests required for qualification are listed below. Computer**-**generated simulator test results should be provided for each test. The results should be produced on a multi-channel recorder, line printer, or other appropriate recording device acceptable to the competent authority. Time histories are required unless otherwise indicated. The ~~following tests~~**tests set out in table 1** are required:

	Test	Tolerance	Flight Condition	Comments
1.	HUD **a**~~A~~ttitude vs. **s**~~S~~imulator **a**~~A~~ttitude **i**~~I~~ndicator (**p**~~P~~itch and **r**~~R~~oll of **h**~~H~~orizon)	Demonstration **m**~~M~~odel		
2.	EVS **r**~~R~~egistration **t**~~T~~est	Demonstration **m**~~M~~odel	Take-off **p**~~P~~oint and 200' AGL	This test validates the visual alignment of the EVS
3.	EVS RVR and visibility calibration	Demonstration **m**~~M~~odel. The scene indicates 350m EVS RVR and correct light intensity	IR scene representative of both 1600 m, and 5 km. Visual scene may be removed	This test validates the RVR and visibility of the EVS
4.	Visual, EVS, **m**~~M~~otion, and **c**~~C~~ockpit **i**~~I~~nstrument **r**~~R~~esponse.	150 ms~~ec~~ or less after control movement, + or -30 ms~~ec~~ from visual system, and not	Pitch, **r**~~R~~oll, **y**~~Y~~aw	One test is required in each axis. (Total of 3 tests)

	Transport **d**~~D~~elay	before motion response		
5.	EVS **t**~~T~~hermal **c**~~C~~rossover	Demonstration **m**~~M~~odel	Day & **n**~~N~~ight	

*Note: Because of the camera position vs. the pilot eye position, this ~~shouldt~~ **should** be checked at both 200 **ft** ~~'~~ on final (similar to a visual ground segment) and on the ground at the take-off point. As height above ground reduces (e.g. at take-off position) it is possible to observe the registration issues caused by the parallax.*

Table 1: O~~o~~bjective tests

5 Subjective tests

~~5.1 DISCUSSION. A FFS Evaluation Specialist will evaluate accurate replication of EVS systems functions. The evaluation will include procedures using the operator's approved manuals and checklists. A FFS Evaluation Specialist qualified in the respective aircraft will subjectively assess handling qualities, performance, and simulator systems operation, while using the EVS system.~~

5.1. ~~TEST REQUIREMENTS~~**Test requirements**. The ground and flight tests and other checks required for qualification of the EVS system are listed below. They include manoeuvres and procedures to assure that the EVS system functions and performs appropriately for use in pilot training and checking in the manoeuvres and procedures delineated in the relevant **JOEB or EASA OEB** ~~JOEB~~ report. The evaluation should be conducted using daylight, dusk, and night conditions. Daylight is the most difficult to simulate.

~~5.2.1~~**5.1.1** IOS:

Check to ensure that the IOS has preset selections that match the training programme.

5.1.2 Pre-flight:

Carry out normal pre-flight procedures and checks, including warnings and annunciations.

~~5.2.3~~**5.1.3** Taxi:

(a) Observe parallax caused by camera position.

(b) Observe ground hazards especially other aircraft and nearby terrain.

(c) Signs may appear as a block (unreadable) due to no temperature variation between the letters and the background.

5.1.4 Take-off:

(a) Normal take**-**off in night VMC conditions. Observe the terrain and surrounding visual scene.

(b) Instrument take**-**off using visual RVR settings of 200m. The EVS RVR should be better than the visual RVR, i.e. 750m+.

5.1.5 In-flight **o**~~O~~perations:

(a) Adjust the scene to VMC and see if the image horizon is conformal with the visual horizon and the combiner horizon.

(b) Using a VMC night or dusk scene, select a thunderstorm at a distance of at least 20 ~~miles~~ **nm** and see if the imager detects the clouds.

5.1.6 Approaches:

(a) Normal approach in night VMC conditions.

(b) ILS approach.

(i) Select the preset that allows the pilot to see the EVS image at approximately 500 **ft**~~'~~. This should preset the EVS visibility to approximately 2300m, and the visual RVR to 750m~~'~~.

(ii) Fly or reposition the aircraft to 500 **ft**~~'~~ **above ground level (**AGL**)** on the ILS. Freeze position. The ~~PF~~ **pilot flying (PF)** should be able to see the image of the runway approach lights. **The pilot not flying (**PNF**)** should not be able to see any lights**.** (Some very slight bleed through of strobes is acceptable, but no steady lights).

(iii) Continue the approach and freeze position at 200 **ft**~~'~~ AGL. The PF should be able to see approximately 1 ~~mile~~ **nm** down the runway, and the PNF should be able to visually acquire the approach lights and **runway end identifier lights (**REILs**)**.

(iv) Continue the approach and landing. Observe the blooming effect of the airport lights.

(c) Non-precision approach.

(d) Missed approach.

Note: Emphasis should be placed on the FFS's capability to demonstrate that the EVS system is able to display the visual for the pilot to identify the required visual references to descend below the published decision altitude (DA) when conducting instrument approaches with vertical guidance. The EVS should continue to provide glide path and alignment information between DH and touchdown. During landing roll out, visual alignment information should be available to the pilot.

5.1.7 Visual **s**~~S~~egment and **l**~~L~~anding:

(a) Normal:

(i) From non-precision approach.

(ii) From precision approach.

5.1.8 Abnormal **p**~~P~~rocedures:

(a) EVS malfunctions on the ground.

(b) EVS malfunctions in the air.

6. Qualification **t**~~T~~est **g**~~G~~uide (QTG)

6.1

(a) The ATO should develop the statement of compliance, accomplish the performance determination and recording, and forward the resulting information to the competent authority. The competent authority ~~will~~ **should** return the package to the ATO with instructions to include the information in the QTG.

(b) The ~~simulator~~ **FFS** ~~will~~ **should** be scheduled for an evaluation in accordance with normal procedures. Use of recurrent evaluation schedules ~~will~~ **should** be used to the maximum extent possible.

(c) During the on**-**site evaluation, the evaluator should ask the ATO to run the performance tests and record the results. The results of these on**-**site tests ~~will~~ **should** be compared to those results previously approved and placed in the QTG.

(d) ~~Qualification Test Guides~~**QTGs** for new or upgraded FFS**s**~~shall~~ **should** contain or reference the information described in ~~paragraphs~~ 2 through 4 of this ~~document~~ **AMC** as applicable for the FFS.

AMC ~~No. 7~~ **6-**~~to~~**CS-FSTD(A).300 Guidance on o**~~O~~**ld v**~~V~~**isual s**~~S~~**ystems and n**~~N~~**ew v**~~V~~**isual s**~~S~~**cenes for full flight simulators (FFSs)**

1. Background.

CS-FSTD(A) FFS specifications for visual systems are ~~3~~ **three** fully simulated airport scenes (so**-**called "real" scenes). Older visual systems are beginning to experience the limitations of these visual systems~~ in this respect, that~~ **, as** they cannot simulate the number of polygons and lightpoints necessary to fully simulate the current large airports expanding to sometimes ~~5~~ **five** or more runways, complex taxi routings etc. Since these large airports do have real training value to airlines**, airlines request that these large airports be modelled, so that the models** ~~they are requested by them to be modelled so they~~ can be used for flight training.

The ATO therefore models these scenes up to the limitations of the visual system, but they cannot fully comply with all CS-FSTD(A) FFS specifications for these scenes to qualify them as "real".

Due to the advances in computer and display techniques, modern visual systems can simulate complex real airports in full detail. All available runways and lighting systems can be simulated including environmental lights in the airport vicinity. Older visual systems are less capable. They are limited in the number of lightpoints, polygons and texture they can display.

At the time of initial ~~certification~~ **qualification certificates issued** in the 1980~~'~~s and 1990~~'~~s these systems were compliant with the specifications of that time. The real scenes of those days were less complex**ly** modelled due to system capabilities. These older, grandfathered, visual systems are not able to simulate the modern large airport scenes of today with sometimes ~~5~~ **five** runways or more, complex taxi routings etc.

Users however, still want to use those simulators to perform their flight training and want to use these complex visual scenes because it happens to be their home base or major destination and request simulator operators to simulate these scenes. The ATO therefore models these scenes up to the limitations of the system, but is unable to fully comply with the current CS-FSTD(A) specifications for visual scenes to qualify them as "real".

2. Practical solution.

2.1. The typical limitation of these previously described older systems is the number of runways that can be simulated and the level of detail. Alternatively, smaller airports can be fully simulated but are sometimes less valuable for training purposes. The ATO can then decide:

(a) To simulate all airport content (runways) but in less detail, by (drastically) reducing the number of light points, textures and polygons used. This can result in ~~less~~ **a lower number of** taxiways, no environmental lights etc.

(b) To simulate only part of the airport, but in full detail. This could result in simulating fewer runways with their associated taxiways and light points.

(c) To simulate only less complex visual scenes~~, which~~ **that** ~~will~~ fulfil the CS-FSTD(A) specifications, but are hardly ever used by the FFS users, because they do not simulate their operational destinations.

2.2. Whatever decision is made, either the resulting requested simulated visual scene will not be fully matching reality and so the requirement for three fully simulated airports will not be met according to the modern standards, or these complex scenes will not be modelled at all.

2.3. In order to prevent the ATO from designing and maintaining airports ~~he~~ **it** does not need for the FFS users, but only to satisfy the ~~au~~**competent au**thorities when they (re-)qualify the FFS, it ~~shall~~**should** be allowed to use models which ~~do~~ satisfy the requirements in parts of their model and lack them in other areas.

2.4. For example, when an airport has ~~5~~ **five** runways it should be ~~allowed~~ **acceptable** to simulate only ~~4~~ **four** of them. The ATO ~~shall~~**should**, when agreed by the competent authority, state this limitation in a rationale, which will form part of the approved MQTG of the FFS. The FFS user ~~shall~~**should** also be aware of this limitation and agree to this in writing and ~~also state this in their~~**it should also be stated in the** ~~user approval~~**ATO certificate or o**~~O~~**perations m**~~M~~**anual (OM)**.

2.5. Previously mentioned older visual systems or other visual systems manufactured before 1994 should therefore be allowed to display only part of the CS-FSTD(A) specified visual details for the scenes offered for evaluation by the competent authority. The detail to be provided should be correct within reasonable limits, up to the decision of the competent authority.

2.6. For these specific scenes, the specifications to have at least one dedicated taxi route from the gate to a specific runway (single designated route) that can be followed using the appropriate airfield charts, taxi lights and taxi signs (also under low visibility conditions) remain valid. Also, the prevention of runway incursions (safety) is paramount**.**~~,~~ **T**~~t~~herefore stop bars should be correctly modelled and switchable on/off. If no switchable feature exists, then they should be modelled "on" where the instructor will grant clearance to cross.

AMC ~~No.~~ 1 ~~to~~ CS-FSTD(A).300(c)(1) Engineering s~~S~~imulator v~~V~~alidation d~~D~~ata

1. When a fully ~~flight-test~~**flight test** validation simulation is modified as a result of changes to the simulated aircraft configuration, a qualified aircraft manufacturer may choose, with the prior agreement of the ~~Au~~**competent au**thority, to supply validation data from an "audited" engineering simulator/simulation to **selectively** supplement ~~selectively~~ flight test data.

This arrangement is confined to changes ~~which~~ **that** are incremental in nature and ~~which~~ **that** are both easily understood and well defined.

2. To be qualified to supply engineering simulator validation data, an aircraft manufacturer should:

~~(a)~~**a.** **h**~~H~~ave a proven track record of developing successful data packages**;**~~:~~

~~(b)~~**b.** **h**~~H~~ave demonstrated high quality prediction methods through comparisons of predicted and flight test validated data;

~~(c)~~**c.** **h**~~H~~ave an engineering simulator ~~which~~**that:**

- ~~-~~**i.** has models that run in an integrated manner**;**~~,~~
- ~~-~~**ii.** uses the same models as released to the training community (which are also used to produce stand**-**~~/~~alone proof-of-match and checkout documents)**; and**~~,~~
- ~~-~~**iii.** is used to support aircraft development and certification;

~~(d)~~**d.** **u**~~U~~se the engineering simulation to produce a representative set of integrated proof-of-match cases; **and**

~~(e)~~**e.** **h**~~H~~ave an acceptable configuration control system in place covering the engineering simulator and all other relevant engineering simulations.

3. Aircraft manufacturers seeking to take advantage of this alternative arrangement ~~shall~~**should** contact the ~~Au~~**competent au**thority at the earliest opportunity.

4. For the initial application, each applicant should demonstrate his**/her** ability to qualify to the satisfaction of the Agency, in accordance with the criteria in this AMC and ~~the~~ **in** ~~corresponding~~ AMC ~~No.~~ 2**-** ~~to~~ CS FSTD(A).300(c)(1).

AMC ~~No.~~ 2**-** ~~to~~ CS-FSTD(A).300(c)(1) Engineering s~~S~~imulator v~~V~~alidation d~~D~~ata – approval guidelines ~~– APPROVAL GUIDELINES~~

1. Background

1.1. In the case of fully ~~flight-test~~**flight test** validated simulation models of a new or major derivative aircraft, it is likely that these models will become progressively unrepresentative as the aircraft configuration is revised.

1.2. Traditionally**,** as the aircraft configuration has been revised, the simulation models have been revised to reflect changes. In the case of aerodynamic, engine, flight control and ground handling models, this revision process normally results in the collection of additional ~~flight-test~~**flight test** data and the subsequent release of new models and validation data.

1.3. The quality of the prediction of simulation models has advanced to the point where differences between the predicted and the ~~flight-test~~**flight test** validation models are often quite small.

1.4. **M**~~The m~~ajor aircraft manufacturers utilise the same simulation models in their engineering simulations as released to the training community. These simulations vary from physical engineering simulators with and without aircraft hardware to non-real-time workstation**-**based simulations.

2. Approval **g**~~G~~uidelines – for using **e**~~E~~ngineering **s**~~S~~imulator **v**~~V~~alidation **d**~~D~~ata

2.1. The current system of requiring flight test data as a reference for validating training simulators should continue.

2.2. When a fully ~~flight-test~~**flight test**-validated simulation is modified as a result of changes to the simulated aircraft configuration, a qualified aircraft manufacturer may choose, with prior agreement of the ~~Au~~**competent au**thority, to supply validation data from an engineering simulator/simulation to **selectively** supplement ~~selectively~~ flight test data.

2.3. In cases where data from an engineering simulator is used, the engineering simulation process ~~would have to~~**should** be audited by the ~~Au~~**competent au**thority.

2.4 In all cases a data package verified to current standards against flight test**ing** should be developed for the aircraft ~~"~~entry-into-service~~"~~ configuration of the baseline aircraft.

2.5 Where engineering simulator data is used as part of a **qualification test guide (**QTG**)**, an essential match is expected as described in Appendix 1 to CS-FSTD(A).300.

2.6 In cases where the use of engineering simulator data is envisaged, a complete proposal should be presented to the appropriate regulatory body(ies). Such a proposal ~~would~~ **should** contain evidence of the aircraft manufacturer's past achievements in high fidelity modelling.

2.7 The process ~~will~~ **should** be applicable to ~~"~~one step~~"~~ away from a fully flight-validated simulation.

2.8 A configuration management process should be maintained, including an audit trail which clearly defines the simulation model changes step by step away from a fully flight-validated simulation, so that it would be possible to remove the changes and return to the baseline (flight validated) version.

2.9 The ~~Au~~**competent au**thorities ~~will~~ **should** conduct technical reviews of the proposed plan and the subsequent validation data to establish acceptability of the proposal.

2.10 The procedure ~~will~~ **should** be considered complete when an approval statement is issued. This statement ~~will~~ **should** identify acceptable validation data sources.

2.11 To be admissible as an alternative source of validation data an engineering simulator ~~would~~**should**:

(a) **h**~~H~~ave to exist as a physical entity, complete with a flight deck representative of the affected class of aircraft, with controls sufficient for manual flight**;**~~.~~

(b) **h**~~H~~ave a visual system~~;~~ and preferably also a motion system**;**~~.~~

(c) **w**~~W~~here appropriate, have actual avionics boxes interchangeable with the equivalent software simulations, to support validation of released software**;**~~.~~

d) **h**~~H~~ave a rigorous configuration control system covering hardware and software**; and**~~.~~

(e) **h**~~H~~ave been found to be a high fidelity representation of the aircraft by the pilots of the manufacturers, operators and the ~~Au~~**competent au**thority.

2.12 The precise procedure followed to gain acceptance of engineering simulator data will vary from case-to-case between aircraft manufacturers and type of change. Irrespective of the solution proposed, engineering simulations/simulators should conform to the following criteria:

(a) **t**~~T~~he original (baseline) simulation models should have been fully ~~flight-test~~**flight test** validated**;**~~.~~

(b) **t**~~T~~he models as released by the aircraft manufacturer to the industry for use in training FSTDs should be essentially identical to those used by the aircraft manufacturer in their engineering simulations/simulators**; and**~~.~~

(c) **t**~~T~~hese engineering simulation/simulators ~~will~~ **should** have been used as part of the aircraft design, development and certification process.

2.13 Training ~~flight simulator(s)~~**FSTDs** utilising these baseline simulation models should be currently qualified to at least internationally recognised standards such as contained in the ICAO Document 9625~~, the "~~*Manual of Criteria for the Qualification of Flight Simulators*~~"~~ **(1995 or as amended)**.

2.14 The type of modifications covered by this alternative procedure will be restricted to those with ~~"~~well-understood effects~~"~~:

(a) **s**~~S~~oftware (e.g., flight control computer, autopilot, etc.)**;**~~.~~

(b) **s**~~S~~imple (in aerodynamic terms) geometric revisions (e.g., body length)**;**~~.~~

(c) **e**~~E~~ngines – limited to non-propeller-driven aircraft**;**~~.~~

(d) **c**~~C~~ontrol system gearing/rigging/deflection limits**; and**

(e) **b**~~B~~rake, tyre and steering revisions.

2.15 The manufacturer~~,~~ who wishes to take advantage of this alternative procedure, is expected to demonstrate a sound engineering basis for his**/her** proposed approach. Such analysis ~~would~~ **should** show that the predicted effects of the change(s) were incremental in nature and both easily understood and well defined, confirming that additional flight test data were not required. In the event that the predicted effects ~~were~~ **are** not deemed to be sufficiently accurate, it might be necessary to collect a limited set of flight test data to validate the predicted increments.

2.16 Any applications for this procedure ~~will~~ **should** be reviewed by the Agency.

Appendix B – Cross reference EASA CS-FSTD(A) to JAR-FSTD A

Cross-reference table EASA CS-FSTD(A) to JAR-FSTD A		
EASA reference	Subject	JAA reference
	BOOK 1 – QUALIFICATION CODE	
Subpart A	**Applicability**	
CS-FSTD(A).001	Applicability	JAR-FSTD A.001
Subpart B	**Terminology**	
CS-FSTD(A).200	Terminology	JAR-FSTD A.005
Subpart C	**Aeroplane flight simulation training devices**	
CS-FSTD(A).300	Qualification basis	JAR-FSTD A.030
Appendix		
Appendix 1 to CS-FSTD(A).300	Flight simulation training devices standards	Appendix 1 to JAR-FSTD A.030
	BOOK 2 – ACCEPTABLE MEANS OF COMPLIANCE	
Subpart B	**Terminology**	
AMC1-CS-FSTD(A).200	Terminology and abbreviations	ACJ to JAR-FSTD A.005
Subpart C	**Aeroplane flight simulation training devices**	
AMC1-CS-FSTD(A).300	Qualification basis	ACJ No.1 to JAR-FSTD A.030
Appendix 1 to AMC1-CS-FSTD(A).300	Validation test tolerances	Appendix 1 to ACJ No.1 to JAR-FSTD A.030
Appendix 2 to AMC1-CS-FSTD(A).300	Validation data roadmap	Appendix 2 to ACJ No.1 to JAR-FSTD A.030
Appendix 3 to AMC1-CS-FSTD(A).300	Data requirements for alternate engines – approval guidelines (applicable to full flight simulators only)	Appendix 3 to ACJ No.1 to JAR-FSTD A.030
Appendix 4 to AMC1-CS-FSTD(A).300	Data requirements for alternate avionics (flight-related computers & controllers) – approval guidelines	Appendix 4 to ACJ No.1 to JAR-FSTD A.030

Cross-reference table EASA CS-FSTD(A) to JAR-FSTD A		
EASA reference	Subject	JAA reference
Appendix 5 to AMC1-CS-FSTD(A).300	Transport delay and latency testing methods	Appendix 5 to ACJ No.1 to JAR-FSTD A.030
Appendix 6 to AMC1-CS-FSTD(A).300	Recurrent evaluations – validation test data presentation	Appendix 6 to ACJ No.1 to JAR-FSTD A.030
Appendix 7 to AMC1-CS-FSTD(A).300	Applicability of CS-FSTD amendments to FSTD data packages for existing aeroplanes	Appendix 7 to ACJ No.1 to JAR-FSTD A.030
Appendix 8 to AMC1-CS-FSTD(A).300	General technical requirements for FSTD qualification levels	Appendix 8 to ACJ No.1 to JAR-FSTD A.030
AMC2-CS-FSTD(A).300	Guidance on design and qualification of level "A" aeroplane full flight simulators (FFSs)	ACJ No. 2 to JAR-FSTD A.030
AMC3-CS-FSTD(A).300	Guidance on design and qualification of flight and navigation procedures trainers (FNPTs)	ACJ No. 3 to JAR-FSTD A.030
AMC4-CS-FSTD(A).300	Guidance on design and qualification of basic instrument training devices (BITDs)	ACJ No. 4 to JAR-FSTD A.030
AMC5-CS-FSTD(A).300	Guidance on enhanced visual system (EVS) and qualification of full flight simulators (FFSs)	JAA Temporary Guidance Leaflet No. 12
AMC6-CS-FSTD(A).300	Guidance on old visual systems and new visual scenes for full flight simulators (FFFs)	JAA Temporary Guidance Leaflet No. 13
AMC1-CS-FSTD(A).300(c)(1)	Engineering simulator validation data	ACJ No.1 to JAR-FSTD A.030(c)(1)
AMC2-CS-FSTD(A).300(c)(1)	Engineering simulator validation data – approval guidelines	ACJ No.2 to JAR-FSTD A.030(c)(1)

Appendix C– Attachments to comments on NPA 2008-22d

7813 EASA 12-6-08 EASA FCL NPA Comments.pdf
Attachment #1 to comment #3

Lettre report EASA FNAM.pdf
Attachment #2 to comment #120

JAR-STD 3A change 1.pdf
Attachment #3 to comment #134

Comments Pertaining to EASA CS-FSTD A .pdf
Attachment #4 to comment #39

CS-FSTD(A) - NPA.pdf
Attachment #5 to comment #137

Scheme.pdf
Attachment #6 to comment #146

Attachment #7 to comment #106