European Aviation Safety Agency

1 Dec 2010

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

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

Certification Specifications for Helicopter Flight Simulation Training Devices

"CS-FSTD(H)"

Explanatory Note

I. General

1. The purpose of the Notice of Proposed Amendment (NPA) 2008-22e, dated 30 October 2008 was to define the qualification code for helicopter FSTDs based on JAA JAR-FSTD H. 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 2008-22e 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 96 comments relevant to CS-FSTD(H), from 16 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 Helicopter 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 2008-22e "CS-FSTD(H)"

A Introduction

8. The Certification Specifications for helicopter 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(H) is based on JAR-FSTD H and JAR-FSTD temporary guidance leaflets (TGLs).

B Comments

9. CS-FSTD(H) received a total of 96 comments. 20 of them are related to 'Book 1 – Qualification Code' and 76 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 2008-22e. However, many commentators may not have been aware that changes had already been introduced when transferring the three JAR-STD H documents into one JAR-FSTD H document (in JAA NPA 12). JAR-FSTD H was the basis for the Agency's CS-FSTD(H). The justification given in the JAA NPA for many of the changes was a harmonisation of the three different documents for helicopter FSTDs because:

    - they had been written at different times by separate groups; and
    - the documents had not been updated since their original drafting.

    During this harmonisation JAR-STD 1H was used as a master document.

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11. Some comments on the apparent introduction of new tolerances for validation tests should be seen in the context of the above. Other comments on the differences between STD/FSTD/CS-FSTD that had not been discussed and dealt with in NPA 12 have been addressed in this CRD. Changes in the table of validation tests which had already been accepted during NPA 12 but not introduced in JAR-FSTD H are now considered in CS-FSTD(H). On the other hand "additional requirements" caused by an incorrect amalgamation of previous requirements into the single JAR-STD H and carried over into CS-FSTD(H) have been removed.

12. 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' (AMC1-CS-FSTD(H).300) indicating which tests are required for each specific level of an FSTD. The positions of these tick marks have been corrected now; or
- missing comments in the right column of that table. Additional clarifications are given now.

13. Generally, different paragraphs omitted or incorrectly simplified during the transfer from JAR-FSTD H to CS-FSTD(H) have been reinstated in their original version.

14. As the introduction of major technical changes in the requirements was outside the scope of this NPA, new requirements as proposed by some commentators (e.g. change of validation test conditions or change of tolerances) were not introduced into this CRD. Such changes would need to undergo suitable stakeholder consultation, including review by a helicopter expert working group, and would necessitate a new rulemaking task.

15. A few alignments of requirements have been made between the table for FSTD standards in Appendix 1 to CS-FSTD(H).300 with those in the table of validation tests in AMC1-CS-FSTD(H).300.

D Description of main changes

16. CS-FSTD(H).200 "Terminology"

Point (f) 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 (terminology and abbreviations) 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(H).

17. CS-FSTD(H).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.

18. CS-FSTD(H).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(H).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

19. Appendix 1 to CS-FSTD(H).300 "Flight Simulation Training Device Standards"

The possibility to use electronically displayed images with physical overlay for FSTD instruments has been extended to FFS as well. During the transition of JAR-STD material to JAR-FSTD the possibility of replacing analogue instruments by electronically displayed images with physical overlay had been omitted for FFS. This assumed that the proper simulation of certain effects like parallax reading error or inherent inertia of pointers was not possible. This topic has been addressed again within the International Working Group drafting the new ICAO Document 9625 (3rd edition).This working group considered the principle of electronically displayed ("analogue") instruments to be suitable for any type of FSTD, including those devices with higher fidelity levels, so long as certain representativity requirements are fulfilled. As these requirements are now technically possible, helicopter FFS may also be permitted to use electronically displayed images with physical overlay.

20. AMC1-CS-FSTD(H).300 "Qualification basis"

The new point 1.5.5 has been introduced to provide additional clarification on the data package for FNPTs and to explain the initial evaluation of FNPTs in more detail.

21. AMC1-CS-FSTD(H).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.

22. AMC1-CS-FSTD(H).300 "Qualification basis"

Point 2.4.3 'Motion system' had been copied incorrectly from CS-FSTD(A) although motion systems of aeroplane FSTD and helicopter FSTD are not validated the same way. Therefore the original sections of JAR-FSTD H have been reinstated.

V. CRD table of comments, responses and resulting text

(General Comments)	-

comment	*46* comment by: *ECA- European Cockpit Association* In the main the NPA is a direct copy of the JAR_FSTD-A dated 0508. The first inspection principles seem reasonable, however, ECA has a 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	*Noted* We assume that you are referring to JAR-FSTD H dated 0508. For the majority of the validation test cases, where snapshot tests are possible, the statement in the requirement is: '*May be <u>a series</u> of snapshot tests*' or '*May be snapshot test<u>s</u>*' to cover a longer duration of the test. Snapshot tests are used for those tests where the dynamic aspect is not the main purpose and are more in connection with the performance 'static' aspect of the helicopter performances assessment.

comment	*60* comment by: *FNAM (Fédération Nationale de l'Aviation Marchande)* Attachment #1 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	*68* comment by: *CAE* CAE has observed a number of changes to both the table of validation tests and function and subjective checks (some of which are identified below) for the helicopter lower level devices FTDs and FNPTs, when JAR-FSTD H was processed as CS-FSTD (H). CAE is unclear whether these changes were indeed intentional or not. Since rationale/justification for these changes could not be found in this NPA 22-2008, CAE recommends such a rationale provided by EASA, clarifying these changes.
response	*Noted* There were some changes introduced by the NPA 12 Working Group when transferring the different JAR-STDs for helicopter training devices to JAR-FSTD H to harmonise and standardise where applicable and possible. But there should have been no major technical changes for FSTD Standards or FSTD Validation Tests when drafting JAR-FSTD H (which is the basis for CS-FSTD(H)). Rationales/justifications should then be given during NPA 12, not during NPA 22-2008.

TITLE PAGE p. 1

comment	*89* comment by: *IACA International Air Carrier Association* IACA has no comments since IACA airlines do not operate FSTD(H).
response	*Noted*

B. Draft Rules - VI. Draft Decision CS-FSTD(H) p. 4

comment	*92* comment by: *Thales Training & Simulation - France* **Comment :** The title of the document is "Certification Specifications" although it adresses in many case the <u>Qualification</u> of the FTSD. We assume the word Certification is used on purpose to be consistent with other proposed EASA rules. **Proposed Change :** • Addition of a preliminary wording explaining the use of Certification and qualification in the document if any difference is to be made between the two words, or • add a reference to a document defining the two meanings in the EASA referential.
response	*Noted*

The document is 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 'qualification certificate' for FSTDs is used to describe a document which finalises the qualification process.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 1 p. 7

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

General comment on document formating:

We think it will be useful to add in the header section of each page of the document the title of the section/subpart it belongs as it appears in the table of contents (e.g. Appendix 2 to AMC No. A to CS FSTD(H).300). This will make the document more readable and the user will easily locate which part of the document is concerned.

response | *Not accepted*

We agree that it would be of help to ease the navigation within the document, but we should have a consistent layout for all new documents. Your proposed option is not envisaged.

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

comment | 8 comment by: *French Army AVN. FTO*

MCC may neither imply nor include the fact that the helicopter is multi engine.
e.g. a single engine helo could be multi pilto in IR flight.

response | *Not accepted*

- The multi-engine requirement only applies to FNPT II and III for MCC training and is pre-existing in the JAR-STD 3H and JAR-FSTD H.
- The definition of exercises for MCC training as defined in AMC FCL 2.261(d) § 10.d requires “engine failure before and after Take off Decision Point (TDP); engine failure before and after Defined Point After Take-off (DPATO)”. This requirement implies that the simulated generic aircraft is a multi-engine helicopter.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 1 - Appendices - Appendix 1 to CS FSTD(H).300 Flight Simulation Training Device Standards - 1.1 General p. 12-19

comment | 9 comment by: *French Army AVN. FTO*

Validation flight test data should be listed in an appendix of this amendement and described upon the type of helicopter (light, medium or heavy)

response | *Not accepted*

	Validation data are part of the QTG not part of this document.

comment	*12* comment by: *Frasca International, Inc.* Comment: The explanatory material for item b.1 in the table of FSTD Standards should be amended to state that electronically displayed images are acceptable to represent analog instruments in FFS. Justification: Historically, the JARs have not stated that electronically displayed instruments are unacceptable for FFS until the most recent amalgamation. Furthermore, experience has shown that properly designed computer generated instrumentation causes no negative transfer of skills. Additionally, computer generated instruments allow for simple and efficient FSTD maintenence and upgrade. Rather than exclude computer generated instruments as a whole, EASA should include a list of standards to which acceptable electronic imagery must conform in order to be acceptable for FFS application.
response	*Noted* Although a change of technical criteria was not foreseen during the NPA 2008-22 process the Agency will not ignore technological advances. The adaptation of new technologies and by that the review and change of criteria could be done with a new rulemaking task or by amending the existing requirements already within this step if it is obvious that a certain requirement has no justification any more. During the transition of JAR-STD material to JAR-FSTD (NPA 11 and 12) the possibility of replacing analogue instruments by electronically displayed images with physical overlay has been omitted for FFS assuming that the proper simulation of certain effects like parallax reading error or inherent inertia of pointers is not possible. This topic has been addressed again within the International Working Group drafting the new ICAO document 9625 (3rd edition) and the principle of electronically displayed ("analogue") instruments may be possible for any types of FSTD even for higher level of fidelity devices if certain representativity requirements are fulfilled which are already now technically possible.

comment	*13* comment by: *Frasca International, Inc.* Comment: Item q.1 in the table of FSTD Standards should be removed. Justification: Items l.2 and q.1 in the table of FSTD Standards from Book 1, Appendix 1 to CS FSTD(H).300 are identical in both wording and requirement, with the only difference being that q.1 applies to FNPT while l.2 applies only to FFS and FTD. Historically, the JARs have not stated a control dynamics requirement for FNPT until the most recent amalgamation. Additionally, control dynamics objective tests are not required for FNPT under the proposed regulations.
response	*Accepted* Item q.1 in the table of FSTD standards will be removed.

comment	*69* comment by: *CAE* - CS-FSTD (H), i.1 and i.2 FSTD standards require 2 Additional seats for the instructor and observer (e.g. 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; also 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. Due to the contribution of European NAAs, the FAA and stakeholders like CAE to the IWG activities in drafting the new ICAO doc. 9625, 3rd edition for Aeroplanes (Vol. I) and Rotary Wings (Vol. II, work still in progress) it has been assumed that harmonisation has taken place while reviewing all criteria for FSTD standards. So it might be that the next revision of Part 60 and the new ICAO document for helicopter FSTD will require three additional seats as well, which again is not according to your arguments regarding the adequate view especially for light helicopter cockpit configurations. This issue will, however, be taken up again in a new, future rulemaking task as foreseen by the Agency when aligning CS-FSTD(A) and (H) with the new ICAO doc. 9625, 3rd edition, Volume I and II.

comment	*90* comment by: *CAA Norway* For item b1, in the Compliance coloumn, the middle sentence reads "The use of electronically displayed images with physical overlay incorporating operable switches, knobs and buttons may be acceptable. ~~This option is not acceptable for analogue instruments in FFS~~." We propose to delete the last sentence, to allow this option for FFS also.
response	*Accepted* This sentence will be deleted. See response to comment No. 12 above.

comment	*94* comment by: *Thales Training & Simulation - France* **Comments :**

	Requirements 1.1.q.1 on page 1-A1-8 appears to be duplicated with additional ticks for FNPT Level II, III and MCC from the requirements 1.1.l.2 on page 1-A1-6 **Proposed change:** Remove the requirement 1.1.q.1
response	*Accepted* Item q.1 in the table of FSTD standards will be removed. (See comment No. 13 above)

comment	*95* comment by: *Thales Training & Simulation - France*
	Comment: The definition of the Tranpsort Delay in column 'FSTD Standard" 1.1.r.1 on page 1-A1-8 is not consistent with the definition proposed in section aaaa on page 2-B-5. **Proposed change:** • Harmonize the Transport Delay defintion through the all document using the wording of the dedicated appendix (Appendix 5 to AMC No.1 to CS FSTD(H).300) • Add a reference to Appendix 5 to AMC No.1 to CS FSTD(H).300 in the compliance column of requirement 1.1.r.1
response	*Partially accepted* As there is no contradiction between the short definition in column 'FSTD Standard' 1.1.r.1 on page 1-A1-8 and the extended definition in AMC to CS FSTD(H).200 section aaaa on page 2-B-5 the text will not be changed, but a reference to Appendix 5 to AMC1-CS FSTD(H).300 will be added.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 1 - Appendices - Appendix 1 to CS FSTD(H).300 Flight Simulation Training Device Standards - 1.2 Motion System p. 19-20

comment	*96* comment by: *Thales Training & Simulation - France*
	Comments: requirement 1.2.b.1, the comments on seat appearing in Compliance column does not seem relevant **Proposed change :** Remove wording in column Compliance of requirement 1.2.b.1
response	*Partially accepted* The comments on seat appearing will be removed from requirement 1.2.b.1. The following will be added to 1.1.i.1: *....Observer and instructor seats need not represent.....*

comment	*98* comment by: *Thales Training & Simulation - France*
	Comment :

	Requirements 1.2.e.1, in the Compliance column the wording indicates "Steady state test are acceptable" although in book 2 AMC test 4.e requires tests conditions in "Low and high speedtransition to & from hover". **Proposed change:** Remove the transition flight condition to be demonstrated. In addition those transition flight conditions impliyn on steady vibration condition which are not compatible for a PSD analysis in order to compare FSTD results with aircraft reference data.
response	*Accepted* The flight condition "transition" will be removed since it is not consistent with the requirement to provide a PSD analysis of the vibration spectrum (see AMC No. 1 to CS FSTD(H).300 para 2.4.3.5) which itself requires a stable flight condition and vibration conditions for a period of time.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 1 - Appendices - Appendix 1 to CS FSTD(H).300 Flight Simulation Training Device Standards - 1.3 Visual System p. 21-24

comment	*3* comment by: *SOGITEC Industries* Comment for surface contrast ratio l.1 The given requirements not less than 5:1 for FFS level C and D not less than 8:1 for FTD 2&3 and FNPT II, III & MCC and Table of Validation Tests for visual test 5b4 not less than 5:1 for all the above devices are not consistent. Requirements for l.1 to be set in accordance to validation table tolerance.
response	*Not accepted* The validation table tolerance will be set in accordance with the requirements as laid down in the FSTD standards. See response to comment 101 below. The comment there is contradictory to yours.

comment	*4* comment by: *SOGITEC Industries* Comment for Lightpoint contrast ratio l.2 Requirement Not less than 25:1 for FFS C&D, FTD 2&3 and no requirements for FNPT and tolerance given in the validation table for visual tests 2b8 Not less than 25:1 for FFS C&D, FTD 3 Not less than 5:1 for FTD 2 and FNPT II, III and MCC are not consistent. Requirements in l.2 to be set in accordance with Validation table tolerances

response	*Partially accepted* NPA 2008-22e (CS-FSTD(H)) reflects the content of JAR-FSTD H 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 those technical criteria which have already been addressed by commentators during NPA-STD 12 and reviewed and adopted by JAAC 06-4. The values/tolerances for the Light Point Contrast Ratio have been reviewed and confirmed during this NPA-STD 12 process and will be kept unchanged (see AMC 1 CS-FSTD(H).300 Table of FSTD Validation Tests, para 5.b.8). Alignment will be done by correction of AMC1-CS-FSTD(H).300 para 2b8.

comment	*10* comment by: *French Army AVN. FTO* FSTD STANDARDS 1.3 Visual System g.1, h.1, l.1 & l.2: Surface resolution, lightpoint size, surface contrast ratio & lightpoint contrast ratio should be compliant only in the minimum visual fiel of view defined in 1.3.b.2
response	*Noted* From the legal point of view this is correct. The requirements for the visual system have to be fulfilled within the required minimum visual field of view. But referring to training tasks, especially for helicopter operation (e.g. sideward hover flight), which require extended fields of view it would be common sense that the extended areas are only of any benefit for training if they comply with the requirements as well.

comment	*70* comment by: *CAE* These visual technical requirements are older, and at times, less stringent than the equivalent technical visual requirements of CS-FSTD(A). Example: section k.3 requires far less number of polygons and light points for scene content (6000 polygons day and 7000 light points night for Level D) as compared with the equivalent requirement for airplanes (10,000 polygons and 6000 lights day and 15,000 light points night), etc Suggest alignment of relevant requirements of CS-FSTD(A) of section 1.3 visual, subsections d.1 to m.6
response	*Not accepted* NPA 2008-22e (CS-FSTD(H)) reflects the content of JAR-FSTD H 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 those technical criteria which have recently been reviewed and adopted by JAAC 06-4. Furthermore it should also be considered that for helicopter application the visual field of view is larger than for aeroplane and the visual cues are observed at a shorter distance so the performance has to be balanced with the real training benefit and cost.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart B: Terminology - AMC to CS FSTD(H).200 Terminology and abbreviations - 2 Abbreviations	p. 32-34

comment	*71* comment by: *CAE* Abbreviations: CS, EASA, and others not on the list Add CS, EASA and other relevant abbreviation from EASA terminology
response	*Not accepted* 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 - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 1 Introduction	p. 35-38

comment	*72* comment by: *CAE* AMC No. 1 to CS-FSTD(H).300 No reference to eQTG; suggest addressing eQTG as per FAA 14 CFR Part 60 and with reference to ARINC 436
response	*Accepted* The following additional paragraph will be added: 1.6.3 Use of an electronic qualification test guide (eQTG) can reduce costs, save time and improve timely communication, and is becoming a practice. ARINC Report 436 defines an eQTG standard (see CS-FSTD(H).300(e)).

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 2 FSTD Validation Tests - 2.1 General	p. 38-39

comment	*62* comment by: *Swedish Transport Agency, Civil Aviation Department (Transportstyrelsen, Luftfartsavdelningen)* Comment: The denomination ACJ is wrong in 2.1.5 and 2.1.5. **Proposal**: Change ACJ to AMC.
response	*Accepted* "ACJ" in para 2.1.2 and 2.1.5 will be changed to "AMC"

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 2 FSTD Validation Tests - 2.2 Test requirements p. 39-40

comment *15* comment by: *UK CAA*

Page No:
2-C-6

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Para 2.2.2.1

Comment:
Sub paragraphs a, b, c and d have been omitted and the text simplified (compared to the accepted standards in JAR-FSTD (H). The correct text however has been retained in CS-FSTD (A) and is equally valid for CS-FSTD (H). The clarifying text is extremely beneficial and should be re-introduced.

Justification:
Consistency between CS Specifications. The proposed text for CS-FSTD (H) also provides a lack of clarity in defining tolerances and how to deal with parameters measured in percent, or those parameters that vary around zero. The previously accepted text in JAR FSTD (H_ (<u>and as included in CS-FSTD A</u>) provides beneficial guidance.

Proposed Text (if applicable):

Re-instate the following text to paragraph 2.2.2.1 of AMC No 1 to CS-FSTD (H). 300 <u>as per the text in the same paragraph of CS-FSTD (A)</u> (note editorial change to add "-" to front of last paragraph):

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 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 be from 45% to 55%).

- for parameters not displayed in units of percent, a tolerance expressed only as a percentage will 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 Authority

- 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 labeled using the tolerances and units specified.

response *Accepted*

	Following your proposal the sub paragraphs will be reinstated. Much effort has been spent on this point during NPA 12 to clarify the addressed items. The text will then be consistent with CS-FSTD(A) again.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 2 FSTD Validation Tests - 2.3 Table of FSTD Validation Tests - 1 Performance	p. 41-48

comment *16* comment by: *UK CAA*

Page No:
2-C-8

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

Comment:
Unnecessary additional requirements for CT&M have been added for the FTD level 2 and 3 devices in paragraphs 1b(1), (2), (3) of the CS.

Justification:
Table 2.3 in JAR-FSTD (H) provides a set of recognised and proven FSTD Validation tests that provides the core requirements for CS-FSTD H that is accepted by regulators and industry. EASA have stated that the intent is to translate these standards into the regulations and Certification Specifications. Imposition of additional regulatory burden can only be justified on the basis of a consequent recognised improvement in fidelity or training benefit that is not evident in this case. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition.

Proposed Text (if applicable):

Delete reference to CT&M for paragraph No: 1b(1), (2), and (3) of table 2.3 in AMC No 1 to CS-FSTD (H). 300 for FTD level 2 and 3. *(as per JAR-FSTD (H) page 2-C-25 and 2-C-26)*

response *Accepted*

CT&M will be deleted for FTD level 2 and 3

comment *17* comment by: *UK CAA*

Page No:
2-C-10

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table 2.3,
Para 1c(3)
Comment:
Amended requirements of CT&M have been introduced for the level FTD 1 & 2 for OEI rejected take-off in paragraph 1c(3). This imposes additional unnecessary requirements for FTD level 1 and alleviates the requirements for

FTD level 2 (i.e. a potential reduction in standards) compared to the currently accepted standards of JAR-FSTD (H).

Justification:
Table 2.3 in JAR-FSTD (H) provides a set of recognised and proven FSTD Validation tests that provide the core requirements for CS-FSTD (H) that is accepted by regulators and industry. EASA have stated that the intent is to translate these standards into the regulations and Certification Specifications. Imposition of additional regulatory burden can only be justified on the basis of a consequent recognised improvement in fidelity or training benefit that is not evident in this case. Deleting requirements already in place and accepted could have an adverse implication on standards of fidelity or training. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition.

Proposed Text (if applicable):

Amend table 2.3 in AMC No 1 to CS-FSTD (H). 300 as follows: -
Delete reference to CT&M for paragraph 1c(3) for FTD level 1
Re-instate the tick (ü) for paragraph 1c(3) for FTD level 2
(as per JAR-FSTD H, page 2-C-28, Paragraph No: 1c(3))

response *Accepted*

CT&M will be deleted for FTD level 1.

A checkmark will be reinstated for FTD level 2.

comment *18* comment by: *UK CAA*

Page No:
2-C-12/13

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table 2.3
Para. 1h(2) & 1i

Comment:
Unnecessary additional requirements for CT&M have been added for the level 1 FTD for OEI autorotation in paragraph 1h(2) and 1i of table 2.3.

Justification:
Table 2.3 in JAR-FSTD (H) provides a set of recognised and proven FSTD Validation tests that provide the core requirements for CS-FSTD (H) that is accepted by regulators and industry. EASA have stated that the intent is to translate these standards into the regulations and Certification Specifications. Imposition of additional regulatory burden can only be justified on the basis of a consequent recognised improvement in fidelity or training benefit that is not evident in this case. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition.

Proposed Text (if applicable):

Delete reference to CT&M for paragraph No: 1h(2) and 1i of table 2.3 in AMC No 1 to CS-FSTD (H). 300 for FTD level 1. *(as per JAR-FSTD page 2-C-33)*

response	*Accepted* CT&M will be deleted for FTD level 1 in para h.(2) and i. Additionally a checkmark will be reinstated for FFS level B with reference to JAR-FSTD H.

comment	*49* comment by: *EUROCOPTER* <u>Test 1.a.(1).(i):</u> • Tolerances applied on engine parameters should be homogeneous : replace « Turbine Gas Temp 30°C » by « Turbine Gas Temp ±30°C or ±5% » <u>Test 1.a.(1).(ii):</u> • Tolerance applied on engine parameters should be homogeneous : replace « Torque ± 3% » by « Torque ± 2% » and replace .« Turbine Gas Temp 20°C » by « Turbine Gas Temp ± 20°C or ± 2% » <u>Test 1.a.(3):</u> • In the "flight conditions" field, replace "Climb/Descent" by "Climb and Descent"
response	*Partially accepted* NPA 2008-22e (CS-FSTD(H)) reflects the content of JAR-FSTD H 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 those technical criteria which have recently been reviewed and adopted by JAAC 06-4. Technical changes (not yet discussed in any forum) will require a helicopter expert group to be established. As a change of CSs is up a decision made by EASA's ED and is not part of the comitology procedure, an amendment of CSs is possible in due time if considered necessary. Not accepted: change of tolerances for tests 1.a.(1)(i) and 1.a.(1)(ii). The object of this NPA 2008-22 is not to review the detail of test tolerances coming from the JAR-FSTD H Accepted: change of flight conditions in test 1.a.(3) from *Climb/Descent* to *Climb and Descent.*

comment	*50* comment by: *EUROCOPTER* <u>Test 1.b.(1):</u> • This test is useless for an helicopter, and more applicable for a fixed wing. <u>Test 1.b.(2):</u> • In the "flight conditions" field, add "Left and Right". • In the "Comments" field, add "Without usage of wheel brake" <u>Test 1.b.(4):</u> • In the "tolerance" field, add "brake system hydraulic pressure change +/- 10%". We propose to add this requirement in order to verify that the input of the maneuver is also matching the h/c measured data. • In the "comments" field, add "record data until full stop".
response	*Partially accepted* Not accepted: removal of test 1.b.(1), because it is not the purpose of this NPA to redefine tests. Even during the NPA 12 review process, the test has not removed. The removal of the test (which applies to wheeled helicopters) from

	the table of FSTD validation tests should then be covered by a subjective test for surface operations. Accepted: modification of test 1.b.(2) in the tolerance field and the comments field as proposed. Not accepted: modification of the tolerance field of test 1.b.(4) as it is a full brake application until full stop. Accepted: modification of the comment field of test 1.b.(4) as proposed

comment	*51* comment by: *EUROCOPTER* <u>Test 1.c.(1):</u> In the "tolerance" field, replace "airspeed" by "groundspeed". In the "comments" field, add the following: "Airspeed data shall be presented to demonstrate consistency with ground speed within sensor accuracy range". <u>Test 1.c.(2):</u> In the "comments" field, add the following: "Airspeed data shall be presented to demonstrate consistency with ground speed within sensor accuracy range".
response	*Partially accepted* As the airspeed is the parameter the pilot is piloting with, specifically during this take-off phase, it will be kept in the tolerance field. Taking into consideration that the airspeed is sometimes not easy to measure and unreadable when the aircraft is starting from rest, the ground speed should be checked as well. The following will be added to the comment field: In addition to the airspeed the ground speed should be taken as reference with the same tolerance of +/- 3 kts until the airspeed is clearly readable.

comment	*52* comment by: *EUROCOPTER* <u>Test 1.c.(3):</u> • In the "tolerance" field, replace "airspeed" by "groundspeed" and and replace "bank attitude +/- 1.5°" by "bank attitude +/- 2°" in order to be homogenous with other takeoffs tests. • In the "comments" field, add the following: "Airspeed data shall be presented to demonstrate consistency with ground speed within sensor accuracy range". • In the "comments" field, add "near limiting performance **(as defined in flight manual)**" <u>Test 1.d:</u> • In the "flight conditions" field, replace "on and off" by "on or off" • In the "comments" field, replace "light/heavy" by "light and heavy"
response	*Partially accepted* Test 1.c.(3): Replacement of airspeed by groundspeed – see response to comment 51 above. The replacement of "bank attitude +/- 1.5°" by "bank attitude +/- 2°" is not accepted as it directly comes from JAR-FSTD H without change.

The additional comment is accepted: "… near limiting performance as per aircraft manual".

Test 1.d.:

Accepted. The changes will be made according to your proposal.

comment 53 comment by: *EUROCOPTER*

Test 1.e:
- In the "flight conditions" field, replace "on and off" by "on or off"
- In the "comments" field, replace "light/heavy" by "light and heavy"

Test 1.f:
- In the "tolerance" field, replace "sideslip +/- 2°" by "bank attitude +/- 1.5°"
- In the "flight conditions" field, add "stability augmentation on or off"
- In the "comments" field, replace "grossweight/cg and two speeds" by "grossweight/cg and **at least** two speeds **(including Vy and maximum cruise speed)**"

Test 1.g:
- In the "tolerance" field, replace "sideslip +/- 2°" by "bank attitude +/- 1.5°"

response *Partially accepted*

Justifications by the commentator are missing

Test 1.e.:

Accepted. The changes will be made according to your proposal as the influence of the augmentation system is not relevant in this case.

Test 1.f.:

The replacement of the sideslip angle by the bank attitude is not accepted as it is not an equivalence.

Additional information in the "flight conditions" field and the "comment" field are accepted according to the proposal.

Test 1.g.: Not accepted (see response to proposal for test 1.f.)

comment 54 comment by: *EUROCOPTER*

Test 1.h.(1):
- In the "tolerance" field, replace "sideslip +/- 2°" by "bank attitude +/- 1.5°"

Test 1.h.(2):
- In the "tolerance" field, replace "sideslip +/- 2°" by "bank attitude +/- 1.5°"
- In the "comments" filed, replace "rotor speed tolerance only applies if collective control position is fully down" by "the test shall be performed with engines desynchronized"

response *Not accepted*

Justifications by the commentator are missing

Test 1.h.(1)

The replacement of the sideslip angle by the bank attitude is not accepted as it is not an equivalence.

Test 1.h.(2)

The replacement of the sideslip angle by the bank attitude is not accepted as it is not an equivalence.

Replacement in the comment field not accepted as there is no justification for this proposal. The rotor speed check with collective control down at a specific airspeed condition is considered as necessary.

comment | *55* | comment by: *EUROCOPTER*

Test 1.i:

- In the "tolerance" field, replace "roll" by "bank" to be homogeneous with the rest of the document
- In the "comments" field, replace "idle" by "a stabilized autorotation with engines desynchronized"

Test 1.j.(1):

- In the "tolerance" field, replace "airspeed" by "groundspeed" and and replace "bank attitude +/- 1.5°" by "bank attitude +/- 2°" in order to be homogenous with other takeoffs tests.
- In the "comments" field, add the following: "Airspeed data shall be presented to demonstrate consistency with ground speed within sensor accuracy range".

response | *Partially accepted*

Test 1.i.:

“Roll attitude” will be replaced by “bank angle” (entire document).

The replacement of “…reduction to idle” by the proposed text is not accepted because the purpose of the test is to check the “response to a rapid power reduction to idle” which is a very basic and readable indication on the way to perform the test.

Test 1.j.(1):

See response to comment 51 and 52 above.

comment | *56* | comment by: *EUROCOPTER*

Test 1.j.(4):

- In the "tolerance" field, replace "bank attitude +/- 2°" by "bank attitude +/- 3°", because this maneuver is much more dynamic than the rest of the T/O and landings
- In the "comments" field, add at the end of the paragraph "(with engines desynchronized)"

response | *Not accepted*

The replacement of "bank attitude +/- 2°" by "bank attitude +/- 3°" is not accepted as it has been transposed directly from JAR-FSTD H, unchanged.

The addition in the comments field is not accepted as the test condition is clear enough (auto-rotational descent).

comment	*73*	comment by: *CAE*
	Tests c.(3) One Engine inoperative: CT&M was added for FTD level 1. JAR FSTD H did not have CT&M for FTD Level 1. Test is not part of FAA Part 60. No visual requirements for FTD level 1. This test is from the take-off point to touch down. Suggest removing the CT&M from FTD Level 1.	
response	*Accepted* See response to comment 17 above.	

comment	*74*	comment by: *CAE*
	f. Level Flight Performance Stability Augmentation On and Off was removed. JAR FSTD H has the info and FAA Part 60 also. Suggest to put back Stability Augmentation On and off in the Flight Conditions section.	
response	*Partially accepted* The information will be reinstated but saying “stability augmentation on <u>or</u> off” as this is a performance test and the augmentation system has no influence on the result.	

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 2 FSTD Validation Tests - 2.3 Table of FSTD Validation Tests - 2 Handling qualitities	p. 49-56

comment	*19*	comment by: *UK CAA*
	Page No: 2-C-18 **Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table 2.3** **Para 2b(2)** **Comment:** JAR FSTD (H) provides additional information in the comment field in Para 2b(2) concerning the rationale regarding precise wind measurement and substitution by translational flight that is extremely beneficial, and should be re-instated. **Justification:** The proposed text (already accepted in <u>JAR</u>-FSTD (H)) provides a useful explanation of an alternative way gathering data and of performing the test. Also there is the issue of consistency in translating requirements to assure effective transition. **Proposed Text (if applicable):** Add the following text in the comments column of AMC No 1 to CS-FSTD (H).	

	300 Table 2.3 Para 2b(2): “Precise wind measurement is very difficult and simulated wind obtained by translational flight in calm weather condition (no wind) is preferred in order to control precisely flight conditions by using groundspeed measurement (usually GPS). In this condition, it would be more practical to realise this test with tests 2b (1) in order to ensure consistency between critical azimuth and other directions (forward, sideward and rearward)”
response	*Accepted* The text will be reinstated entirely.

comment	*57* comment by: *EUROCOPTER* Test 2.d.(2): • In the "tolerance" field, replace "roll" by "bank"
response	*Partially accepted* See response to comment 55 above.

comment	*58* comment by: *EUROCOPTER* Test 2.d.(3).(ii): This test should be removed because the experience shows that this test is not applicable for Helicopter or with very low added value for validation of an helicopter simulator. Moreover, this is not required for Helicopter Certification: - With stability augmentation on, autopilot handles the attitudes and any aircraft spiral stability cannot be identified. - With stability augmentation off, due to natural helicopter unstability (eg: dutch roll), helicopter behaviour is rapidly divergent and non repeatable without capacity to characterize the spiral stability. Indeed, the manoeuver initiation (release from pedal only or cyclic only turn) is enough to make the roll and yaw oscillations start. When the Dutch roll is unstable, these oscillations increase with time and it is thus not possible to get the long-term roll behavior. Even when the Dutch roll is stable, the poor damping means that a long time is required to make the short-term oscillations vanish and allow demonstrating the long-term roll attitude change. - Spiral stability is not a known reference for the design and the flight tuning of helicopter
response	*Not accepted* Although the Agency can follow your arguments the test will not be deleted during this NPA for the following reasons: a) Complete deletion of validation tests is not within the scope of this NPA. b) Changes such as the deletion of tests will require a helicopter expert group to be established for discussion. As a change of CSs is a decision made by EASA’s ED and is not part of the comitology procedure, an amendment of CSs is possible in due time if considered necessary. c) The test has been confirmed by the International Working Group drafting

	the new ICAO doc. 9625 Vol.II, Rotary Wings (not yet published). The proposal is noted for future changes.

comment	*75* comment by: *CAE* Tests (5) Control Dynamics CT&M was added to FTD level 1. Is there a rationale to explain the changes? (Control forces should be representative only if required, as appropriate for the system training required)
response	*Accepted* The Agency fully supports your proposal. Furthermore the checkmark for FTD level 2 will be replaced by CT&M as it has been in JAR-FSTD H.

comment	*77* comment by: *CAE* Tests c.(2) Static Stability CT&M was removed from FTD level 1 and CT&M is replacing the checkmark for FTD Level 2. Different from JAR FSTD H FTD level 1. Reconsider adding CT&M for FTD level 1 and a checkmark for FTD level 2. Similar to case 2C4 (Maneuvering Stability).
response	*Accepted* The Agency fully supports your proposal. The requirements will be changed back to the JAR-FSTD H standard.

comment	*78* comment by: *CAE* Tests c.(5) Landing Gear Operating Time CT&M is now replacing the checkmark for FTD level 1. Different from JAR FSTD H FTD level 1. Suggest to remove the section c.(5) as per FAA Part 60 and JAR FSTD A.
response	*Partially accepted* Checkmark for FTD level 1 will be reinstated. No deletion of section (5). See response to comment 58 above.

comment	*79* comment by: *CAE* (2) Directional Static Stability The Flight Condition CLIMB has been removed. JAR FSTD H has CLIMB and FAA Part 60 also has CLIMB. Suggest to change the flight condition to : Cruise or Descent (may use Climb instead of Descent if desired)
response	*Partially accepted* Flight conditions as per JAR-FSTD H will be reinstated requiring '*Cruise*' or '*Climb and Descent*'. '*Climb/Descent*' has been changed to '*Climb and Descent*' in NPA 12 and

complies with comment to Test 1.a.(3) (see above) during this NPA 2008-22.

comment	*103*	comment by: *Thales Training & Simulation - France*

Test 2.a." Brake Pedal Force vs Position :

Proposed change :
We propose to modify the tolerance value for this test from 5 to 10 lb or 10% to 20%.

Rationale for this change:
The tolerance requirement for this test (brake pedal force) is not consistent with the spread of measurement of the effort on a same helicopter model for various tail number. Moreover, taking into account the usual layout of the brake pedal (on top of the rudder pedal) the piece of hardware to be designed to reach the required tolerance is really more often not in accordance with the state of the art. It is also to be noticed that the braking aspect on most helicopter is not really a strong training requirement.

response *Not accepted*

The object of this NPA 2008-22 is not to review the detail of test tolerances coming from the JAR-FSTD H.

Technical changes like the one you proposed (not yet discussed in any forum) will require a helicopter expert group to be established. As a change of CSs is a decision made by EASA's ED and is not part of the comitology procedure, an amendment of CSs is possible in due time if considered necessary.
The proposal is noted for future changes.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 2 FSTD Validation Tests - 2.3 Table of FSTD Validation Tests - 4 Motion system p. 56-60

comment	*20*	comment by: *UK CAA*

Page No:
2-C-23

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table 2.3
Paragraph 4a(3)

Comment:
A new tolerance has been introduced (± 20°) which has been applied to FFS Level A and B yaw motion tests (displacement, velocity, acceleration) in paragraph 4a(3). This imposes an additional unnecessary regulatory burden for level A devices and alleviates the requirements for level B devices compare to the current accepted standards without justification.

Justification:
Table 2.3 in JAR-FSTD (H) provides a set of recognised and proven FSTD Validation tests that provide the core requirements for CS-FSTD (H) that is accepted by regulators and industry. EASA have stated that the intent is to

	translate these standards into the regulations and Certification Specifications. Imposition of additional regulatory burden can only be justified on the basis of a consequent recognised improvement in fidelity or training benefit that is not evident in this case. Alleviating requirements already in place and accepted could have an adverse implication on standards of fidelity or training. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition. **Proposed Text (if applicable):** **Delete** new (± 20°) tolerance in paragraph 4a(3) of table 2.3 in AMC No 1 to CS-FSTD (H). 300 *(as per JAR-FSTD page 2-C513).* **Re-instate** the tick (ü) for FFS Level B only against the ± 25° tolerance in the same paragraph.
response	*Accepted* The Agency fully agrees with your comment. The tolerances for 4.a.(3)(i) will be reinstated as they have been in JAR-FSTD H. For FFS Level A there is only a minimum of 3 DOF (pitch, roll, heave; see Appendix 1 to CS-FSTD(H).300 FSTD standard 1.2.b.1) and no yaw motion.

comment	*43*	comment by: *DGAC FRANCE*
	AMC 1 to CS FSTD (H) 300, §2.3 Table of FSTD Validation tests, Paragraph e (1) and (2), last column Any reference to a JAR-FSTD document should disappear. Please replace any reference to JAR-FSTD H.030 by the right reference which is Appendix to CS FSTD H (300), paragraph 1.e.2.1.	
response	*Partially accepted* The sentence in the comments field will be replaced by: *Refer to book 1, appendix 1 to CS-FSTD(H).300 paragraph 1.2.e.1.*	

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 2 FSTD Validation Tests - 2.3 Table of FSTD Validation Tests - 5 Visual system p. 60-66

comment	*5*	comment by: *SOGITEC Industries*
	Comment for Visual System test 5a Visual Ground Segment Text "Static at 200ft .... 1850ft RVR" end of page 2-C-26 not aligned with associated devices FTD 2&3 and FNPT II, III and MCC. Text implementaion could be clearer to avoid confusion.	
response	*Accepted* Text will be aligned with the associated checkmarks for FTD and FNPT.	

comment	*6*	comment by: *SOGITEC Industries*

	Comment for Visual System test Visual Ground Segment 5a: For FTD 2&3 and FNPT II,III and MCC the column flight conditions specifies 200ft height and 550m RVR These conditions are nor in coherence with Annex 1 to JAR OPS 3.340 -Table 4 Onshore Precision Approach Minima Category I which states 500m RVR for 200ft height. Replace 550m by 500m
response	*Accepted* To be consistent with OPS 3 CAT I definition the RVR distance required will be changed to 500 m.

comment	*7* comment by: *SOGITEC Industries* Comment for System Geometry Visual validation test 5b3: For a side by side cockpit, devices such as FNPT could have a design eye point optimized for one of the pilots, for economical or technical reasons (customer requirement about duration of the test, ...). For these devices, test for only the pilot's eyepoint is recommended.
response	*Noted* The requirements should not be in contradiction with book 1, FSTD standards.

comment	*21* comment by: *UK CAA* **Page No:** 2-C-29 **Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table 2.3** **Paragraph 5.2** **Comment:** Unnecessary additional requirements for occulting tests for FFS level A and FFS level B have been added in paragraph 5.2 of table 2.3 **Justification:** Table 2.3 in JAR-FSTD (H) provides a set of recognised and proven FSTD Validation tests that provide the core requirements for CS-FSTD (H) that is accepted by regulators and industry. EASA have stated that the intent is to translate these standards into the regulations and Certification Specifications. Imposition of additional regulatory burden can only be justified on the basis of a consequent recognised improvement in fidelity or training benefit that is not evident in this case. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition. **Proposed Text (if applicable):**

	Delete the ticks (ü) for paragraph 5.2 of table 2.3 in AMC No 1 to CS-FSTD (H). 300 for FFS level A and B. *(as per JAR-FSTD page 2-C-63)*
response	*Accepted* The checkmarks will be removed for FFS level A and B to remain consistent with the FSTD standards for level A and B devices (Appendix 1 to CS-FSTD(H).300), to comply with the decision made during NPA 12 (adopted at JAAC 06-4) and by that to comply with JAR-FSTD H. It is noted for future review (expert group) either to introduce this requirement for level A and B devices as well, since it is a requirement even for FNPT II, or to remove the test from the table of validation tests for all FSTD types.

comment	*22* comment by: *UK CAA* **Page No:** 2-C-32 **Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table 2.3** **Paragraph 5.b.7** **Comment:** The Lightpoint size Test Requirement for FTD 3 in test definition 5.b.7 does not match the Standards Requirements in BOOK 1 SUBPART C CS-FSTD (H) Qualification code, page 1-A1-12, paragraph 1.3.h.1 (I.e. the requirement for FTD 3 test specifies 6 arc mins. whereas the standard calls for 8 arc mins. In addition there is no test definition for FFS B, which has a defined Standard of 8 arc mins. Additionally it is noted that the standards required for FTD 2 & 3 are now lower than as defined in JAR-STD 2H (this is an anomaly between JAR STD 2H and JAR FSTD H which needs to be resolved). The standards and test requirement for lightpoint size for FFS C, D and FTD 2, 3 should all be set to 6 arc mins as per JAR-STD, which is the original baseline standard. **Justification:** JAR-FSTD H defines a standard that has been accepted by industry and regulators and is supposed to replicate the requirements of JAR-STD 1H, 2H and 3H. There is an anomaly between FSTD H and JAR-STD 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 the standards known and accepted by industry. The text as proposed would reduce the standards unnecessarily. There is no basis for changing the existing standards. **Proposed Text (if applicable):** Change the tabulated ticks (ü) in BOOK 1 page 1-a1-12 **and** BOOK 2 page 2-C-32 to ensure that the lightpoint size requirements are as follows: For FFS level C and D: 6 arc mins For FTD level 2 and 3: 6 arc mins For FFS level B: 8 arc mins For FNPT Level II, III, MCC: 8 arc mins (These requirements will be consistent with currently accepted standards of

	JAR STD)
response	*Partially accepted* During the JAA NPA 12 process when all the requirements were aligned across all FSTD types some discrepancies arose. These have been identified and corrected by the FSTD H working group (when the requirements were sometimes higher for FTD or FNPT than for FFS some changes have been introduced). But there have been proposals for changes during NPA 12 agreed by JAAC but not introduced in JAR-FSTD H like the current value of 6 arc minutes for the FTD 3 light point size which has been agreed to be changed to 8 arc minutes with the justification that the former requirement for light point size may impose the use of calligraphic light. The requirements will be as follows: For FFS level C and D: 6 arc mins For FTD level 2 and 3: 8 arc mins For FFS level B: 8 arc mins For FNPT Level II, III, MCC: 8 arc mins See as well comment 100 below.

comment	*47* comment by: *Rockwell Collins* ***Make the changes identified in Bold / Italic*** ***NPA 2008-22e*** ***Test 5.b.(5) on page 2-C-31*** ***For Calligraphic systems*** Highlight brightness should be measured by maintaining the full test pattern described in paragraph 5.b 3 above, superimposing a highlight on the centre white square of each channel and measuring the brightness. Lightpoints 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	*Accepted* The proposed text will be added for clarification and reflecting the technical capabilities of raster systems and the way they are validated.

comment	*99* comment by: *Thales Training & Simulation - France* **Test 5.a :** **Comments :** 1. The formating of the text is wrong since the ticks applicable to FTD and FNPT are not placed on the same page as the applicable flight test conditions descritpion. 2. The wording of the test flight conditions is not consistent beween FFS and FNPT & FTD, although the test conditions should be similar (Trimmed in

landing configuration, on glide slope...) but a differents height above ground

Proposed change:

1. Reformat the text to display applicable FTD & FNPT ticks aligned with applicable flight conditions description
2. Use a consistent description for all FSTD flight conditions descriptions

response *Accepted*

1. Table will be reformatted.

2. Description for flight conditions will be consistent for all FSTD

comment *100* comment by: *Thales Training & Simulation - France*

Test 5.b.7 Light Point Size:

Comment:

1. The tolerance value "not greater than 6 arc minute" applicable to FTD 3 is not consistent with the value required in FSTD Standard 1.3.h.1 "Not greater than 8 arc minutes'
2. No tolerance specified for FFS B although the FSTD standard requires "Not greater than 8 arc minutes"

Proposed chage:

1. Set the tests tolerance value for FTD 3 in accordance to FSTD Standard value : 8 arc minutes
2. Set the tests tolerance value for FFS B in accordance to FSTD Standard value : 8 arc minutes

response *Accepted*

See response to comment 22 above.

comment *101* comment by: *Thales Training & Simulation - France*

Test 5.b.4 Surface Contrast Ratio

Comment :

The tolerance value required for this test is "Not less thant 5:1" for all FSTD types. This is not consistent with the required values in FSTD standard 1.3.l.1 : 5:1 for FNPT II,III and FTD 2,3 - 8:1 for FFS C,D.

Proposed change:

Set the tolerance values for FSTD type in accordance with relevant FSTD standard values:

- 5:1 for FNPT II,III and FTD 2,3
- 8:1 for FFS C,D.

response *Not accepted*

This is in contradiction with the JAR-STDs requiring 5:1 for FFS C and D and 8:1 for FTD 2 and 3, and FNPT II and III which is then consistent with the FSTD standards in CS-FSTD(H). As there is no consistency between the FSTD standards and the validation tests neither in CS-FSTD(H) nor in JAR-FSTD H

	the Agency aligns with the requirements as described in the FSTD standards for the validation tests until any future decision by a helicopter expert group.

comment	*102* comment by: *Thales Training & Simulation - France* Test 5.b.8 Light Point Contrast Ratio **Comment :** The tolerance value required for this test is "Not less thant 25:1" for FFS C,D and FTD3 - "Not less thant 5:1 for FTD2 and FNPT II,III. This is not consistent with the required values in FSTD standard 1.3.l.2 : Not less than 25:1 for all FSTD types. **Proposed change:** 1. Modify the FSTD Standard 1.3.l.2 values as follows : • 5:1 for FTD2,3 and FNPT II,III • 25:1 for FFS C,D 2. Modify the Test 5.b.8 tolerance value consistently These values have been accepted during the JAR FTS H NPA 12 and incorrectly applied in the JAR-FSTD H first issue.
response	*Accepted* The requirements in FSTD standards paragraph 1.3.l.2 and FSTD validation tests paragraph 5.b.8 will be modified according to the values already accepted during NPA 12.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 2 FSTD Validation Tests - 2.3 Table of FSTD Validation Tests - 6 FSTD systems	p. 66-70

comment	*23* comment by: *UK CAA* **Page No:** 2-C-35 **Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table 2.3** **Paragraph 6b** **Comment:** The requirement for realistic eng & rotor sound for FNPT 1 missing or omitted. This means there would be NO sound requirement for FNPT 1 and lowers the standard to unacceptable levels for FNPT 1 from the accepted standards of JAR-FSTD H. **Justification:** Table 2.3 in JAR-FSTD H provides a set of recognised and proven FSTD Validation tests that provide the core requirements for CS-FSTD H that is accepted by regulators and industry. EASA have stated that the intent is to translate these standards into the regulations and Certification Specifications. Deletion of valid requirements will have an adverse effect on fidelity or training standards. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition.

Proposed Text (if applicable):

Re-instate the following text in Paragraph 6b of table 2.3, as 6b(1) *(as per JAR-FSTD H, page 2-C-71, paragraph No: 6b(1))*

First Column: (1) Realistic engine and rotor sounds.
Second Column: Not applicable
Add a tick (ü) to the column applicable for FNPT level 1
Comment column to read: "Statement of Compliance or demonstration of representative sounds"

Re-number exiting items in paragraph 6b as 6b(2)

response *Accepted*

The text (complete row) will be reinstated according to your proposal.

comment *24* comment by: *UK CAA*

Page No:
2-C-35

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

Comment:
The application of CT&M to FFS level A, B&C and FTD level 2&3 in this paragraph [as opposed to the tick (ü) as per JAR FSTD H] is considered to be an acceptable philosophy (see justification). However, CT&M is necessarily valid for all FSTDs requiring this test, including FNPTs.

Justification:
In the context of this test and the description of how the test results should be viewed as described in the comment field, a 'tick' will convey the same requirement as 'CT&M'. Therefore, all the devices identified as requiring this test should have the same criteria, i.e. all CT&M.

Proposed Text (if applicable):

Write 'CT&M' into requirement for FFS level A, B, C & FTD level 2,3 & FNPT type II, III, MCC in paragraph 6b(1) of table 2.3.

response *Accepted*

Checkmarks will be replaced by CT&M for FNPT II, III, MCC

comment *25* comment by: *UK CAA*

Page No:
2-C-36

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table 2.3
Paragraph 6b(3)

Comment:

	Special Cases: sounds have been changed inappropriately from CT&M (JAR-FSTD H) to tick (ü) in CS-FSTD (H) for FFS level D. **Justification:** Since there is no tolerance applicable for this test, a CT&M requirement is more appropriate **Proposed Text (if applicable):** Replace existing tick (ü) with 'CT&M' into requirement for FFS D in paragraph. 6b(3) in table 2.3.
response	*Accepted* The checkmark will be replaced by CT&M

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 2 FSTD Validation Tests - 2.4 Information for Validation Tests - 2.4.2 Ground effect	p. 74-75

comment	*14* comment by: *Frasca International, Inc.* Comment: The Ground Effect tests required by Paragraph 2.4.2 of Book 2, Subpart C (pages 2-C-40 and 2-C-41) should be included in the table of objective tests, in a manner similar to objective test 2.f.1 in the proposed CS-FSTD A. Justification: The referenced paragraph clearly requires the inclusion of multiple objective tests in the QTG for an FSTD; however, the requirement is noted in the midst of a substantial amount of otherwise explanitory material. In order to avoid confusion about the requirements or omission from the QTG, these tests should be incorporated in Paragraph 2.3, "Table of FSTD Validation Tests". Additionally, all requirements should be removed from Paragraph 2.4.2, leaving only the required explanatory material for these tests. This change would have the further benefit of allowing these tests to be marked only for the applicable level of FSTD.
response	*Not accepted* CS-FSTD(H) already includes an objective testing of the ground effect in test 1.d "Hover Performance". The corresponding flight condition column requires tests to be performed in ground effect (IGE) and out of ground effect (OGE). In its' comments column, this test refers to the section 2.4.2 (Ground Effect) providing precise guidance on how to perform it. The material included in this section is too long to be directly included in the test 1.d comment column.

comment	*26* comment by: *UK CAA* **Page No:** 2-C-40 **Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 para.2.4.2.1** **Comment:**

There is no indication of what primary parameters are expected for the validation of Ground Effect characteristics.

Justification:
The preferred parameters were identified and listed in JAR-FSTD (H) and should be similarly listed in this document as useful additional material.

Proposed Text (if applicable):

Add the following text to BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 para.2.4.2.1:

The primary validation parameters for characteristics in Ground Effect are:
a. Longitudinal, lateral, directional and collective control positions
b. Torque required for hover
c. Height
d. Airspeed
e. Pitch Attitude
f. Roll Attitude

(as per the equivalent JAR FSTD (H) paragraph)

response *Accepted*

The list of parameters will be reinstated. Furthermore section 2.4.2.3 will be removed as it is more applicable for ground effect validation for aeroplanes.

comment *80* comment by: *CAE*

Ground effect

The primary validation parameters for characteristics in ground effect are not listed here contrary to JAR-FSTD (H).

Suggest restoring this list of parameters from JAR FSTD-H, unless there is a specific reason why this list was removed, as follows:
a. Longitudinal, lateral directional and collective control positions
b. Torque required for hover
c. Height
d. Airspeed
e. Pitch Attitude
f. Roll Attitude

response *Accepted*

See response to comment 26 above.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 2 FSTD Validation Tests - 2.4 Information for Validation Tests - 2.4.3 Motion system p. 75-77

comment *81* comment by: *CAE*

The entire section 2.4.3 Motion system

	Section drastically different from JAR FSTD(H). 2.4.3.3 Motion Cueing Performance Signature seems to be incorrectly put in that section. The test section 4.f refers to Motion Cues Repeatability and this section refers to Cueing Performance Signature. Suggest restoring section as per JAR FSTD (H) 2.4.3.3
response	*Accepted* Section *2.4.3 Motion System* of ACJ No.1 to JAR-FSTD H.030 will be reinstated entirely. The text of section 2.4.3 of CS-FSTD (H) is not consistent with the table of objective tests for cabin motion sub-systems. The proposed paragraph 2.4.3.3 introduces a new test method, which comes from the airplane standard. We have to consider that so far airplane and helicopter simulator motion systems are not validated in the same way. Helicopter FFS have to demonstrate more extensive objective testing with a rather demanding level of “robotic” performance. To introduce an additional cueing performance signature would bring an additional burden to helicopter FFS testing. Maybe a more standardised and improved way of testing airplane and helicopter cabin motion systems has to be considered (as the ICAO 9625 is trying to do) but this task is far beyond the scope of this NPA2008-22e.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 2 FSTD Validation Tests - 2.4 Information for Validation Tests - 2.4.4 Visual system	p. 77-78

comment	*97* comment by: *CAE* Motion Vibrations: The text states. “If such filtering is required the notch filter bandwidth should be limited to 1 Hz to ensure that the buffet……”’ Due to the unique motion vibration frequency spectrum of a helicopter simulator (very distinct spikes), a notch filter will not work, because you could actually eliminate one of the dominant spikes. The approach normally used in helicopter simulators is to shift the frequency spectrum away from the structural (visual mylar) resonance frequency; if this is adopted then it might be good to define how much frequency shift is allowed.
response	*Not accepted* The whole text of this current section is to explain that by “engineering judgement” one may consider to put less stress on the secondary frequency characteristics of the simulated buffet, particularly if any part of this frequency spectrum has been filtered to avoid resonance problems with the FSTD structure components. It is obvious that the main vibrating frequencies of the simulated helicopter have to be simulated and the structure of the FSTD has to be designed in order to sustain such vibrating characteristics. We don't see the need to introduce a tolerance for a potential frequency shift. If a secondary or transitional frequency is causing a resonance problem for the FSTD it may be filtered or attenuated providing that the main specific frequencies (1/rev ,

	N/rev) are correctly simulated.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 2 FSTD Validation Tests - 2.4 Information for Validation Tests - 2.4.5 Sound system p. 78-81

comment	*63* comment by: *Irish Aviation Authority* Figure 3, which is referred to in 2.4.5.6 b. appears to be situated in the middle of 2.4.5.9. It should be moved to a more logical position. DCr 270509
response	*Accepted* Figure 3 will be moved closer to section 2.4.5.6 b.

comment	*64* comment by: *Irish Aviation Authority* Table 3 has moved from its logical position above the Table 3 foot note to inside 3 Functions and Subjective Tests. It should be moved back. DCr 270509
response	*Accepted* The logical order will be reestablished.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 3 Functions and Subjective Tests - Table of functions and subjective tests p. 83

comment	*82* comment by: *CAE* b(2) Surface operations Rotor start/engagement and acceleration check was removed Suggest restoring this check as per JAR FSTD(H)
response	*Accepted* The test will be restored.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 3 Functions and Subjective Tests - Table of functions and subjective tests - b. Surface operations p. 83-84

comment	*27* comment by: *UK CAA* **Page No:** 2-C-49

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table of Function and Subjective tests Paragraph b (1)(b)

Comment:
Unnecessary additional requirements have been imposed for Alternate Start procedure subjective tests have been added in paragraph b (1)(b) for FNPTs in the CS.

Justification:
The Function and Subjective test requirements table in JAR-FSTD (H) provides a set of recognised and proven tests that provide the core requirements for CS-FSTD (H) that is accepted by regulators and industry. EASA has stated that the intent is to translate these standards into the regulations and Certification Specifications. Imposition of additional regulatory burden can only be justified on the basis of a consequent recognised improvement in fidelity or training benefit that is not evident in this case. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition.

Proposed Text (if applicable):

Delete the ticks (ü) from the FNPT applicability columns in paragraph b (1)(b) of the function and subjective test table: -*[As per JAR-FSTD (H), page 2-C-87, paragraph No: b (1)(b)]*

response *Accepted*

The checkmarks for FNPT will be deleted.

An alternative engine start procedure may be strongly dependent on the helicopter type being simulated and FNPT are just representing a *class of aeroplane* or (equivalent) a *type of helicopters* (generic model, not a *specific* type). The training performed on these FSTD should not be made representative of any specific aircraft type.

comment *28* comment by: *UK CAA*

Page No:
2-C-49

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table of Function and Subjective tests Paragraph b (2)

Comment:
There is no subjective test identified for rotor start/engagement and acceleration for any of the devices. This is a fundamental and basic expectation in the subjective tests and should be re-instated as per the JAR FSTD requirements.

Justification:
The Function and Subjective test requirements table in JAR-FSTD (H) provides a set of recognised and proven tests that provide the core requirements for CS-FSTD (H) that is accepted by regulators and industry. EASA have stated that the intent is to translate these standards into the regulations and Certification Specifications. Deletion of a fundamental test requirement is

	detrimental to the standards of fidelity and training. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition. **Proposed Text (if applicable):** Amend Paragraph b (2) of the table of function and subjective tests to require rotor start/engagement and acceleration tests by adding ticks (ü) across all FSTD types. [See JAR-FSTD H, page 2-C-87, paragraph No: b (2)(a) and (b)]
response	*Accepted* See response to comment 82

comment	*29* comment by: *UK CAA* **Page No:** 2-C-49/50 **Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table of Function and Subjective tests Paragraph b (3)** **Comment:** There are no subjective tests for ground taxi for FFS A devices in the CS. The current requirement in JAR FSTD H is to 'check for the absence of negative effects' and is considered an appropriate level of test. **Justification:** The Function and Subjective test requirements table in JAR-FSTD (H) provides a set of recognised and proven tests that provide the core requirements for CS-FSTD (H) that is accepted by regulators and industry. EASA have stated that the intent is to translate these standards into the regulations and Certification Specifications. Dilution of such an accepted test requirement is detrimental to the standards of fidelity and training. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition. **Proposed Text (if applicable):** Add an asterisk (*) against FFS Level A for the ground taxi requirements of para.b (3) of the function and subjective test table. *[As per JAR-FSTD (H), page 2-C-88, paragraph No: b (3)]*
response	*Accepted* An asterisk will be added to each ground taxi test for FFS level A according to your proposal.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 3 Functions and Subjective Tests - Table of functions and subjective tests - c. Hover p. 84

comment *30* comment by: *UK CAA*

Page No:
2-C-50

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table of Function and Subjective tests Paragraph c (1)

Comment:
Unnecessary additional requirements for subjective testing of lift-off have been included for FTD levels 2 & 3, and for FNPT Types II, III, and MCC in the CS.

Justification:
The Function and Subjective test requirements table in JAR-FSTD (H) provides a set of recognised and proven tests that provide the core requirements for CS-FSTD (H) that is accepted by regulators and industry. EASA have stated that the intent is to translate these standards into the regulations and Certification Specifications. Imposition of additional regulatory burden can only be justified on the basis of a consequent recognised improvement in fidelity or training benefit that is not evident in this case. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition.

Proposed Text (if applicable):

Delete the ticks from item c (1) of the function and subjective test table for FTD levels 2 & 3, and for FNPT Types II, III, and MCC *[As per JAR-FSTD (H), page 2-C-88, paragraph No: c (1)]*

response *Accepted*

The checkmarks will be removed for FTD and FNPT.

comment *31* comment by: *UK CAA*

Page No:
2-C-50

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table of Function and Subjective tests Paragraph c (6)

Comment:
There is no requirement for subjective testing of Ant-torque effect for FFS Level A or B. This is an accepted test requirement that is valid for such level A and level B devices and should be re-instated.

Justification:
The Function and Subjective test requirements table in JAR-FSTD (H) provides a set of recognised and proven tests that provide the core requirements for CS-FSTD (H) that is accepted by regulators and industry. EASA have stated that the intent is to translate these standards into the regulations and

Certification Specifications. The deletion of valid test requirements from the accepted standard can have an adverse effect on fidelity and training benefit. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition.

Proposed Text (if applicable):

Add an asterix (*) for Level A FFS and a tick (ü) for Level B FFS in paragraph c (6) of the function and Subjective Test Table. *[As per JAR-FSTD (H), page 2-C-88, paragraph No: c (6)]*

response *Accepted*

The asterisk will be added to FFS level A.

comment *32* comment by: *UK CAA*

Page No:
2-C-50

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table of Function and Subjective tests Paragraph c (8)

Comment:
There is no requirement for subjective testing of Crosswind/tailwind hover for FFS Level A or B. This is considered to be a valid test requirement and should be re-instated.

Justification:
The Function and Subjective test requirements table in JAR-FSTD (H) provides a set of recognised and proven tests that provide the core requirements for CS-FSTD (H) that is accepted by regulators and industry. EASA have stated that the intent is to translate these standards into the regulations and Certification Specifications. The deletion of valid test requirements from the accepted standard can have an adverse effect on fidelity and training benefit. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition.

Proposed Text (if applicable):

Add an asterix (*) for Level A FFS and a tick (ü) for Level B FFS in paragraph c (8) of the function and Subjective Test Table. *[As per JAR-FSTD (H), page 2-C-88, paragraph No: c (8)]*

response *Accepted*

An asterisk will be added for FFS level A and a checkmark will be added for FFS level B.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 3 Functions and Subjective Tests - Table of functions and subjective tests - e. Take-off	p. 85

comment	*83* comment by: *CAE* e (1)(a) Take off Tick mark in the MCC column appears in the wrong location; tick mark should be placed in the MCC column at the same line as hover check number e(1)(a)(I)
response	*Accepted* Placement of checkmark will be corrected according to your proposal. It was already misplaced in JAR-FSTD H.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 3 Functions and Subjective Tests - Table of functions and subjective tests - f. Climb	p. 85-86

comment	*33* comment by: *UK CAA* **Page No:** 2-C-52 **Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table of Function and Subjective tests Paragraph f (1)(e)** **Comment:** A new requirement for subjective testing of Climb "Other" has been introduced for almost all devices. There is no information to define what this means as a test and so its value is not clear. Propose deletion. **Justification:** It is not appropriate to add new test requirements that are not clear as to their intent or content. **Proposed Text (if applicable):** Delete sub paragraph f (1) (e) from the table of function and subjective test requirements.
response	*Not accepted* The sub paragraph f (1) (e) will not be deleted because: 1. "other" is not an additional requirement. 2. it should be considered as an information for functions and subjective testing not to limit the evaluation to the given items but to check other functions and features which may be simulated as well and used for training and checking. This applies to all FSTD. 3. the paragraph is consistent with for instance b.(3)(f) and c.(7)(f) (same

as JAR-FSTD H) which have the same intention.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 3 Functions and Subjective Tests - Table of functions and subjective tests - g. Cruise p. 86-87

comment *34* comment by: *UK CAA*

Page No:
2-C-53

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table of Function and Subjective tests Paragraph g (6)(h)

Comment:
Unnecessary additional requirements for subjective testing of f Rotor vibration cues has been included for FTD levels 2 & 3, and for FNPT types II, III, and MCC.

Justification:
The Function and Subjective test requirements table in JAR-FSTD (H) provides a set of recognised and proven tests that provide the core requirements for CS-FSTD (H) that is accepted by regulators and industry. EASA have stated that the intent is to translate these standards into the regulations and Certification Specifications. Imposition of additional regulatory burden can only be justified on the basis of a consequent recognised improvement in fidelity or training benefit that is not evident in this case. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition.

Proposed Text (if applicable):

Delete the ticks (ü) from the FTD and FNPT applicability columns in paragraph g (6)(h) of the function and subjective test table: -*[As per JAR-FSTD (H), page 2-C-91, paragraph No: g (6(h)]*

response *Accepted*

The checkmarks will be removed according to your proposal as there is no requirement for FNPT and FTD to have a motion or vibration system installed to produce such an effect.

comment *35* comment by: *UK CAA*

Page No:
2-C-53

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table of Function and Subjective tests Paragraph g (6)(i)

Comment:
Unnecessary additional requirements for subjective testing of abnormal/emergency Procedures (Other) has been included for FNPT types II,

III, and MCC.

Justification:
The Function and Subjective test requirements table in JAR-FSTD (H) provides a set of recognised and proven tests that provide the core requirements for CS-FSTD (H) that is accepted by regulators and industry. EASA have stated that the intent is to translate these standards into the regulations and Certification Specifications. Imposition of additional regulatory burden can only be justified on the basis of a consequent recognised improvement in fidelity or training benefit that is not evident in this case. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition.

Proposed Text (if applicable):

Delete the ticks (ü) from the FNPT applicability colum(n)s in paragraph g (6)(i) of the function and subjective test table: -*[As per JAR-FSTD H, page 2-C-91, paragraph No: g (6(h)]*

response *Not accepted*

See response to comment 33 above.

1. "other" is not an additional requirement.
2. it should be considered as an information for functions and subjective testing not to limit the evaluation to the given items but to check other functions and features which may be simulated as well and used for training and checking. This applies to all FSTD.
3. the paragraph is consistent with for instance b.(3)(f) and c.(7)(f) (same as JAR-FSTD H) which have the same intention.

comment *44* comment by: *UK CAA*

Page No:
2-C-52

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table of Function and Subjective tests Paragraph g (5)

Comment:
Unnecessary additional requirements for subjective testing of High Airspeed vibration has been included for FTD levels 2 & 3, and for FNPT types II, III, and MCC.

Justification:
The Function and Subjective test requirements table in JAR-FSTD (H) provides a set of recognised and proven tests that provide the core requirements for CS-FSTD (H) that is accepted by regulators and industry. EASA have stated that the intent is to translate these standards into the regulations and Certification Specifications. Imposition of additional regulatory burden can only be justified on the basis of a consequent recognised improvement in fidelity or training benefit that is not evident in this case. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition.

	Proposed Text (if applicable): Delete the ticks (ü) from the FTD and FNPT applicability columns in paragraph g (5) of the function and subjective test table: -*[As per JAR-FSTD (H), page 2-C-91, paragraph No: g (5)]*
response	*Accepted* The checkmarks will be removed according to your proposal.

comment	*84* comment by: *CAE* g(4) Cruise Not clear why accelerations / decelerations tick marks not present in the FTD and FNPT columns of the function & subjective tables. CAE recommends consideration for FTD 2, 3 and FNPT II, III, MCC as well since these devices have programming level to demonstrate this capability.
response	*Noted* Accelerations and decelerations will be subjectively tested anyway. Since this is a change with respect to JAR-FSTD H the (new) requirement could be added as a future amendment of this document.

comment	*85* comment by: *CAE* g(5) Cruise High speed vibrations cues are shown applicable on FSTDs without motion/vibrations systems installed; applies only to FFS
response	*Accepted* See response to comment 44 above.

comment	*86* comment by: *CAE* g(5)(h) Cruise Rotor vibrations cues are shown applicable on FSTDs without motion/vibrations systems installed; applies only to FFS
response	*Accepted* See response to comment 34 above.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 3 Functions and Subjective Tests - Table of functions and subjective tests - i. Visual approaches	p. 87-88

comment	*36* comment by: *UK CAA* **Page No:** 2-C-54 **Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300**

	Table of Function and Subjective tests Paragraph i (1)(b)(vii) **Comment:** Unnecessary additional requirements for subjective testing of the visual approaches for Abnormal Procedures (Other) has been included for FNPT types II, III, and MCC. **Justification:** The Function and Subjective test requirements table in JAR-FSTD (H) provides a set of recognised and proven tests that provide the core requirements for CS-FSTD (H) that is accepted by regulators and industry. EASA have stated that the intent is to translate these standards into the regulations and Certification Specifications. Imposition of additional regulatory burden can only be justified on the basis of a consequent recognised improvement in fidelity or training benefit that is not evident in this case. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition. **Proposed Text (if applicable):** Delete the ticks (ü) from the FNPT applicability columns in paragraph I (1)(b)(vii) of the function and subjective test table: -*[As per JAR-FSTD (H), page 2-C-91, paragraph No: I (1)(b)(vii)]*
response	*Not accepted* See response to comments 33 and 35 above. 1. "other" is not an additional requirement. 2. it should be considered as an information for functions and subjective testing not to limit the evaluation to the given items but to check other functions and features which may be simulated as well and used for training and checking. This applies to all FSTD. 3. the paragraph is consistent with for instance b.(3)(f) and c.(7)(f) (same as JAR-FSTD H) which have the same intention.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 3 Functions and Subjective Tests - Table of functions and subjective tests - j. Instrument approaches	p. 88-89

comment	*87* comment by: *CAE* i(1)c(II) Cruise Balked landing for one engine or more inop is missing a tick mark in the FNPT II column which seems to have been an unintentional error as this tick mark appears in JAR FSTD (H) equivalent check. Recommend adding tick mark.
response	*Accepted* The checkmark will be added for FNPT II.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS	p. 89-90

FSTD(H).300 Qualification basis - 3 Functions and Subjective Tests - Table of functions and subjective tests - k. Approach to landing and touchdown

comment | *37* | comment by: *UK CAA*

Page No:
2-C-56

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table of Function and Subjective tests Paragraph k (1)(c)

Comment:
All the requirements in this section for FFS Level A have been identified as a ‘check for the absence of negative effects’ This appears to lower the standard of test for these devices compared to JAR-FSTD H which requires a normal subjective evaluation. A normal subjective evaluation is considered appropriate in this case.

Justification:
The Function and Subjective test requirements table in JAR-FSTD (H) provides a set of recognised and proven tests that provide the core requirements for CS-FSTD (H) that is accepted by regulators and industry. EASA have stated that the intent is to translate these standards into the regulations and Certification Specifications. Dilution of the accepted test requirement is detrimental to the standards of fidelity and training. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition.

Proposed Text (if applicable):

Change all the exiting asterisks (*) to ticks (ü) for all the elements of paragraph k (1)(c) of the functional and subjective tests table relating to FFS Level A. *[As per JAR-FSTD (H), page 2-C-95, paragraph No: k (1)(c)]*

response | *Partially accepted*

The asterisks will be replaced by checkmarks except for k (1)(c)(vi) (with respect to the requirement in JAR-FSTD H).

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 3 Functions and Subjective Tests - Table of functions and subjective tests - m. Engine shutdown and parking p. 92

comment | *38* | comment by: *UK CAA*

Page No:
2-C-58

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table of Function and Subjective tests Paragraph m (1)

Comment:
There is no requirement for subjective testing of Engine Shutdown and Parking for FNPT 1, which is considered a valid test requirement. JAR FSTD H includes

this requirement.

Justification:
The Function and Subjective test requirements table in JAR-FSTD (H) provides a set of recognised and proven tests that provide the core requirements for CS-FSTD (H) that is accepted by regulators and industry. EASA have stated that the intent is to translate these standards into the regulations and Certification Specifications. The deletion of valid test requirements from the accepted standard can have an adverse effect on fidelity and training benefit. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition.

Proposed Text (if applicable):

Add a tick (ü) to the FNPT I column for paragraph m1 of the function and subjective test table. *[As per JAR-FSTD (H), page 2-C-99, paragraph No: m (1)]*

response *Accepted*

A checkmark will be added to the FNPT I column for paragraph m(1).

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 3 Functions and Subjective Tests - Table of functions and subjective tests - o. Sound system p. 93

comment *39* comment by: *UK CAA*

Page No:
2-C-59

Paragraph No: BOOK 2 SUBPART C: AMC No 1 to CS-FSTD (H). 300 Table of Function and Subjective tests Paragraph o (2)

Comment:
The requirement for subjective testing of a crash sound has been removed for FNPT 1 but added for FNPT MCC. This appears to change the standards for FNPTs compared to JAR-FSTD H. For any device that can simulate landings, the crash sound is required, and therefore a subjective test (as previously required by JAR FSTD (H) is considered appropriate. The additional requirement for MCC would not require a crash sound, because the basic device will already have that function. This is reflected in the current JAR FSTD H.

Justification:
The Function and Subjective test requirements table in JAR-FSTD (H) provides a set of recognised and proven tests that provide the core requirements for CS-FSTD (H) that is accepted by regulators and industry. EASA have stated that the intent is to translate these standards into the regulations and Certification Specifications. The deletion of valid test requirements from the accepted standard can have an adverse effect on fidelity and training benefit. Additionally, consistent and accurate translation of existing JAR standards into the CS specifications is essential for an effective transition.

Proposed Text (if applicable):

	As per JAR-FSTD H, page 2-C-100, paragraph No: o (2)
response	*Accepted* The checkmark will be deleted for MCC, as it is already required for the basic device, and will be reinstated for FNPT I.

comment	*88* comment by: *CAE* q. 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, also 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* Whereas JAR-FSTD A and CS-FSTD(A) are talking about a “minimum of three *specific* airport scenes” JAR-FSTD H and CS-FSTD(H) require “at least three different heliport scenes”. But visual databases will be required to be current for certain approved training programmes.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - 3 Functions and Subjective Tests - Table of functions and subjective tests - Notes p. 97

comment	*65* comment by: *Irish Aviation Authority* These notes are a repeat to the notes at the top of this table and should be removed. DCr 270509
response	*Accepted* The notes will be removed at the top of the table.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - Appendix 3 to AMC No.1 to CS FSTD(H).300 Rotor Aerodynamic Modelling Techniques p. 102-103

comment	*66* comment by: *Irish Aviation Authority* Figure 2 - rotor map models - is usually produced in colour. Will this be done in the final version? DCr 270509
response	*Noted*

The printed version of the document will be black and white only.

comment | *67* | comment by: *Irish Aviation Authority*

The reproduction of figure 3 is very poor. It should be enhanced.

DCr 270509

response | *Noted*

We hope that the quality is better in the final version.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 1 to CS FSTD(H).300 Qualification basis - Appendix 9 to AMC No.1 to CS FSTD(H).300 General technical requirements for FSTD Qualification Levels - Table 1 – General technical requirements for Level A, B, C and D FFS p. 114

comment | *48* | comment by: *FlightSafety International*

Comment

The requirements for a Level D FSTD state: "...and there shall be complete fidelity of sounds and motion buffets.

Proposal
Change the requirement to read "and 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 FlightSafety
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*

The text will be changed to:

There shall be complete fidelity of sounds and motion buffets validated through objective tests.

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 3 to CS FSTD(H).300 Guidance on Design and Qualification of Helicopter FTDs p. 120-122

comment | *45* | comment by: *UK CAA*

Page No:
2-C-86

Paragraph No: BOOK 2 SUBPART C AMC No 3 to CS-FSTD (H). 300

Para 2

Comment:
An incorrect reference to JAR-FSTD H remains in the text.

Justification:
The correct reference should be CS-FSTD (H)

Proposed Text (if applicable):
Proposed change is ***bold italic and underlined.***

There are three sets of FTD design standards specified within **CS-FSTD (H),** FTD Levels 1, 2 and 3, the most demanding being those for FTD Level 3.

response *Accepted*

The reference will be corrected to 'CS-FSTD(H)'

B. Draft Rules - VI. Draft Decision CS-FSTD(H) - Book 2 - Subpart C: Helicopter Flight Simulation Training Devices - AMC No. 5 to CS FSTD(H).300 Guidance on Design and Qualification of Helicopter FNPTs p. 124-128

comment *40* comment by: *UK CAA*

Page No:
2-C-90

Paragraph No: BOOK 2 SUBPART C AMC No 5 to CS-FSTD (H). 300, paragraph 2

Comment:
An incorrect reference to JAR-FSTD (H) remains in the text, and it describes five design standards for FNPTs, whereas all the tabulated standards and regulations have only four columns for four standards.

Justification:
The correct reference should be CS-FSTD (H)

Proposed Text (if applicable):
Proposed change is ***bold italic and underlined.***

There are **four** sets of design standards specified within ***CS-FSTD (H)***, FNPT I, II, III and MCC.

response *Partially accepted*

The reference will be corrected to 'CS-FSTD(H)'

We do not agree with the second part of your proposed change regarding the number of type of FNPT. The standard defines three levels of "single" FNPT (explicitly I, II and III) and two levels of FNPT with an MCC training capability (explicitly FNPT II MCC and FNPT III MCC). The presentation of the 4th column is explained by the fact that only FNPT II and FNPT III are able to be "enhanced" to have MCC capability taking into account the additional requirements listed in Appendix 1 to CS-FSTD(H).300.

comment	*41* comment by: *UK CAA* **Page No:** 2-C-92 **Paragraph No: BOOK 2 SUBPART C AMC No 5 to CS-FSTD (H). 300, paragraph 4** **Comment:** The subparagraphs 4.1, 4.2, 4.3 appear to have been omitted compared to JAR-FSTD (H) **Justification:** These subparagraphs provide valuable extra clarification, although it is noted that the word 'buffet' should be replaced by 'vibration'. **Proposed Text (if applicable):** Add the following paragraphs (from JAR FSTD (H)) to AMC No 5 to CS-FSTD (H). 300, paragraph 4 (wording changes are ***<u>bold/italic and underlined</u>***): 4.1 For Level A flight simulators, the requirements for both the primary cueing and ***<u>vibration</u>*** 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 flight simulator, it is felt appropriate that the simulator manufacturer should be allowed to decide on the complexity of the motion system. However, during the evaluation, the motion system will be assessed subjectively to ensure that it is supporting the piloting task, including engine failures, and is in no way providing negative cueing. 4.2 ***<u>Vibration</u>*** simulation is important to add realism to the overall simulation; for Level A, the effects can be simple but they should be appropriate, in harmony with the sound cues and in no way providing negative training. 4.3 The motion system transport delay should meet the standards prescribed for the visual and flight instruments.
response	*Partially accepted* The paragraphs you mention in your comment will be reinstated to be consistent with AMC No. 2 to CS-FSTD(H).300 (FFS level A) and AMC No. 3 to CS-FSTD(H).300 (FTD). Regarding the change from buffet to vibration: if it is done here it has also to be done in the entire table of subjective test. The definition of buffet vs. vibration for helicopter is covered in AMC to CS-FSTD(H).200 and both terms may be used even if a slight difference exists.

comment	*42* comment by: *UK CAA* **Page No:** 2-C-94 **Paragraph No: BOOK 2 SUBPART C AMC No 5 to CS-FSTD (H). 300,** **Comment:**

	A detailed flowchart depicting guidance on design and qualification was presented on the page after paragraph 6 of ACJ No.5 to JAR-FSTD (H).030 (pages 2-C-138 to 140), which provided a valuable overview of the design, certification and qualification process. It would add considerably in respect of providing context in the CS Specification. **Justification:** The flowchart provides a useful and comprehensive quick reference and guide to the processes. **Proposed Text (if applicable):** Introduce the flowchart as per JAR-FSTD (H), page 2-C-138/140 at the end of AMC No 5 to CS-FSTD (H). 300, or some other suitable location.
response	*Not accepted* The content of the flowchart in JAR-FSTD H refers now to and is contained in Part-AR, Part-OR and CS-FSTD(H) and is from its principle structure not only applicable to FNPTs. FSTD operators may develop flowcharts within their compliance monitoring programme (processes) if necessary.

Appendix A — Resulting text to Draft Opinion for Implementing Rule

SUBPART A - APPLICABILITY

CS-~~-~~FSTD(H).001 Applicability

(a) CS-FSTD(H) as amended applies to~~—~~ approved training organisations operating a **f**~~F~~light **s**~~S~~imulation **t**~~T~~raining **d**~~D~~evice~~s~~ (FSTD) seeking initial qualification of FSTDs.

(b) The version of the CS-FSTD(H) 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(H).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(H). Further terms and abbreviations are contained in AMC**1-**~~ to ~~CS**-**~~-~~FSTD(H).200.

(a) ~~Flight Simulation Training Device (FSTD). A training device which is a Full Flight Simulator (FFS), a Flight Training Device (FTD), a Flight & Navigation Procedures Trainer (FNPT)~~ **'Flight simulation training device (FSTD)'** ***means*** **a training device which is:**

In the case of aeroplanes, a full flight simulator (FFS), a flight training device (FTD), a flight navigation procedures trainer (FNPT), or a basic instrument training device (BITD)

In the case of helicopters, a full flight simulator (FFS), a flight training device (FTD) or a flight navigation procedures trainer (FNPT).

(b) **'Full flight simulator (FFS)' means a full size replica of a specific type or make, model and series aircraft flight deck/cockpit, including the assemblage of all equipment and computer programmes necessary to represent the aircraft 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 qualification.**~~*Full Flight Simulator (FFS)*. A full size replica of a specific type or make, model and series helicopter flight deck, including the assemblage of all equipment and computer programmes necessary to represent the helicopter in ground and flight operations, a visual system providing an out of the flight deck view, and a force cueing motion system. It is in compliance with the minimum standards for FFS Qualification.~~

(c) **'Flight training device (FTD)' means a full size replica of a specific aircraft type's instruments, equipment, panels and controls in an open flight deck/cockpit area or an enclosed aircraft flight deck/cockpit, including the assemblage of equipment and computer software programmes necessary to represent the 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 level of qualification.**~~*Flight Training Device (FTD)*. A full size replica of a specific helicopter type's instruments, equipment, panels and controls in an open flight deck area or an enclosed helicopter flight deck, including the assemblage of equipment and computer software programmes necessary to represent the helicopter 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 Level of Qualification.~~

(d) **'Flight and navigation procedures trainer (FNPT)' means a training device which represents the flight deck/cockpit environment including the assemblage of equipment and computer programmes necessary to represent an aircraft or class/type of aircraft in flight operations to the extent that the systems appear to function as in an aircraft. It is in compliance with the minimum standards for a specific FNPT level of qualification.** ~~*Flight and Navigation Procedures Trainer* ***(FNPT).*** A training device which represents the flight deck or cockpit environment including the assemblage of equipment and computer programmes necessary to represent a helicopter in flight operations to the extent that the systems appear to function as in a helicopter. It is in compliance with the minimum standards for a specific FNPT Level of Qualification.~~

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

~~(f) *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 helicopter FSTD differences and the operating and training ability of the organisation.~~

(**f**~~g~~) **'Flight simulation training device user (FSTD user)' means the organisation or person requesting training, checking or testing through the use of an FSTD.**~~*Flight Simulation Training Device User (FSTD User).* The person, organisation or enterprise requesting training, checking and testing credits through the use of an FSTD~~.

(**g**~~h~~) **'Flight simulation training device qualification (FSTD qualification)' means the level of technical ability of an FSTD as defined in the compliance document.**~~*Flight Simulation Training Device Qualification (FSTD Qualification).* The level of technical ability of an FSTD as defined in the compliance document.~~

(**h**~~i~~) ~~*Qualification Test Guide (QTG).* A document designed to demonstrate that the performance and handling qualities of an FSTD agree within prescribed limits with those of the helicopter and that all applicable regulatory requirements have been met. The QTG includes both the helicopter and FSTD data used to support the validation.~~ **'Qualification test guide (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.**

SUBPART C – HELICOPTER FLIGHT SIMULATION TRAINING DEVICES

CS-‑FSTD(H).300 Qualification basis

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

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

(c) The FSTD shall be subjected to:

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

APPENDICES

Appendix 1 to CS--FSTD(H).300 Flight Simulation Training Device Standards ~~General~~

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) and **f**~~F~~light **n**~~N~~avigation **p**~~P~~rocedures **t**~~T~~rainer (FNPT) requirements for qualifying devices to the required **q**~~Q~~ualification **l**~~L~~evels. Certain requirements included in this ~~book~~ **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 requirements 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 l**~~L~~evel II or III, with the following additions or amendments:

1	Multi--engine and multi--pilot helicopter
2	Performance reserves, in case of an engine failure, to be in accordance with C**ategory**~~AT.~~ A criteria~~.~~
3	Anti--icing or de-icing systems
4	Fire detection / suppression system
5	Dual controls
6	Autopilot with upper modes
7	2 VHF transceivers
8	2 VHF NAV receivers (VOR, ILS, DME)
9	1 ADF receiver
10	1 Marker receiver
11	1 transponder
12	Weather radar

The following indicators shall be located in the same positions on the instrument panels of both pilots:

1	Airspeed
2	Flight attitude
3	Altimeter and radio altimeter
4	HSI
5	Vertical speed
6	ADF
7	VOR, ILS, DME
8	Marker indication
9	Stop watch

~~FSTD~~ **FLIGHT SIMULATION TRAINING DEVICE STANDARDS**		**FFS LEVEL**				**FTD LEVEL**			**FNPT LEVEL**				**COMPLIANCE**
		A	**B**	**C**	**D**	**1**	**2**	**3**	**I**	**II**	**III**	**MCC**	
	1.1 General												
a.1	A ~~flight deck~~**cockpit** that is a full-scale replica of the helicopter simulated. Additional required crew member duty stations and those required bulkheads aft of the pilot seats are also considered part of the cockpit and shall replicate the helicopter.	✓	✓	✓	✓		✓	✓					
	A ~~flight deck~~**cockpit** that replicates the helicopter.					✓			✓	✓	✓	✓	
a.2	The ~~flight deck~~**cockpit**, including the instructor's station is fully enclosed.	✓	✓	✓	✓								
	A ~~flight deck~~**cockpit**, including the instructor's station that is sufficiently closed off to exclude distractions.					✓	✓	✓	✓	✓	✓	✓	
b.1	Full size panels with functional controls, switches, instruments and primary and secondary flight controls, which shall be operating in the correct direction and with the correct range of movement.	✓	✓	✓	✓	✓	✓	✓					For FTD **l**~~L~~evel 1 as appropriate for the replicated system The use of electronically displayed images with physical overlay **or masking for FSTD instruments and/or instrument panels** incorporating **instrument controls and**~~operable~~ switches ~~**which**~~**that replicate those of the helicopter and operate with the same technique, effort, travel and in the same direction**~~, knobs and buttons~~ may be acceptable. ~~This option is not acceptable for analogue instruments in FFS.~~
	Functional controls, switches, instruments and primary and secondary flight controls sufficient for the training events to be accomplished, shall be located in a spatially correct area of the ~~flight deck~~**cockpit**.								✓	✓	✓	✓	~~The use of electronically displayed images with physical overlay incorporating operable switches, knobs and buttons is acceptable.~~**FSTD instruments and/or instrument panels using electronically displayed images with physical overlay or masking and operable controls representative of those in the type of**

~~FSTD~~ **FLIGHT SIMULATION TRAINING DEVICE STANDARDS**		**FFS LEVEL**				**FTD LEVEL**			**FNPT LEVEL**				**COMPLIANCE**
		A	**B**	**C**	**D**	**1**	**2**	**3**	**I**	**II**	**III**	**MCC**	
													helicopter are acceptable. The instruments displayed should be free of quantisation (stepping)
c.1	Lighting for panels and instruments shall be as per the helicopter.	✓	✓	✓	✓		✓	✓					
	Lighting for panels and instruments shall be sufficient for the training events					✓			✓	✓	✓	✓	
c.2	~~Flight deck~~**Cockpit** ambient lighting environment shall be dynamically consistent with the visual display and sufficient for the training event.			✓	✓								
	The ambient lighting should provide an even level of illumination which is not distracting to the pilot.	✓	✓				✓	✓		✓	✓	✓	
d.1	Relevant ~~flight deck~~**cockpit** circuit breakers shall be located as per the helicopter and shall function accurately when involved in operating procedures or malfunctions requiring or involving flight crew response.	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	
e.1	Effect of aerodynamic changes for various combinations of airspeed and power normally encountered in flight, including the effect of change in helicopter attitude, aerodynamic and propulsive forces and moments, altitude, temperature, mass, centre of gravity location and configuration.	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	Effects of C_g, mass and configuration changes are not required for FNPT ~~I~~Level I.
	Aerodynamic and environment modelling shall be sufficient to permit accurate systems operation and indication.					✓							
e.2	Aerodynamic modelling which includes ground effect, effects of airframe and rotor icing (if applicable), aerodynamic interference effects between the rotor wake and fuselage, influence of the rotor on control and stabili**s**~~z~~ation systems, and representations of nonlinearities due to			✓	✓		✓	✓		✓	✓	✓	

~~FSTD~~ **FLIGHT SIMULATION TRAINING DEVICE STANDARDS**		**FFS LEVEL**				**FTD LEVEL**			**FNPT LEVEL**				**COMPLIANCE**
		A	**B**	**C**	**D**	**1**	**2**	**3**	**I**	**II**	**III**	**MCC**	
	sideslip, vortex ring and retreating blade stall.												
f.1	Validation flight test data shall be used as the basis for flight and performance and systems characteristics.		✓	✓	✓			✓					
	Representative/generic aerodynamic data tailored to the helicopter with fidelity sufficient to meet the objective tests and sufficient to permit accurate system operation and indication.	✓				✓	✓		✓	✓	✓	✓	Aerodynamic data need not be necessarily based on flight test data.
g.1	All relevant ~~flight deck~~**cockpit** instrument indications automatically respond to control movement by a crew member, helicopter performance, or external simulated environmental effects upon the helicopter	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
h.1	All relevant communications, navigation, caution and warning equipment shall correspond to that installed in the helicopter. All simulated navigation aids within range shall be usable without restriction. Navigational data shall be capable of being updated.	✓	✓	✓	✓	✓	✓	✓					For FTD 1 applies where the appropriate systems are replicated.
h.2	Navigation equipment corresponding to that of a helicopter, with operation within the tolerances typically applied to the airborne equipment. This shall include communication equipment (interphone and air/ground communications systems).								✓	✓	✓	✓	
h.3	Navigational data with the corresponding approach facilities. Navigation aids should be usable within range without restriction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	For FFSs and FTDs the navigation database should be updated within 28 days. For FNPTs 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.

~~FSTD~~ FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
		A	B	C	D	1	2	3	I	II	III	MCC	
i.1	In addition to the flight crew member stations, at least two suitable seats for the instructor and an additional observer shall be provided permitting adequate vision to the crew members' panel and forward windows. Observer **and instructor** seats need not represent those found in the helicopter but shall be adequately secured to the floor of the ~~flight simulator~~**FFS**, fitted with positive restraint devices and be of sufficient integrity to safely restrain the occupant during any known or predicted motion system excursion.	✓	✓	✓	✓								The ~~Authority~~**competent authority** ~~will~~ **shall** consider options to this standard based on unique cockpit configurations. Any additional seats installed shall be equipped with similar safety provisions.
i.2	Crew member seats shall afford the capability for the occupants to be able to achieve the design eye reference position. In addition to the flight crew member stations, at least two suitable seats for the instructor and an additional observer shall be provided permitting adequate vision to the crew members' panel and forward windows.					✓	✓	✓	✓	✓	✓	✓	The instructor's and observer's seats need not represent those found in the helicopter.
j.1	FFS systems shall simulate the applicable helicopter system operation, both on the ground and in flight. Systems shall be operative to the extent that normal, abnormal, and emergency operating procedures appropriate to the simulator application can be accomplished. Once activated, proper system operation shall result from system management by the flight crew and not require input from instructor controls.	✓	✓	✓	✓								
j.2	FTD systems represented shall be fully operative to the extent that normal, abnormal and emergency operating procedures can be accomplished. Once activated, proper system operation shall result from system management by the flight crew and not require input from instructor controls.					✓	✓	✓					
j.3	The systems should be operative to the extent that it should be possible to perform normal, abnormal,								✓	✓	✓	✓	

~~FSTD~~ FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
		A	B	C	D	1	2	3	I	II	III	MCC	
	and emergency operations appropriate to a helicopter as required for training. Once activated, proper systems operations should result from the system management by the crew member and not require any further input from the instructor's controls.												
k.1	The instructor shall be able to control system variables and insert abnormal or emergency conditions into the helicopter systems. Independent freeze and reset facilities shall be provided.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	FNPT I: applicable only to enable the instructor to carry out selective failure of basic flight instruments and navigation equipment. For FNPT ~~Level~~**level** I: **a**~~A~~bility to set the FNPT to minimum IMC speed or above
l.1	Control forces and control travel which correspond to that of the replicated helicopter. Control forces shall react in the same manner as in the helicopter under the same flight conditions.	✓	✓	✓	✓								For ~~Level~~ **level** A only static control force characteristics need to be tested.
	Control forces and control travel shall be representative of the replicated helicopter under the same flight conditions as in the helicopter.~~.~~					✓	✓	✓					For FTD level 1 as appropriate for the system training required
	Control forces and control travel shall broadly correspond to that of a helicopter.								✓				Only static control force characteristics need to be tested.
	Control forces and control travels shall respond in the same manner under the same flight conditions as in a helicopter.									✓	✓	✓	Only static control force characteristics need to be tested.
l.2	Cockpit control dynamics, which replicate the helicopter simulated. Free response of the controls shall match that of the helicopter within the given tolerance. Initial and upgrade evaluation ~~will~~ **shall** include control free response (cyclic, collective, and pedal) measurements recorded at the controls. The measured responses shall correspond to those of the helicopter in ground operations, hover, climb, cruise, and auto-rotation.		✓	✓	✓		✓	✓					For helicopters with irreversible control systems, measurements may be obtained on the ground. Engineering validation or helicopter manufacturer rationale ~~will~~ **shall** be submitted as justification for ground test or to omit a configuration. For FFS requiring static and dynamic tests at the controls, special test fixtures ~~will~~ **shall** not be required during the initial evaluations if the FSTD operator's QTG shows both test fixture results and alternate test method results, such as computer

~~FSTD~~ FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
		A	B	C	D	1	2	3	I	II	III	MCC	
													data plots, which were obtained concurrently. Use of the alternate method during initial evaluation may then satisfy this test requirement. FTD **l**~~L~~evel 2 **aerodynamic** data can be representative/generic and need not necessarily be based on flight test data.
m.1	Ground handling and aerodynamic programming to include the following: Ground effect - hover and transition IGE. (Ground reaction - reaction of the helicopter upon contact with the landing surface during landing to include strut deflections, tire or skid friction, side forces, and other appropriate data, such as weight and speed, necessary to identify the flight condition and configuration. Ground handling characteristics -~~-~~ control inputs to include braking, deceleration turning radius and the effects of crosswind.	✓	✓	✓	✓								Level A can utilise generic simulation of ground effect and ground handling.
	Ground handling and aerodynamic ground effects models should be provided to enable lift-off, hover, and touch down effects to be simulated and harmoni**s**~~z~~ed with the sound and visual system.						✓	✓					
	Generic ground handling and aerodynamic ground effects models should be provided to enable lift-off, hover, and touch down effects to be simulated and harmoni**s**~~z~~ed with the sound and visual system.									✓	✓	✓	
n.1	Instructor controls for**:**												
	(i) -**w**~~W~~ind speed and direction	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	
	(ii) -**t**~~T~~urbulence	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	
	(iii) -**o**~~O~~ther atmospheric models to support the required training~~.~~				✓			✓			✓	✓	Examples: **g**~~G~~eneric atmospheric models of local wind patterns around mountains and structures~~.~~

~~FSTD~~ FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
		A	B	C	D	1	2	3	I	II	III	MCC	
	(iv) **a**~~A~~djustment of cloud base and visibility~~.~~	✓	✓	✓	✓		✓	✓		✓	✓	✓	
	(v) **t**~~T~~emperature and barometric pressure.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
o.1	Representative stopping and directional control forces for at least the following landing surface conditions based on helicopter related data, for a running landing**:**~~.~~ (i) **d**~~D~~ry (ii) **w**~~W~~et (soft surface and hard surface) (iii) **i**~~I~~cy (iv) **p**~~P~~atchy **w**~~W~~et (v) **p**~~P~~atchy **i**~~I~~cy			✓	✓								
p.1	Representative brake and tire failure dynamics.			✓	✓								
~~q.1~~	~~Cockpit control dynamics, which replicate the helicopter simulated. Free response of the controls shall match that of the helicopter within the given tolerance. Initial and upgrade evaluation will include control free response (cyclic, collective, and pedal) measurements recorded at the controls. The measured responses shall correspond to those of the helicopter in ground operations, hover, climb, cruise, and auto-rotation.~~		~~✓~~	~~✓~~	~~✓~~		~~✓~~	~~✓~~		~~✓~~	~~✓~~	~~✓~~	~~For helicopters with irreversible control systems, measurements may be obtained on the ground. Engineering validation or helicopter manufacturer rationale will be submitted as justification for ground test or to omit a configuration.~~ ~~For FFS requiring static and dynamic tests at the controls, special test fixtures will not be required during the initial evaluations if the FSTD perator's QTG shows both test fixture results and alternate test method results, such as computer data plots, which were obtained concurrently. Use of the alternate method during initial evaluation may then satisfy this test requirement. FTD Level 2 aerodynamic data can be representative/generic and need not necessarily be based on flight test data.~~
q~~r~~.1	(1) Transport delay. Transport delay is the time between control input and the individual hardware (systems) responses.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	For FTD ~~L~~**l**evel 1, only instrument response is required within a maximum permissible delay of 200 ~~milliseconds (~~**ms**~~)~~**.**

	~~FSTD~~ FLIGHT SIMULATION TRAINING DEVICE STANDARDS	FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
		A	B	C	D	1	2	3	I	II	III	MCC	
	As an alternative, a **l**~~L~~atency test may be used to demonstrate that the ~~flight simulator~~**FSTD** system does not exceed the permissible delay.												For **l**~~L~~evel 'A' & 'B' FFS and **l**~~L~~evel 2 FTD the maximum permissible delay is 150 ~~milliseconds~~**ms.** For **l**~~L~~evel 'C' & 'D' FFS and **l**~~L~~evel 3 FTD the maximum permissible delay is 100 ~~milliseconds~~**ms.**
	(2) Latency. Relative response of the visual system, cockpit instruments and initial motion system response shall be coupled closely to provide integrated sensory cues. These systems shall respond to abrupt pitch, roll, and yaw inputs at the pilot's position within the permissible delay, but not before the time, when the helicopter would respond under the same conditions. Visual scene changes from steady state disturbance shall occur within the system dynamic response limit but not before the resultant motion onset.	✓	✓	✓	✓	✓	✓	✓					For FTD **l**~~L~~evel 1 and FNPT **l**~~L~~evel I, only instrument response is required within a maximum permissible delay of 200 ~~milliseconds~~**ms.** For **l**~~L~~evel 'A' & 'B' FFS, **l**~~L~~evel 2 FTD and FNPT **l**~~L~~evel II and III the maximum permissible delay is 150 ~~milliseconds~~**ms** For **l**~~L~~evel 'C' & 'D' FFS and **l**~~L~~evel 3 FTD the maximum permissible delay is 100 ~~milliseconds~~**ms.** **(see Appendix 5 to AMC1-CS-FSTD(H).300)**
r~~s~~.1	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.	✓	✓				✓				✓	✓	Recommended for FTD Level 1, FNPT **l**~~L~~evel I and II**.** Automatic flagging of "out-of-tolerance" tests results is encouraged.
	Self-testing 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 helicopter standard			✓	✓			✓					
s~~t~~.1	A system allowing for timely continuous updating of FSTD hardware and programming consistent with helicopter modifications.	✓	✓	✓	✓	✓	✓	✓					
t~~u~~.1	The FSTD operator shall submit a ~~Qualification Test Guide~~**QTG** in a form and manner acceptable to the ~~Authority~~**competent authority**. A recording system	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

~~FSTD~~ **FLIGHT SIMULATION TRAINING DEVICE STANDARDS**		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
		A	B	C	D	1	2	3	I	II	III	MCC	
	shall be provided that will enable the FSTD performance to be compared with QTG criteria.												
u~~v~~.1	FSTD computer capacity, accuracy, resolution and dynamic response sufficient for the **q**~~Q~~ualification **l**~~L~~evel sought.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
v~~w~~.1	Daily pre-flight documentation either in the daily log or in a location easily accessible for review.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	1.2 Motion System												
a.1	Motion cues as perceived by the pilot shall be representative of the helicopter, e.g. touch down cues should be a function of the simulated rate of descent.	✓	✓	✓	✓								Motion tests to demonstrate that each axes onset cues are properly phased with pilot input and helicopter response.
b.1	A motion system: Having a minimum of 3 degrees of freedom (pitch, roll, heave) to accomplish the required task. 6 degrees of freedom synergistic platform motion system	✓ (3 degrees)	✓ (6 degrees)	✓ (6 degrees)	✓ (6 degrees)								~~The instructor's and observer's seats need not represent those found in the helicopter.~~ For level B, a reduced motion performance envelope is acceptable.
c.1	A means of recording the motion response time as required	✓	✓	✓	✓								See para 1.1 (r.1) above.
d.1	Special effects programming to include the following: (1) **r**~~R~~unway rumble, oleo deflections, effects of groundspeed and uneven surface characteristics**;**~~.~~ (2) **b**~~B~~uffet due to translational lift**;**~~.~~ (3) **b**~~B~~uffet during extension and retraction of landing gear**;**~~.~~ (4) **b**~~B~~uffet due to high speed and retreating	✓	✓	✓	✓								For level A it may be of a generic nature sufficient to accomplish the required tasks. See Appendix 4 to AMC ~~No.~~ 1**-** ~~to~~ CS**-**FSTD(H).300 para 2.2 on **v**~~V~~ibration **p**~~P~~latforms for **h**~~H~~elicopter FSTDs.

~~FSTD~~ FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
		A	B	C	D	1	2	3	I	II	III	MCC	
	blade stall**;**~~.~~ (5) **b**~~B~~uffet due to vortex ring**;**~~.~~ (6) **r**~~R~~epresentative cues resulting from**:**~~;~~ (i) touch down (ii) translational lift**;**~~.~~ (7) **a**~~A~~ntitorque device ineffectiveness**;**~~.~~ (8) **b**~~B~~uffet due to turbulence.												
e.1	Characteristic vibrations/buffets that result from operation of the helicopter and which can be sensed in the cockpit. Simulated cockpit vibrations to include seat(s), flight controls and instrument panel(s), although these need not be tested independently.				✓								Statement of **c**~~C~~ompliance required. ~~-~~Tests required with recorded results which allow the comparison of relative amplitudes versus frequency in the longitudinal, lateral and vertical axes with helicopter data.~~.~~ Steady state tests are acceptable. See Appendix 4 to AMC~~ No.~~ 1**-**~~ to ~~CS**-**FSTD(H).300 para 2.2 on **v**~~V~~ibration **p**~~P~~latforms for **h**~~H~~elicopter FSTDs.
	1.3 Visual System												
a.1	Visual system capable of meeting all the standards of this paragraph and the respective paragraphs of validation tests as well as functions and subjective tests as applicable to the **l**~~L~~evel of **q**~~Q~~ualification requested by the FSTD operator.	✓	✓	✓	✓		✓	✓		✓	✓	✓	The choice of the display system and of the field of view requirements should fully consider the intended use of the FSTD. The balance between training and testing/checking may influence the choice and geometry of the display system. In addition the diverse operational requirements should be addressed.
b.1	Visual system capable of providing at least a 45 degree horizontal and 30 degree vertical field of view simultaneously for each pilot.	✓											
	Visual system capable of providing at least a 75 degrees horizontal and 40 degrees vertical field of view simultaneously for each pilot.		✓										
	"Continuous", cross-cockpit, minimum visual field of view providing each pilot with 150 degrees horizontal and 40 degrees vertical			✓			✓			✓		✓	A minimum of 75 degrees horizontal field of view on either side of the zero degree azimuth line relative to the helicopter fuselage is required.
b.2	"Continuous," cross-cockpit, minimum visual field of view providing each pilot with 150 degrees horizontal							✓			✓		A minimum of 75 degrees horizontal field of view on either side of the zero degree azimuth line

~~FSTD~~ FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
		A	B	C	D	1	2	3	I	II	III	MCC	
	and 60 degrees vertical												relative to the helicopter fuselage is required. This will allow an offset per side of the horizontal field of view if required for the training. Where training tasks require extended fields of view beyond the 150 degrees x 60 degrees, then such extended fields of view should be provided.
b.3	~~.~~"Continuous" cross cockpit, minimum visual field of view providing each pilot with 180 degrees horizontal and 60 degrees vertical				✓								A minimum of 75 degrees of horizontal field of view on either side of zero degrees azimuth line relative to the helicopter fuselage is required. This will allow an offset per side of the horizontal field of view if required for the training. Where training tasks require extended fields of view beyond the 180 degrees x 60 degrees, then such extended fields of view shall be provided.
c.1	A means of recording the visual response time for the visual system shall be provided.	✓	✓	✓	✓		✓	✓		✓	✓	✓	
d.1	Visual cues to assess rate of change of height, translational displacements and rates, during take-off and landing.	✓	✓										For **l**~~L~~evel 'A', **v**~~V~~isual cueing sufficient to support changes in approach path by using **the final approach and take-off (**FATO**)** perspective**.**
	Visual cues to assess rate of change of height, height AGL, translational displacements and rates, during take-off, low altitude/low airspeed manoeuvring, hover, and landing.			✓	✓		✓	✓		✓	✓	✓	~~.~~
e.1	Test procedures to quickly confirm visual system colour, RVR, focus, intensity, level horizon, and attitude as compared with the specified parameters.	✓	✓	✓	✓		✓	✓		✓	✓	✓	Statement of compliance required. Test required
f.1	A minimum of 10 levels of occulting. This capability should be demonstrated by a visual model through each channel.			✓	✓		✓	✓		✓	✓	✓	Statement of compliance required. Test required
g.1	Surface (Vernier) resolution shall be demonstrated by a test pattern of objects shown to occupy a visual angle of not greater than 3 arc minutes in the visual display used on a scene from the pilot's eye point.~~.~~			✓	✓		✓	✓		✓	✓	✓	Statement of compliance required. Test required
h.1	Lightpoint size shall not be greater than 6 arc minutes			✓	✓								This is equivalent to a light–point resolution of 3 arc minutes.
	Lightpoint size shall not be greater than 8 arc		✓				✓	✓		✓	✓	✓	This is equivalent to a light–point resolution of 4

~~FSTD~~ **FLIGHT SIMULATION TRAINING DEVICE STANDARDS**		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
		A	B	C	D	1	2	3	I	II	III	MCC	
	minutes												arc minutes.
i.1	Daylight, dusk, and night visual scenes with sufficient scene content to recognise aerodromes, ~~heliports~~**operating sites**, terrain, and major landmarks around the ~~Final Approach and Take-off (~~FATO~~)~~ area and to successfully accomplish low airspeed/low altitude manoeuvres to include lift-off, hover, translational lift, landing and touch down.			✓	✓		✓	✓		✓	✓	✓	
j.1	A visual database sufficient to support the requirements, including **(i)** Specific areas within the database needing higher resolution to support landings, take-offs and ground cushion exercises and training away from a**n aerodrome / operating site**~~heliport~~. Including elevated ~~helipad~~**FATO**, helidecks and confined areas **(ii)** For cross-country flights sufficient scene details to allow for ground to map navigation over a sector length equal to 30 minutes at an average cruise speed. **(iii)** For offshore airborne radar approaches (ARA), harmoni**s**~~z~~ed visual/radar representations of installations. (**iv)** For training in the use of **n**~~N~~ight **v**~~V~~ision **g**~~G~~oggles (NVG) a visual display with the ability to represent various scenes with the required levels of ambient light/colour.		✓	✓	✓		✓	✓		✓	✓	✓	Generic database is acceptable only for FTDs and FNPTs. Where applicable Where applicable Where applicable
k.1	Daylight, twilight (dusk/dawn) and night visual capability for system brightness and contrast ratio criteria as applicable for level of qualification sought.			✓	✓		✓	✓		✓	✓	✓	The ambient lighting should provide an even level of illumination, which is not distracting to the pilot.
	Night and Dusk scene	✓	✓										
k.2	The visual system should be capable of producing: Full colour presentations. Full colour texture shall be used to enhance visual cue perception for illuminated landing surfaces.			✓	✓		✓	✓		✓	✓	✓	

	~~FSTD~~ FLIGHT SIMULATION TRAINING DEVICE STANDARDS	FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
		A	B	C	D	1	2	3	I	II	III	MCC	
k.3	The visual system should be capable of producing, as a minimum:												Statement of **c**~~C~~ompliance required. Test required. Freedom of apparent quanti**s**~~z~~ation and other distracting visual effects are also applicable for **l**~~L~~evels A and B.
	(i) A scene content comparable in detail with that produced by 6~~,~~000 polygons for daylight and 1 000 visible light–points for night and dusk scenes for the entire visual system.						✓	✓		✓	✓	✓	
	(ii) A scene content comparable in detail with that produced by 4~~,~~000 polygons for daylight and 5 000 visible light–points for night and dusk scenes for the entire visual system			✓									
	(iii) A scene content comparable in detail with that produced by 6~~,~~000 polygons for daylight and 7 000 visible light–points for night and dusk scenes for the entire visual system.				✓								
l.1	Surface contrast ratio: Demonstration model												
	Not less than 5:1.			✓	✓								
	Not less than 8:1						✓	✓		✓	✓	✓	
l.2	Lightpoint contrast ratio. Not less than 25:1.			✓	✓		✓	✓					
m.1	Highlight Brightness. The minimum light measured at the pilot's eye position should be :												
	14 cd/m² -(4 ft-Lamberts)			✓									
	17 cd/m² -(5ft-Lamberts)						✓	✓		✓	✓	✓	
	20 cd/m² -(6 ft-Lamberts)				✓								
	1.4 Sound Systems												
a.1	Significant ~~flight deck~~**cockpit** sounds, and those, which result from pilot actions corresponding to those of the helicopter shall be provided.	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	For FTD level 1 as appropriate for the system training required. Statement of **c**~~C~~ompliance required for FFS.
a.2	Sounds due to engines, transmission and rotors should be available								✓				

~~FSTD~~ FLIGHT SIMULATION TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
		A	B	C	D	1	2	3	I	II	III	MCC	
b.1	Sound of precipitation, windshield wipers, the sound resulting from a blade strike and a crash condition when operating the helicopter in excess of limitations.			✓	✓		✓	✓					Crash sounds may be generic Statement of **c**~~C~~ompliance or **d**~~D~~emonstration of representative sounds required.
c.1	Realistic amplitude and frequency of cockpit acoustic environment.				✓								Objective steady-state tests required
d.1	The volume control shall have an indication of sound level setting which meets all qualification requirements.	✓	✓	✓	✓								

APPENDIX 1 to CS-‑FSTD(H).300 (continued)

These standards always refer to the type of helicopter being simulated, except for FNPT, which may be generic. For FNPT, the term "the/a helicopter" is used to represent the aircraft being modelled**,** which can be a specific helicopter type, a family of similar helicopter types or a totally generic helicopter.

Wherever the term runway is used, it includes runways**,** ~~and~~ FATO~~/~~ **and touch down and lift-off (**TLOF**) areas**.

Certification Specifications

for

Helicopter
Flight Simulation Training Devices

CS-FSTD(H)
Book 2

Acceptable Means of Compliance

SUBPART B – TERMINOLOGY

AMC1-~~to~~ CS--FSTD(H).200 Terminology and abbreviations

1 Terminology

1.1 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**’**~~.~~ **m~~M~~eans 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**’ means**~~.~~ **p**~~P~~erformance 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 when relevant or other airspeed which is clearly annotated.

d **‘**Altitude**’**~~.~~ **means p**~~P~~ressure altitude when relevant or other altitude which is clearly annotated.

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

f **‘**Automatic **t**~~T~~esting**’ means**~~.~~ ~~Flight Synthetic Training Device (~~FSTD~~)~~ testing wherein all stimuli are under computer control.

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

h **‘**Baseline**’**~~.~~ **means a**~~A~~ fully flight ~~-~~test validated production aircraft simulation. May 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**’**~~.~~ **means 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**’**~~.~~ **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**~~E~~ngine **p**~~P~~arameter**’**~~.~~ **means** ~~T~~**t**he engine parameter which is the most appropriate measure of the engine power delivered.

o ‘Damping (critical)**’**~~.–~~ **means** ~~The ‘Critical Damping’ is~~ that minimum damping 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 ‘**o**~~O~~ver-**d**~~D~~amped’ response is that damping 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 ‘**u**~~U~~nder-**d**~~D~~amped’ 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** 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 Simulator**’**~~. The term for~~ **means** the aircraft manufacturer’s ~~flight~~ simulator which typically includes a full-scale representation of the simulated aircraft flight deck**/cockpit**, 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**.**~~÷~~ **The engineering simulator**~~–and~~ 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**’**~~.~~ **means 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~~**aa** ‘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.

~~Cc~~**bb** **‘**Free **r**~~R~~esponse**’**~~.~~ **means t**~~T~~he response of the aircraft after completion of a control input or disturbance.

~~dd~~**cc** **‘**Frozen/**l**~~L~~ocked**’**~~.~~ **means a**~~A~~ state where a variable is held constant with time.

~~ee 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.~~

~~ff~~**dd** **‘**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.

~~gg~~**ee** **‘**FSTD **e**~~E~~valuation**’**~~.~~ **means a**~~A~~ detailed appraisal of an FSTD by the ~~Authority~~**competent authority** to ascertain whether or not the standard required for a specified **q**~~Q~~ualification **l**~~L~~evel is met.

~~hh~~**ff** **‘**FSTD **o**~~O~~perator**’**~~.~~ **means t**~~T~~hat organisation directly responsible to the ~~authority~~**competent authority** for requesting and maintaining the qualification of a particular FSTD.

~~ii ‘FSTD Qualification Level’. **means t**The level of technical capability of a FSTD.~~

~~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 JAA~~**an EASA** member state. Also the right of an FSTD user to retain the training and testing/checking credits which were gained under a previous regulation of a 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**’**~~.~~ ~~**Is**~~**means the h**~~H~~eight above ground ~~=~~**(**AGL**)** (meters or feet)

~~tt~~**qq** **‘**Highlight **b**~~B~~rightness**’**~~.~~ **means t**~~T~~he maximum displayed brightness~~,~~ which 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~~ **in** the ~~flight deck~~**cockpit**.

~~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 **flight** ~~air~~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 ~~Authority~~**competent authority-**–approved QTG which incorporates the results of tests witnessed by the ~~Authority~~**competent authority**. 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 **c**~~C~~ontrol is the state where one or more of the intended control, augmentation or protection functions are not fully available.

(N**ote**~~OTE~~: 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'~~.~~ **is a**~~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 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 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'. **means a**A person, organisation or enterprise engaging in c 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~~ **in** the ~~flight deck~~**cockpit**. This may also be referred to as PLA, THROTTLE, or 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 ~~an Authority~~**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~~**cockpit** 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'. **is s**Sideslip **a**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~~**cockpit**.

~~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** **‘**Vibration**’**~~.~~ **means a**~~A~~ permanent effect resulting from airframe interaction with rotor, engine or transmission, as opposed to buffet which is a transient vibration effect resulting from either pilot action or aerodynamic effect on the airframe.

~~iiii~~**cccc** **‘**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 ILS approach.

~~jjjj~~**dddd** **‘**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.

~~kkkk~~**eeee** **‘**Well-**u**~~U~~nderstood **e**~~E~~ffect**’**~~.~~ **means a**~~A~~n incremental change to a configuration or system which 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
A_d	=	**t**~~T~~otal initial displacement of pilot controller (initial displacement to final
ADF	**=**	**automatic direction finder**
		resting amplitude)
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 (metres or feet)
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)
ARA	=	**a**~~A~~irborne **r**~~R~~adar **a**~~A~~pproach
ATO	**=**	**approved training organisation**
BC	=	ILS locali**s**~~z~~er back course
CAT I/II/III	=	**l**~~L~~anding category operations
CCA	=	**c**~~C~~omputer **c**~~C~~ontrolled **a**~~A~~eroplane
CCH	=	**c**~~C~~omputer **c**~~C~~ontrolled **h**~~H~~elicopter
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 **p**~~P~~oint **b**~~B~~efore **l**~~L~~anding
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.)~~
FATO	=	**f**~~F~~inal **a**~~A~~pproach and **t**~~T~~ake**-**off
FD	=	**f**~~F~~light **d**~~D~~irector
FOV	=	**f**~~F~~ield **o**~~O~~f **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~~eet~~/s~~ec~~^{2}), 1g = 9~~.~~**·**81 m/s~~ec~~^{2} or 32~~.~~**·**2 f~~eet~~/s~~ec~~^{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
HSI	**=**	**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~~
km	=	**k**~~K~~ilometres, 1 km = 0~~.~~·62137 **s**~~S~~tatute **m**~~M~~iles
kPa	=	**k**~~K~~iloPascal (**k**~~K~~ilo-Newton/**m**~~M~~etres2). 1 psi = 6~~.~~·89476 kPa
kts	=	**k**~~K~~nots calibrated airspeed unless otherwise specified, 1 **k**~~K~~not = 0~~.~~·5148 m/s~~ec~~ or 1~~.~~·689 ft/s~~ec~~
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**d** **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 Used 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~~	~~=~~	~~National Aviation 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)
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 – Part B (AFM)
OTD	=	**o**~~O~~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~~ec~~ or f~~ee~~t/min)
R/D	=	**r**~~R~~ate of **d**~~D~~escent (metres/s~~ec~~ 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 = 5 280 f~~ee~~t = 1 609 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~~ouch down 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
V_{mca}	=	**m**~~M~~inimum **c**~~C~~ontrol **s**~~S~~peed (**a**~~A~~ir)
V_{mcg}	=	**m**~~M~~inimum **c**~~C~~ontrol **s**~~S~~peed (**g**~~G~~round)
V_{mcl}	=	**m**~~M~~inimum **c**~~C~~ontrol **s**~~S~~peed (**l**~~L~~anding)
VOR	=	VHF omni-directional range
V_r	=	**r**~~R~~otate **s**~~S~~peed
$V_{\mathbf{S}}$~~S~~	=	**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
$V_{\mathbf{Y}}$~~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

SUBPART C – HELICOPTER FLIGHT SIMULATION TRAINING DEVICES

AMC ~~No.~~ 1**-** ~~to~~ CS**-**~~-~~FSTD(H).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 crew members. These test criteria and methods of compliance were derived from extensive experience of competent authorities and the industry.~~This AMC establishes the criteria which 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 the Authorities 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 crew –members. The complexity, costs and operating environment of modern aircraft also encourages 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 ~~Authorities~~**competent authorities**, operators, ~~and~~ **helicopter and FSTD** manufacturers**.** ~~of helicopters and FSTDs (FFS, FTD and FNPT).~~

1.3 Levels of FSTD qualification~~.~~

~~1.3.1~~ ~~Parts~~ **Subparagraphs** 2~~,~~ and 3 of this AMC describe the minimum requirements for qualifying **l**~~L~~evel A, B, C and D helicopter FFS, **l**~~L~~evel 1, 2 and 3 helicopter FTDs and FNPT levels I, II, II MCC, III and III MCC for generic helicopters.

*Note: Where an FTD **l**~~L~~evel 1 simulates a single helicopter system, it ~~shall~~ **should** comply with the subjective and objective tests relevant to that system.*

1.4 Terminology~~.~~

~~1.4.1~~ Terminology and abbreviations of terms used in this AMC are contained in AMC**1-** ~~to~~ CS-~~-~~FSTD(H).200.

1.5 Testing for FSTD qualification

1.5.1 The FSTD should be assessed in those areas which are essential to completing the flight crew-member training, testing and checking process. This includes the FSTD's longitudinal and lateral-directional responses; performance in take-off, hover, climb, cruise, descent, approach, touch down; specific operations; control checks; ~~flight deck~~**cockpit** 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.

1.5.2 ~~1.5.2~~ **For FFSs and FTDs t**~~T~~he 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 ~~FSTD and~~**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 Tolerances listed for parameters in the validation tests (**p**~~P~~aragraph 2) of this AMC are the maximum acceptable for FSTD qualification and should not be confused with FSTD design tolerances.

1.5.4 For initial qualification of ~~FSTDs~~ **FFSs and FTDs** helicopter manufacturer's validation flight test data is preferred. Data from other sources may be used, subject to the review and concurrence of the ~~Authority~~**competent authority**.

1.5.5 For FNPTs generic data packages can be used; for an initial evaluation only correct trend and magnitude (CT&M) 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, validation data should be used. They may be derived from a specific helicopter within the type of helicopter the FNPT is representing or they may be based on information from several helicopters within the type. With the concurrence of the competent authority, it may be in the form of a manufacturer's previously approved set of validation data for the applicable FNPT. Once the set of data for a specific FNPT has been accepted and approved by the competent authority, it will become the validation data that 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 validation data should be in the form of an engineering report and should show that the proposed validation data are representative of the helicopter or the type of helicopter modelled. This report may include flight test data, manufacturer's design data, information from the aircraft flight manual and maintenance manuals, 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.**6**~~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 FFS ~~FSTDs~~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 ~~Operational Suitability Data~~OSD as approved under Part-21**. The schedule should be as agreed by the ~~Authority~~**competent authority**, FSTD operator, FSTD manufacturer, and aircraft manufacturer.

1.5.**7**~~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.**8**~~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.**9**~~8~~ Validation tests ~~which~~ **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 should submit a QTG which includes **the following**:

a. A title page with FSTD operator and approval ~~Authority~~ **authority** 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**;**~~.~~

~~(~~ii**.**~~)~~ **h**~~H~~elicopter model and series 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 helicopter 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~~**cockpit** 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 helicopter result, including tolerances and, if necessary, a further definition of the point at which the information was extracted from the source data**;**

~~(~~x**.**~~)~~ Test result**:**~~.~~ **d**~~D~~ated FSTD validation test results obtained by the FSTD operator. Tests run on a computer which is independent of the FSTD are not acceptable.

~~(~~xi**.**~~)~~ **Source data:**~~.~~ **c**~~C~~**opy of the helicopter source data (in the case of FFS/FTD) or other validation data (in the case of FNPT), clearly marked with the document, page number, issuing authority, and the test number and title as specified in 1.6.2.i. above.**

Computer-–generated displays of flight test data (in the case of FFS, FTD) or other validation data (in the case of FNPT) 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.;~~Source data. Copy of the helicopter source data, clearly marked with the document, page number, issuing authority, and the test number and title as specified sub-para (i) above. Computer generated displays of flight test data overplotted with FSTD data are insufficient on their own for this requirement.~~

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

(xiii)~~Note: ~~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 ~~Authority~~ **competent authority** conducting the test. FSTD results should be labelled using terminology common to helicopter 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. Helicopter 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~~ **should** 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 helicopter 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 helicopter data. The cross plotting of the FSTD operator's simulator data to helicopter 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 ~~Authority~~ **competent authority** 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(H).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 except as noted in the application form. The FSTD operator 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 helicopter.

1.8.2 A copy of the FSTD operator's QTG, marked with test results, should accompany the request. Any QTG deficiencies raised by the ~~Authority~~ **competent authority** 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 ~~Authority~~**competent authority**. After review**ing** ~~of~~ these tests, the ~~Authority~~ **competent authority** ~~will~~ **should** schedule an initial evaluation. The QTG should be clearly annotated to indicate when and where each test was accomplished.

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 competent authority. As a minimum, the QTG tests should be run progressively in at least four approximately equal three-‒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 should be dated and retained in order to satisfy both the FSTD operator as well as the competent authority that the FSTD standards are being maintained. It is not acceptable that the complete QTG is run just prior to the annual evaluation.**~~The FSTD operator should run the complete QTG, which includes validation, functions & subjective tests, between each annual evaluation by the Authority. The QTG tests should be run progressively on an annual cycle. Results shall be dated and retained in order to satisfy both the FSTD operator as well as the Authority that the FSTD standards are being maintained.~~

2 FSTD **v**~~V~~alidation **t**~~T~~ests

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 helicopter data unless specifically noted otherwise. To facilitate the validation of the FSTD, an appropriate recording device acceptable to the ~~Authority~~ **competent authority** 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 *Manual of Criteria for the Qualification of Flight Simulators*, 1993 by a 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 which 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 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.

2.1.5 The table of FSTD **v**~~V~~alidation **t**~~T~~ests in this ~~ACJ~~ **AMC** indicates the test requirements. Unless noted otherwise, FSTD tests should represent helicopter 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 helicopter data at one extreme weight or cg, another test supported by helicopter 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.

2.1.6 For the testing of **c**~~C~~omputer **c**~~C~~ontrolled **h**~~H~~elicopter (CCH) FSTDs, flight test data are required for both the normal (N) and non-normal (NN) control states, as applicable to the helicopter 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 ~~Authority~~ **competent authority** at the time of definition of a set of specific helicopter 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. rotor blade pitch position or equivalent

2.1.7 Where extra equipment is fitted, such as a motion system or in an FTD **l**~~L~~evel 1 or FNPT **l**~~L~~evel I, a visual system, such equipment is expected to satisfy tests as follows:

a. **v**~~V~~isual system: where fitted to an FNPT **l**~~L~~evel I or FTD **l**~~L~~evel 1, validation tests are those specified for a FNPT **l**~~L~~evel II or for a FTD **l**~~L~~evel 2 respectively**; and**~~.~~

b. **m**~~M~~otion system: where fitted to an FTD or FNPT, validation tests are those specified for a **l**~~L~~evel A FFS.

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 ~~Authority~~**competent authority**. Time histories are required unless otherwise indicated in the table of validation tests.

2.2.2 Approved validation data which 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 helicopter 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 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.**~~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 only as a percentage, then the percentage of the maximum operating range of a parameter will be used. 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 labeled using the tolerances and units specified.~~

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 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 competent authority.**

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 helicopter, sufficient data should also be provided to verify the correct flight condition. All airspeed values should be clearly annotated as to indicated, calibrated, true airspeed, etc**.** ~~...~~ and like values used for comparison.

2.2.2.3 Where the tolerances have been replaced by '**c**~~C~~orrect **t**~~T~~rend and **m**~~M~~agnitude' (CT&M), the FSTD should be tested and assessed as representative of the helicopter to the satisfaction of the ~~Authority~~**competent authority**. To facilitate future evaluations, sufficient parameters should be recorded to establish a reference. For the initial qualification of FNPTs no tolerances are to be applied and the use of CT&M is to be assumed throughout.

2.3 Table of FSTD **v**~~V~~alidation **t**~~T~~ests

2.3.1 A number of tests within the QTG have had their requirements reduced to ~~'Correct Trend and 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.

*Note 1: **i**~~I~~t is accepted that tests and associated tolerances ~~will~~ **should** only apply to a **l**~~L~~evel 1 FTD if that system or flight condition is simulated.*

*Note 2: **f**~~F~~or piston engines, suitable alternative parameters should be used, which have to be agreed with the ~~Authority~~**competent authority**.*

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
														For FNPT CT&M should be used for initial evaluations. The tolerances should be applied for recurrent evaluations (see AMC1-CS-FSTD(H).300, 1.5.5). **It is accepted that tests and associated tolerances ~~will~~ only apply to a level 1 FTD if that system or flight condition is simulated.**
1. PERFORMANCE														
a. Engine Assessment														
(1) Start **o**~~O~~perations (i) Engine **s**~~S~~tart and acceleration (transient)	Light **o**~~O~~ff **t**~~T~~ime ±~~-~~ 10% or ±~~-~~1 ~~sec~~ Torque ±~~-~~ 5% Rotor **s**~~S~~peed ±~~-~~ 3% Fuel **f**~~F~~low ±~~-~~ 10% Gas **g**~~G~~enerator **s**~~S~~peed ± ~~-~~5% Power **t**~~T~~urbine **s**~~S~~peed ±~~-~~ 5% Turbine **g**~~G~~as **t**~~T~~emp. ± 30°C	Ground **r**~~R~~otor **b**~~B~~rake used / Not used	C T & M	✓	✓	✓	C T & M	✓	✓		✓	✓	✓	Time histories of each engine from initiation of start sequence to steady state idle and from steady state idle to operating RPM. Tolerance to be only applied in the validity domain of the engine parameter sensors
(ii) Steady **s**~~S~~tate **i**~~I~~dle and **o**~~O~~perating RPM **c**~~C~~onditions	Torque ±~~-~~ 3% Rotor **s**~~S~~peed ± ~~-~~1~~·~~.5% Fuel **f**~~F~~low ±~~-~~ 5% Gas **g**~~G~~enerator **s**~~S~~peed ±~~-~~ 2% Power **t**~~T~~urbine **s**~~S~~peed ±~~-~~ 2% Turbine **g**~~G~~as **t**~~T~~emp. ± 20°C	Ground	C T & M	✓	✓	✓	C T & M	✓	✓		✓	✓	✓	Present data for both steady state idle and operating RPM conditions. May be ~~a~~ snapshot tests.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(2) ~~-~~Power **t**~~T~~urbine **s**~~S~~peed **t**~~T~~rim	±~~-~~ 10% of total change of power turbine speed or ± ~~-~~0~~·~~.5% rotor speed	Ground	C T & M	✓	✓	✓	C T & M	✓	✓		✓	✓	✓	Time history of engine response to trim system actuation (both directions)
(3) ~~-~~Engine & **r**~~R~~otor **s**~~S~~peed **g**~~G~~overning	Torque ±~~-~~ 5% Rotor **s**~~S~~peed ± ~~-~~1~~·~~.5%	Climb~~/~~ **and d**~~D~~escent	C T & M	✓	✓	✓	C T & M	✓	✓	✓ ~~C T & M~~	✓	✓	✓	Collective step inputs. Can be conducted with climb & descent performance tests
b. Ground Operations														
(1) Minimum **r**~~R~~adius **t**~~T~~urn	Helicopter turn radius ± ~~-~~3 ft (0~~·~~.9 m) or 20%	Ground		✓	✓	✓		~~C T & M~~	~~C T & M~~					If differential braking is used, brake force ~~shall~~ **should** be set at the helicopter test flight value.
(2) Rate of **t**~~T~~urn vs **p**~~P~~edal **d**~~D~~eflection or nosewheel angle	Turn rate **(left and right)** ±~~-~~ 10% or 2° /~~-sec~~	Ground		✓	✓	✓		~~C T & M~~	~~C T & M~~					**Without usage of wheel brakes.**
(3) Taxi	Pitch ~~attitude~~**angle** ± 1~~·~~.5° Torque ± ~~-~~3% Longitudinal **c**~~C~~ontrol **p**~~P~~osition ± ~~-~~5% Lateral **c**~~C~~ontrol **p**~~P~~osition ± ~~-~~5% Directional **c**~~C~~ontrol **p**~~P~~osition ± ~~-~~5% Collective **c**~~C~~ontrol **p**~~P~~osition ±~~-~~ 5%	Ground	C T & M	✓	✓	✓		~~C T & M~~	~~C T & M~~					Control **p**~~P~~osition & **p**~~P~~itch ~~Attitude~~ **angle** during ground taxi for a specific ground speed & direction, and density altitude
(4) Brake **e**~~E~~ffectiveness	Time : ±~~-~~ 10%or ±~~-~~1 s and Distance : ±~~-~~ 10%or ± 30 m (100 ft)	Ground	C T & M	✓	✓	✓		C T & M	C T & M					**Record data until full stop.**

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
c. Take-off														
(1) All engines	Airspeed ±~~-~~ 3 ~~-~~kt Altitude ±~~-~~ 20 ~~-~~ft (6·~~.~~1 ~~-~~m) Torque ±~~-~~ 3% Rotor **s**~~S~~peed ± ~~-~~1·~~.~~5% Pitch ~~Attitude~~**angle** ±~~-~~ 1~~.~~·5° Bank ~~Attitude~~**angle** ± ~~-~~2° Heading ± ~~-~~2° Longitudinal **c**~~C~~ontrol **p**~~P~~osition ± ~~-~~10% Lateral **c**~~C~~ontrol **p**~~P~~osition ± ~~-~~10% Directional **c**~~C~~ontrol **p**~~P~~osition ±~~-~~ 10% Collective **c**~~C~~ontrol **p**~~P~~osition ±~~-~~ 10%	Ground/lift off and initial climb	C T & M	✓	✓	✓	C T & M	✓	✓		✓	✓	✓	Time history of take-off flight path as appropriate to helicopter model simulated [running take-~~-~~off for FFS **l**~~L~~evel B & FTD **l**~~L~~evel 2. Take-off from a hover for F**F**S **l**~~L~~evel C & D or FTD **l**~~L~~evel 3]. **In addition to the airspeed the ground speed should be taken as reference with the same tolerance of ±~~-~~3 ~~-~~kts until the airspeed is clearly readable.** For FFS **l**~~L~~evel B and FTD **l**~~L~~evel 2, criteria apply only to those segments at airspeeds above effective translational lift. Record data to at least 200 ~~-~~ft (61 ~~-meters~~**m**) AGL/V_Y~~y~~ whichever comes later
(2) ~~One Engine Inoperative~~**OEI** continued take-off	See 1.c.(1) above for tolerances and flight conditions	Take-off & initial climb	C T & M	✓	✓	✓	C T & M	✓	✓		✓	✓	✓	Time history of take-off flight path as appropriate to helicopter model simulated. Record data to at least 20-0 ft (61 **m** ~~-meters~~) AGL/V~~y~~$_Y$ whichever comes later

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(3) ~~One Engine inoperative~~**OEI** rejected take**-**off	Airspeed ± 3 kt Altitude ± 20 ft (6.1 m) Torque ± 3% Rotor **s**~~S~~peed ± 1.5% Pitch ~~Attitude~~ **angle** ± 1.5° Bank ~~Attitude~~ **angle** ± 1.5° Heading ± 2° Longitudinal **c**~~C~~ontrol **p**~~P~~osition ± 10% Lateral **c**~~C~~ontrol **p**~~P~~osition ± 10% Directional **c**~~C~~ontrol **p**~~P~~osition ± 10% Collective **c**~~C~~ontrol **p**~~P~~osition ± 10% Distance: ± 7.5% or ± 30 m (100 ft)	Ground/**t**~~T~~ake**-**off	C T & M	C T & M	✓	✓	~~C~~ ~~T~~ ~~&~~ ~~M~~	✓ ~~C~~ ~~T~~ ~~&~~ ~~M~~	✓			✓	✓	Time history from the take**-**off point to touch down. Test conditions near limiting performance **as per aircraft manual.** **In addition to the airspeed the ground speed should be taken as reference with the same tolerance of ± 3 kts until the airspeed is clearly readable.**
d. Hover Performance	Torque ± 3% Pitch ~~Attitude~~ **angle** ± 1.5° Bank ~~Attitude~~ **angle** ± 1.5° Longitudinal **c**~~C~~ontrol **p**~~P~~osition ± 5% Lateral **c**~~C~~ontrol **p**~~P~~osition ± 5% Directional **c**~~C~~ontrol **p**~~P~~osition ± 5% Collective **c**~~C~~ontrol **p**~~P~~osition ± 5%	In **g**~~G~~round **e**~~E~~ffect (IGE) Out of **g**~~G~~round **e**~~E~~ffect (OGE) Stability augmentation on ~~and~~ **or** off	C T & M	✓	✓	✓	C T & M	✓	✓		✓	✓	✓	Light~~/~~ **and** heavy gross weights. May be snapshot tests. Refer to point 2.4.2 below for additional guidance.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
e. Vertical Climb Performance	Vertical **v**~~V~~elocity ± 100 fpm (0.50 m/s~~ec~~) or 10% Directional **c**~~C~~ontrol **p**~~P~~osition ± 5% Collective **c**~~C~~ontrol **p**~~P~~osition ± 5%	From OGE **h**~~H~~over Stability augmentation on ~~and~~ **or** off	C T & M	✓	✓	✓	C T & M	✓	✓		✓	✓	✓	Light **and** ~~/~~heavy gross weights. May be snapshot tests.
f. Level Flight Performance and Trimmed Flight Control Position	Torque ± -3% Pitch ~~Attitude~~**angle** ± 1.5° Sideslip **a**~~A~~ngle ± -2° Longitudinal **c**~~C~~ontrol **p**~~P~~osition ± -5% Lateral **c**~~C~~ontrol **p**~~P~~osition ± -5% Directional **c**~~C~~ontrol **p**~~P~~osition ± -5% Collective **c**~~C~~ontrol **p**~~P~~osition ± -5%	Cruise **s**~~S~~tability **Stability augmentation on or off**	C T & M	✓	✓	✓	C T & M	✓	✓	✓	✓	✓	✓	Two combination of ~~grossweight~~**gross weight**/cg and **at least** two speeds **(including V~~v~~$_y$ and maximum cruise speed)** within the flight envelope. May be snapshot tests. For FNPT **l**~~L~~evel 1 changes in Cg are not required For FNPT (any level), only one stability augmentation case is required.
g. Climb Performance and Trimmed Flight Control Position	Vertical **v**~~V~~elocity ± 100 fpm (0·~~.~~50 -m/s~~ec~~) or 10% Pitch ~~Attitude~~**angle** ± 1·~~.~~5° Sideslip **a**~~A~~ngle ± -2° Longitudinal **c**~~C~~ontrol **p**~~P~~osition ± -5% Lateral **c**~~C~~ontrol **p**~~P~~osition ± 5% Directional **c**~~C~~ontrol **p**~~P~~osition ± -5% Collective **c**~~C~~ontrol **p**~~P~~osition ± -5% Speed ± -3 kts	All engines operating ~~One engine inoperative~~**OEI** Stability augmentation on or off	C T & M	✓	✓	✓	C T & M	✓	✓	✓	✓	✓	✓	Two gross weight/cg combinations. Data presented at relevant climb power conditions. The achieved measured vertical velocity of the FSTD cannot be less than the appropriate **a**~~A~~pproved ~~Flight Manual~~**AFM** values. For FNPT **l**~~L~~evel 1 changes in Cg are not required. May be snapshot tests.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
h. Descent														
(1) Descent **p**~~P~~erformance and trimmed **f**~~F~~light **c**~~C~~ontrol **p**~~P~~osition	Torque ± 3% Pitch ~~Attitude~~ **angle** ± 1.5° Sideslip **a**~~A~~ngle ± 2° Longitudinal Control Position ± 5% Lateral Control Position ± 5% Directional Control Position ± 5% Collective Control Position ± 5%	At or near 1 000 fpm (5 m/s~~ec~~) **r**~~R~~ate of **d**~~D~~escent (R**/**~~o~~D) at normal approach speed. Stability augmentation on or off	C T & M	✓	✓	✓	C T & M	✓	✓	✓	✓	✓	✓	Two gross weight/CG combinations For FNPT **l**~~L~~evel 1 changes in ~~Cg~~ **CG** are not required. May be snapshot tests
(2) Autorotation **p**~~P~~erformance and trimmed **f**~~F~~light **c**~~C~~ontrol **p**~~P~~osition	Vertical **v**~~V~~elocity ± 100 fpm (0**·**~~.~~50 m/s~~ec~~) or 10% Rotor **s**~~S~~peed ± 1**·**~~.~~5% Pitch ~~Attitude~~ **angle** ± 1**·**~~.~~5° Sideslip **a**~~A~~ngle ± 2° Longitudinal **c**~~C~~ontrol **p**~~P~~osition ± 5% Lateral **c**~~C~~ontrol **p**~~P~~osition ± 5% Directional **c**~~C~~ontrol **p**~~P~~osition ± 5% Collective **c**~~C~~ontrol **p**~~P~~osition ± 5%	Steady descents Stability augmentation on or off	C T & M	✓	✓	✓	~~C~~ ~~T~~ ~~&~~ ~~M~~	✓	✓	✓	✓	✓	✓	Two gross weight/CG combinations. Rotor speed tolerance only applies if collective control position is fully down. Speed sweep from approximately 50 kt**s** to at least maximum glide distance airspeed. May be a series of snapshot tests.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
i. Auto-rotational Entry	Torque ± 3% Rotor speed ± 3% Pitch ~~Attitude~~ **angle** ± 2° ~~Roll Attitude~~**Bank angle** ± 3° Heading ± 5° Airspeed ± 5 kt Altitude ± 20 ft (6·~~.~~1 m)	Cruise or climb	C T & M	✓ ~~C T & M~~	✓	✓	~~C T & M~~	✓	✓	✓	✓	✓	✓	Time history of vehicle response to a rapid power reduction to idle. If cruise, data should be presented for the maximum range airspeed. If climb, data should be presented for the maximum rate of climb airspeed at or near maximum continuous power.
j. Landing														
(1) All **e**~~E~~ngines	Airspeed ± 3 kt Altitude ± 20 ft (6·~~.~~1 m) Torque ± 3% Rotor **s**~~S~~peed ± 1.5% Pitch ~~Attitude~~ **angle** ± 1·~~.~~5° Bank ~~Attitude~~ **angle** ± 1·~~.~~5° Heading ± 2° Longitudinal **c**~~C~~ontrol **p**~~P~~osition ± 10% Lateral **c**~~C~~ontrol **p**~~P~~osition ± 10% Directional **c**~~C~~ontrol **p**~~P~~osition ± 10% Collective **c**~~C~~ontrol **p**~~P~~osition ± 10%	Approach and landing	C T & M	✓	✓	✓	C T & M	✓	✓	✓ ~~C T & M~~	✓	✓	✓	Time history of approach and landing profile as appropriate to helicopter model simulated (running landing for FFS **l**~~L~~evel B/FTD **l**~~L~~evel 2, approach to a hover and to touch down for FFS **l**~~L~~evel C & D/FTD **l**~~L~~evel 3). For FFS levels A & B, and FTD **l**~~L~~evels 1 and 2, & FNPT **l**~~L~~evel II and III criteria apply only to those segments at airspeeds above effective translational lift. **In addition to the airspeed the ground speed should be taken as reference with the same tolerance of ± 3 kts until the airspeed is clearly readable.**

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(2) ~~One Engine Inoperative~~**OEI**	See 1j(1) above for tolerances	Approach and landing	C T & M	✓	✓	✓	C T & M	✓	✓		✓	✓	✓	Include data for both Category A & Category B **a**~~A~~pproaches & landings as appropriate to the helicopter model being simulated. For FFS levels A & B, and FTD **l**~~L~~evels 1 and 2, and FNPT **l**~~L~~evel II and III criteria apply to only those segments at airspeeds above effective translational lift
(3) Balked **l**~~L~~anding/missed approach	See 1j(1) above for tolerances	Approach, ~~one engine inoperative~~**OEI**		✓	✓	✓		✓	✓		✓	✓	✓	From a stabili**s**~~z~~ed approach at the landing decision point (LDP).
(4) Auto-rotational **l**~~L~~anding with **t**~~T~~ouch down	Airspeed ± 3 kts Torque ± 3% Rotor **s**~~S~~peed ± 3% Altitude ± 20 ft (6·1 m) Pitch ~~Attitude~~ **angle** ± 2° Bank ~~Attitude~~ **angle** ± 2° Heading ± 5° Longitudinal **c**~~C~~ontrol **p**~~P~~osition ± 10% Lateral **c**~~C~~ontrol **p**~~P~~osition ± 10% Directional **c**~~C~~ontrol **p**~~P~~osition ± 10% Collective **c**~~C~~ontrol **p**~~P~~osition ± 10%	Approach and **t**~~T~~ouch down			✓	✓		C T & M	C T & M					Time history of auto-rotational deceleration and touch down from a stabili**s**~~z~~ed auto-rotational descent.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
2. HANDLING QUALITIES														
a. Control System Mechanical Characteristics														
(1) Cyclic	Breakout ± 0.25 ~~-~~lb (0·~~.~~112 ~~-~~daN) or 25% Force ± 0.5 ~~-~~lb (0·~~.~~224 daN) or 10%	Ground, **s**~~S~~tatic Trim **o**~~O~~n and **o**~~O~~ff Friction **o**~~O~~ff Stability augmentation on and off	✓	✓	✓	✓	C T & M	✓	✓	✓	✓	✓	✓	Uninterrupted control sweeps. This test is not required for aircraft hardware modular controllers. Cyclic position vs. force ~~shall~~ **should** be measured at the control. An alternate method acceptable to the ~~Authority~~ **competent authority** in lieu of the test fixture at the controls would be to instrument the FSTD in an equivalent manner to the flight test helicopter. The force position data from instrumentation can be directly recorded and matched to the helicopter data. Such a permanent installation could be used without requiring any time for installation of external devices.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(2) Collective/ Pedals	Breakout ± 0.5 lb (0·~~.~~224 daN) or 10% Force ± 1.0 lb (0·~~.~~448 daN) or 10%	Ground, **s**~~S~~tatic Trim **o**~~O~~n **and** ~~/~~**o**~~O~~ff Friction **o**~~O~~ff Stability augmentation on/off	✓	✓	✓	✓	C T & M	✓	✓	✓	✓	✓	✓	Uninterrupted control sweeps. This test is not required for aircraft hardware modular controllers. Collective and pedal position vs. force ~~shall~~ **should** be measured at the control. An alternate method acceptable to the ~~Authority~~ **competent authority** in lieu of the test fixture at the controls would be to instrument the FSTD in an equivalent manner to the flight test helicopter. The force position data from instrumentation can be directly recorded and matched to the helicopter data. Such a permanent installation could be used without requiring any time for installation of external devices.
(3) Brake **p**~~P~~edal **f**~~F~~orce vs**.** **p**~~P~~osition	± 5 lb (2·~~.~~224 daN) or 10%	Ground, **s**~~S~~tatic	C T & M	✓	✓	✓	C T & M	✓	✓					Simulator computer output results may be used to show compliance.
(4) Trim **s**~~S~~ystem **r**~~R~~ate (all applicable axes)	Rate ± 10%	Ground, **s**~~S~~tatic Trim on Friction off	✓	✓	✓	✓	C T & M	✓	✓	✓	✓	✓	✓	Tolerance applies to recorded value of trim rate.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(5) Control **d**~~D~~ynamics (all axes)	± 10% of time for first zero crossing and ± 10 (N+1)% of period thereafter ± 10% amplitude of first overshoot ± 20% of amplitude of 2nd and subsequent overshoots greater than 5% of initial displacement ± 1 overshoot	Hover and **c**~~C~~ruise Trim on Friction off Stability augmentation on and off		✓	✓	✓	~~C T & M~~	**C T & M** ~~✓~~	✓					Control dynamics for irreversible control systems may be evaluated in a ground/static condition. Data should be for a normal control displacement in both directions in each axis (approximately 25% to 50% of full throw). N is the sequential period of a full cycle of oscillation. Refer to 2.4.1 below.
(6) Free play	± 0.10 in (2~~·~~.5 mm)	Ground, **s**~~S~~tatic Friction **o**~~O~~ff		✓	✓	✓		✓	✓					Applies to all controls.
b. Low Airspeed Handling Qualities														
(1) Trimmed **f**~~F~~light **c**~~C~~ontrol **p**~~P~~ositions	Torque ± 3% Pitch ~~Attitude~~ **angle** ± 1~~·~~.5° Bank ~~Attitude~~ **angle** ± 2° Longitudinal **c**~~C~~ontrol **p**~~P~~osition ± 5% Lateral **c**~~C~~ontrol **p**~~P~~osition ± 5% Directional **c**~~C~~ontrol **p**~~P~~osition ± 5% Collective **c**~~C~~ontrol **p**~~P~~osition ± 5%	Translational **f**~~F~~light IGE. Sideways, rearward and forward Stability augmentation on or off			✓	✓		✓	✓					Several airspeed increments to translational airspeed limits and 45 kt**s** forward. May be a series of snapshot tests.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(2) Critical **a**~~A~~zimuth	Torque ± -3% Pitch ~~Attitude~~**angle** ± 1·~~.~~5° Bank ~~Attitude~~**angle** ± 2° Longitudinal **c**~~C~~ontrol **p**~~P~~osition ± -5% Lateral **c**~~C~~ontrol **p**~~P~~osition ± -5% Directional **c**~~C~~ontrol **p**~~P~~osition ± -5% Collective **c**~~C~~ontrol **p**~~P~~osition ± -5%	Stationary **h**~~H~~over Stability augmentation on or off			✓	✓		✓	✓					Present data for three relative wind directions (including the most critical case) in the critical quadrant. May be a snapshot test. **Precise wind measurement is very difficult and simulated wind obtained by translational flight in calm weather condition (no wind) is preferred in order to control precisely flight conditions by using groundspeed measurement (usually GPS). In this condition, it would be more practical to realis~~z~~e this test with tests 2b (1) in order to ensure consistency between critical azimuth and other directions (forward, sideward and rearward)**
(3) Control **r**~~R~~esponse														
(i) Longitudinal	Pitch **r**~~R~~ate ± -10% or ± 2°/s~~ec~~ Pitch ~~Attitude~~ **angle c**~~C~~hange ± -10% or ± 1·~~.~~5°	Hover **s**~~S~~tability augmentation on and off			✓	✓		C T & M	✓					Step control input. Off axis response must show correct trend for unaugmented cases.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(ii) Lateral	Roll **r**~~R~~ate ± 10% or ± 3°/s~~ec~~ ~~Roll Attitude~~**Bank angle c**~~C~~hange ± 10% or ± 3°	Hover **s**~~S~~tability augmentation on and off			✓	✓		C T & M	✓					Step control input. Off axis response must show correct trend for unaugmented cases.
(iii) Directional	Yaw **r**~~R~~ate ± 10% or ± 2°/s~~ec~~ Heading **c**~~C~~hange ± 10% or ± 2°	Hover **s**~~S~~tability augmentation on and off			✓	✓		C T & M	✓					Step control input. Off axis response must show correct trend for unaugmented cases.
(iv) Vertical	Normal **a**~~A~~cceleration ± 0.1 g	Hover **s**~~S~~tability augmentation on and off			✓	✓		C T & M	✓					Step control input. Off axis response must show correct trend for unaugmented cases
c. Longitudinal Handling Qualities														
(1) Control **r**~~R~~esponse	Pitch **r**~~R~~ate ± 10% or ± 2°/s~~ec~~ Pitch ~~Attitude~~ **angle c**~~C~~hange ± 10% or ± 1.5°	Cruise Stability augmentation on and off		✓	✓	✓		C T & M	✓					Two cruise airspeeds to include minimum power required speed. Step control input. Off axis response must show correct trend for unaugmented cases
(2) Static **s**~~S~~tability	Longitudinal **c**~~C~~ontrol **p**~~P~~osition ± 10% of change from trim or ± 0.25 in (6.3 mm) or Longitudinal **c**~~C~~ontrol **f**~~F~~orce ± 0.5 lb (0.224 daN) or ± 10%	Cruise or **c**~~C~~limb and Autorotation Stability augmentation on or off	✓	✓	✓	✓	**C T & M**	✓ ~~C T & M~~	✓					Minimum of two speeds on each side of the trim speed. May be a snapshot test.
(3) Dynamic **s**~~S~~tability														

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(i) Long **t**~~T~~erm **r**~~R~~esponse	± 10% of **c**~~C~~alculated **p**~~P~~eriod ± 10% of **t**~~T~~ime to ½ ~~1/2~~ or Double **a**~~A~~mplitude or ± 0·~~.~~02 of **d**~~D~~amping **r**~~R~~atio	Cruise Stability augmentation off		✓	✓	✓		C T & M	✓		✓	✓	✓	Test should include three full cycles (6 overshoots after input completed) or that sufficient to determine time to ½ or double amplitude, whichever is less. For non-periodic response the time history should be matched.
(ii) Short **t**~~T~~erm **r**~~R~~esponse	± 1·~~.~~5° **p**~~P~~itch ~~attitude~~ **angle** or ± 2°/~~sec~~ **p**~~P~~itch **r**~~R~~ate ± 0·~~.~~1 g **n**~~N~~ormal **a**~~A~~cceleration	Cruise or **c**~~C~~limb Stability augmentation on and off		✓	✓	✓		C T & M	✓		✓	✓	✓	Two airspeeds. Time history to validate short helicopter response due to control pulse input. Check to stop 4 seconds after completion of input.
(4) Manoeuvring **s**~~S~~tability	Longitudinal **c**~~C~~ontrol **p**~~P~~osition ± –10% of change from trim or ± 0·~~.~~25 in (6·~~.~~3 –mm) or Longitudinal **c**~~C~~ontrol **f**~~F~~orce ± –0·~~.~~5 –lb (0·~~.~~224 –daN) or ± –10%	Cruise or **c**~~C~~limb Stability augmentation on or off Left and right turns	C T & M	✓	✓	✓	C T & M	✓	✓					Force may be a cross plot for irreversible systems. Two airspeeds. May be a series of snapshot tests. Approximately 30° and 45° bank ~~attitude~~ **angle** data should be presented.
(5) Landing **g**~~G~~ear **o**~~O~~perating **t**~~T~~ime	± 1 ~~sec~~	Take-off (**r**~~R~~etraction) Approach (**e**~~E~~xtension)	✓	✓	✓	✓	✓ ~~C T & M~~	✓	✓	✓	✓	✓	✓	
d. Lateral & Directional Handling Qualities.														
(1) Control **r**~~R~~esponse (i) Lateral	Roll **r**~~R~~ate ± –10% or ± 3°/~~sec~~ ~~Roll Attitude~~**Bank angle c**~~C~~hange ± –10% or ± –3°	Cruise **s**~~S~~tability augmentation on and off		✓	✓	✓		C T & M	✓	✓	✓	✓	✓	Two airspeeds to include one at or near the minimum power required speed. Step control input. Off axis response must show correct trend for unaugmented cases.
(ii) Directional	Yaw rate ± –10% or 2^0 /~~sec~~. Yaw ~~Attitude~~ **angle c**~~C~~hange ± –10% or ± –2^0	Cruise **s**~~S~~tability augmentation on and off		✓	✓	✓		C T & M	✓	✓	✓	✓	✓	Two airspeeds to include one at or near the minimum power required speed. Step control input. Off axis response must show correct trend for unaugmented cases.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(2) Directional **s**~~S~~tatic **s**~~S~~tability	Lateral **c**~~C~~ontrol **p**~~P~~osition ± 10% of change from trim or ± 0**·**~~.~~25 in (6**·**~~.~~3 mm) , or ~~,~~ **l**~~L~~ateral **c**~~C~~ontrol **f**~~F~~orce ± 0**·**~~.~~5 lb (0**·**~~.~~224 daN) or ± 10% ~~Roll Attitude~~**Bank angle** ± 1.5° Directional **c**~~C~~ontrol **p**~~P~~osition ± 10% of change from trim or ± 0.25 in (6**·**~~.~~3 mm) or **d**~~D~~irectional **c**~~C~~ontrol **f**~~F~~orce ± 1 lb (0**·**~~.~~448 daN) or ± 10% Longitudinal **c**~~C~~ontrol **p**~~P~~osition ± 10% of change from trim or ± **0** **·**~~.~~25 in (6**·**~~.~~3 mm)	Cruise or **Climb and d**~~D~~escent Stability augmentation on or off	C T & M	✓	✓	✓	C T & M	✓	✓					Steady heading sideslip. Minimum of two sideslip angles on either side of the trim point. Force may be a cross plot for irreversible control systems. May be a snapshot test.
(3) Dynamic **l**~~L~~ateral and **d**~~D~~irectional **s**~~S~~tability														
(i) Lateral-**d**~~D~~irectional **o**~~O~~scillations	± 0**·**~~.~~5 s~~ec~~ or ± 10% of **p**~~P~~eriod ± 10% of **t**~~T~~ime to ½ or **d**~~D~~ouble **a**~~A~~mplitude or ± **0**.02 of **d**~~D~~amping **r**~~R~~atio ± 20% or ± 1 s~~ec~~ of Time **d**~~D~~ifference between peaks of **b**~~B~~ank and **s**~~S~~ideslip	Cruise or **c**~~C~~limb Stability augmentation on and off	C T & M	✓	✓	✓	C T & M	C T & M	✓		✓	✓	✓	Two airspeeds. Excite with cyclic or pedal doublet. Test should include six full cycles (12 overshoots after input completed) or that sufficient to determine time to ½ or double amplitude, whichever is less. For non-periodic response, time history should be matched.
(ii) Spiral **s**~~S~~tability	Correct trend on **b**~~B~~ank - ± 2° or ± 10% in 20 ~~sec~~	Cruise or **c**~~C~~limb Stability augmentation on and off	C T & M	✓	✓	✓	C T & M	C T & M	✓		✓	✓	✓	Time history of release from pedal only or cyclic only turns in both directions. Terminate check at zero bank or unsafe attitude for divergent cases.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
				FFS				FTD			FNPT				
				A	B	C	D	1	2	3	I	II	III	MCC	
	(iii) Adverse/ p~~P~~roverse y~~Y~~aw	Correct trend on side slip ± 2°	Cruise or c~~C~~limb Stability augmentation on and off	C T & M	✓	✓	✓		C T & M	✓					Time history of initial entry into cyclic only turns in both directions. Use moderate cyclic input rate.
3.	**ATMOSPHERIC MODELS**														
	(1) A test to demonstrate turbulence models	N/A	Take-off, c~~C~~ruise and l~~L~~anding	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	
	(2) Tests to demonstrate other atmospheric models to support the required training						✓			✓			✓	✓	
4.	**MOTION SYSTEM ******														
a.	**Motion Envelope**														
	(1) Pitch (i) Displacement -± 20^{0} -± 25^{0}		N/A	 ✓ 	 ✓ 	 ✓	 ✓								
	(ii) Velocity ± 15^{0}/s~~ec~~ ± 20^{o}/s~~ec~~			 ✓ 	 ✓ 	 ✓	 ✓								
	(iii) Acceleration ± 75^{o}/s~~ec~~^{2} ± 100^{o}/s~~ec~~^{2}			 ✓ 	 ✓ 	 ✓	 ✓								
	(2) Roll (i) Displacement ± 20^{0} ± 25^{0}		N/A	 ✓ 	 ✓ 	 ✓	 ✓								

** For Level A, if more than the three specified degrees of freedom (DOF) are used, then the corresponding Level B performance standards should be used.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(ii) Velocity														
± 15°/s~~ec~~			✓	✓										
± 20°/s~~ec~~					✓	✓								
(iii) Acceleration														
± 75°/s~~ec~~			✓	✓										
± 100°/s~~ec~~					✓	✓								
(3) Yaw		N/A												
(i) Displacement														
~~± 20°~~			~~✓~~	~~✓~~										
± 25°				✓	✓	✓								
(ii) Velocity														
± 15°/s~~ec~~			✓	✓										
± 20°/s~~ec~~					✓	✓								
(iii) Acceleration														
± 75°/s~~ec~~²			✓	✓										
± 100°/s~~ec~~²					✓	✓								
(4) Vertical		N/A												
(i) Displacement														
± 22 in			✓	✓										
± 34 in					✓	✓								
(ii) Velocity														
± 16 in/s~~ec~~			✓	✓										
± 24 in/s~~ec~~					✓	✓								
(iii) Acceleration														
± 0·~~.~~6 g			✓	✓										
± 0·~~.~~8 g					✓	✓								
(5) Lateral		N/A												
(i) Displacement														
± ~~-~~26 in				✓										
± ~~-~~45 in					✓	✓								
(ii) Velocity														
± 20 in/s~~ec~~				✓										
± 28 in/s~~ec~~					✓	✓								

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(iii) Acceleration														
± 0·~~.~~4 g				✓										
± 0·~~.~~6 g					✓	✓								
(6) Longitudinal		N/A												
(i) Displacement														
± 27 in				✓										
± 34 in					✓	✓								
(ii) Velocity														
± 20 in/s~~ec~~				✓										
± 28 in/sec					✓	✓								
(iii) Acceleration														
± 0·~~.~~4 g				✓										
± 0·~~.~~6 g					✓	✓								
(7) Initial **r**~~R~~otational **a**~~A~~cceleration **r**~~R~~ate		N/A												All relevant rotational axes
All **a**~~A~~xes ± 225^{0}/s~~ec~~^{2}/s~~ec~~			✓	✓										
± ~~-~~300^{0}/s~~ec~~^{2}/s~~ec~~					✓	✓								
(8) Initial **l**~~L~~inear ~~A~~**a**cceleration **r**~~R~~ate		N/A	✓	✓										
(i) Vertical														
± 4 g/s~~ec~~														
± 6 g/s~~ec~~					✓	✓								
(ii) Lateral														
± 2 g/s~~ec~~				✓										
± 3 g/s~~ec~~					✓	✓								
(iii) Longitudinal														
± 2 g/s~~ec~~				✓										
± 3 g/s~~ec~~					✓	✓								
b. **Frequency Response Band, Hz**	Phase **a**~~A~~mplitude	N/A		✓	✓	✓								All six axis
	d~~D~~eg **r**~~R~~atio Db													
0·~~.~~1 to~~–~~ 1·~~.~~0	0 to -20 ± 2													
1·~~.~~1 to 3·~~.~~0	0 to -40 ± 4													

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
c. Leg Balance or Parasitic **a**~~A~~cceleration	1·~~.~~5 deg 0·~~.~~02 g or 3 deg/s~~ec~~² (peak)	N/A		✓	✓	✓								The phase shift between a datum jack & any other jack ~~shall~~ **should** be measured using a heave (vertical) signal of 0·~~.~~5 **H**~~h~~z at ± –0~~.~~·25 g**.** The acceleration in the other five axes should be measured using a heave (vertical) signal of 0.5 **H**~~h~~z at ± –0·~~.~~1 g**.**
d. Turn Around	0·~~.~~05 g			✓	✓	✓								The motion base ~~shall~~ **should** be driven sinusoidally in heave through a displacement of 6 in (150 –mm) peak to peak at a frequency of 0·~~.~~5 Hz. Deviation from the desired sinusoidal acceleration ~~shall~~ **should** be measured
e. Characteristic vibrations/buffet (1) Vibrations - **t**~~T~~ests to include 1/**r**~~R~~ev and n/**r**~~R~~ev vibrations where n is the number of rotor blades	+ 3 / - 6 db or ± –10% of nominal vibration level in flight cruise & correct trend (see comment)	On ground (idle **f**~~F~~lt **n**~~N~~r); **l**~~L~~ow & **h**~~H~~igh speed**;**~~; transition to & from hover;~~ Level flight; Climb/descent (including vertical climb; Auto–rotation; Steady **t**~~T~~urns				✓								Refer to ~~section~~ **book** 1, appendix 1 to ~~JAR-FSTD H 030~~**CS-FSTD(H).300** paragraph 1.2.e.1. Correct trend refers to a comparison of vibration amplitudes between different manoeuvres. E.g. If the 1/rev vibration amplitude in the helicopter is higher during steady state turns than in level flight this increasing trend ~~shall~~ **should** be demonstrated in the ~~simulator~~**FFS**.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(2) Buffet A test with recorded results is required for characteristic buffet motion which can be sensed in the cockpit	+ 3 / - 6 db or ± ~~-~~10% of nominal vibration level in flight cruise & correct trend (see comment)	On ground and in flight				✓								Refer to section 1, appendix 1 to **CS**~~JAR~~-FSTD**(**~~-~~H**)**.~~0~~30**0** paragraph 1.2.e.1. The recorded test results for characteristic buffets should allow the checking of relative amplitude for different frequencies. For atmospheric disturbance, general purpose models are acceptable which approximate demonstrable flight test data
f. Motion Cue Repeatability	N/A			✓	✓	✓								See para 2.4.3.3 below
5. VISUAL SYSTEM Note: **r**~~R~~efer to the table of functions & subjective tests for additional visual tests.														
a. Visual **g**~~G~~round **s**~~S~~egment (VGS)	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~~ **landing gear** height above touch down zone ~~elevation~~ on glide slope **with**~~at a RVR setting of~~ 300 ~~-~~m ~~(1 000 ft)~~ or 350 ~~-~~m ~~(1 200 ft)~~**RVR** ~~Static at 200 ft (61 m) landing gear height above touchdown zone on glide slope with 550 metres or 1805ft RVR~~	✓	✓	✓	✓								Visual **g**~~G~~round **s**~~S~~egment. 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**:** 1) RVR**;**~~,~~ 2) **g**~~G~~lideslope (G/S) and localiser modelling accuracy (location and slope) for an ILS**;**~~,~~ 3) **f**~~F~~or a given weight, configuration and speed representative of a point within the helicopter's operational envelope for a normal approach and landing.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
Visual **g**~~G~~round **s**~~S~~egment (VGS) (continued)		**Trimmed in landing configuration at 200 ft landing gear height above touch down zone on glide slope with 500 -m RVR**						✓	✓		✓	✓	✓	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. The downward field of view may be limited by the aircraft structure or the visual system display**,**~~-~~ whichever is ~~the~~ less.
b. Display **s**~~S~~ystem **t**~~T~~ests														
1. (a) Continuous cross-cockpit visual field of view	Continuous visual field of view providing each pilot with 180º horizontal and 60º vertical field of view. Horizontal FOV: **n**~~N~~ot less than a total of 176º (including not less than 75º measured either side of the centre of the design eye point). Vertical FOV: **n**~~N~~ot less than a total of 56~~-~~º measured from the pilot's and co-pilot's eye point.	~~Not Applicable~~**n/a**				✓								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. The 75º minimum~~s~~ allows an offset either side of the horizontal field of view if required for the intended use.
1. (b) Continuous cross-cockpit visual field of view	Continuous visual field of view providing each pilot with 150º horizontal and 60º vertical field of view. Horizontal FOV: **n**~~N~~ot less than a total of 146º (including not less than 60º measured either side of the centre of the design eye point).	~~Not Applicable~~**n/a**							✓			✓	✓	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. The 60º minimum~~s~~ allows an offset either side of the horizontal field of view if

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
	Vertical FOV: **n**~~N~~ot less than a total of 56~~-~~º measured from the pilot's and co-pilot's eye point.													required for the intended use.
1. (c) Continuous cross-cockpit visual field of view	Continuous visual field of view providing each pilot with 150º horizontal and 40º vertical field of view. Horizontal FOV: **n**~~N~~ot less than a total of 146º (including not less than 60º measured either side of the centre of the design eye point). Vertical FOV: **n**~~N~~ot less than a total of 36 º measured from the pilot's and co-pilot's eye point.	~~Not Applicable~~**n / a**			✓			✓			✓		✓	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. The 60º minimum~~s~~ allows an offset either side of the horizontal field of view if required for the intended use.
1. (d) Visual field of view	**V**~~v~~isual system providing each pilot with 75º horizontal and 40º vertical field of view **V**~~v~~isual system providing each pilot with 45º horizontal and 30º vertical field of view	~~Not Applicable~~**n / a**	 ✓	✓										
2. Occulting **d**~~D~~emonstrate 10 levels of occulting through each channel of the system	Demonstration model	~~Not applicable~~**n / a**	~~✓~~	~~✓~~	✓	✓		✓	✓		✓	✓	✓	
3. System geometry	5° even angular spacing within ± ~~-~~1° as measured from either pilot eye-point, and within 1·5° for adjacent squares.	~~Not Applicable~~**n / a**	✓	✓	✓	✓		✓	✓		✓	✓	✓	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

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
														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.
4. Surface **c**~~C~~ontrast **r**~~R~~atio	Not less than 5:1~~.~~ Demonstration model **Not less than 8:1. Demonstration model**				✓	✓		✓	✓		✓	✓	✓	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, no larger than 10° ~~degrees~~ and no smaller than 5° 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° spot photometer. This value should have a minimum brightness of 7 cd/m2 (2 ~~foo~~t-**L**~~l~~amberts). Measure any adjacent dark squares. The contrast ratio is the bright square value divided by the dark square value. *Note**:**~~.~~ **d**~~D~~uring contrast ratio testing, FSTD aft-cab and ~~flight deck~~**cockpit** ambient light levels should be zero.*
5. Highlight **b**~~B~~rightness	Not less than 20 cd/m^2 (6 ~~foo~~t-Lamberts) from the display measured at the design eye point	~~Not Applicable~~**n/a**			✓	✓								Highlight brightness should be measured by maintaining the full test pattern described in paragraph 5.b 3 above,

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
	Not less than 17 -cd/m^2 (5 -~~foo~~t-Lamberts) from the display measured at the design eye point							✓	✓		✓	✓	✓	superimposing a highlight on the centre white square of each channel and measuring the brightness. Lightpoints 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.**
6. Vernier **r**~~R~~esolution	Not greater than 3 arc minutes	~~Not Applicable~~**n/a**			✓	✓		✓	✓		✓	✓	✓	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.
7. Light-point **s**~~S~~ize	Not greater than 6 arc minutes	~~Not Applicable~~**n/a**			✓	✓			~~✓~~					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 40 lights in the case of 6 arc minutes (30 lights in the case of 8 arc minutes) will form a 4° angle or less.
	Not greater than 8 arc minutes Demonstration model	~~Not Applicable~~**n/a**		✓				✓	✓		✓	✓	✓	
8. Light-point **c**~~C~~ontrast	Not less than 25:1	~~Not applicable~~**n/a**			✓	✓		✓	✓					Lightpoint contrast ratio

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
r~~R~~atio	Not less than 5:1 Demonstration model							~~✓~~			✓	✓	✓	should be measured using a test pattern demonstrating a 1º area filled with lightpoints (i.e. lightpoint modulation just discernible) and should be compared to the adjacent background. *Note**:**~~.~~ **d**~~D~~uring contrast ratio testing, FSTD aft-cab and ~~flight deck~~**cockpit** ambient light levels should be zero*
6 FSTD SYSTEMS														
a Visual, Motion and Cockpit Instrument Response														
(1) Transport **d**~~D~~elay	200 ~~milliseconds~~ **ms** or less after control movement						✓			✓				One test is required in each axis (**p**~~P~~itch, **r**~~R~~oll & **y**~~Y~~aw)
	150 ~~milliseconds~~ **ms** or less after control movement		✓	✓				✓			✓	✓	✓	
	100 ~~milliseconds~~ **ms** or less after control movement				✓	✓			✓					
(1) Transport **d**~~D~~elay (continued)														This 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 (where applicable), to the visual system and instrument displays. A recordable start time for the test should be provided by a pilot flight control input. The

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
														test mode should permit normal computation time to be consumed and should not alter the flow of information through the hardware/software system. The Transport Delay of the system is then the time between control input and the individual hardware (systems) responses. It need only be measured once in each axis, being independent of flight conditions. Visual change may start before motion response but motion acceleration must occur before completion of visual scan of first video field that contains different information.
OR alternative test:														
Latency (2) Visual, motion (where fitted), **i**~~I~~nstrument **s**~~S~~ystem response to an abrupt pilot controller input, compared to helicopter response for a similar input.	150 ~~milliseconds~~ **ms** or less after helicopter response'	Climb, **c**~~C~~ruise and **d**~~D~~escent	✓	✓										One test is required in each axis (pitch, roll. and yaw) for each of the flight conditions, compared to helicopter data. Visual change may start before motion response but motion acceleration must occur before completion of visual scan of first video field that contains different information

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
Latency (continued)	100 ~~milliseconds~~ **ms** or less after helicopter response	Climb, **c**~~C~~ruise, **d**~~D~~escent and **h**~~H~~over (**h**~~H~~over FFS only)			✓	✓			✓					The test to determine compliance should include simultaneously recording the output from the pilot's cyclic, collective and pedals, the output from an accelerometer attached to the motion system platform located at an acceptable location near the pilot's seats (where applicable), the output from the visual system display (including visual system delays), and the output signal to the pilot's attitude indicator or an equivalent test approved by the ~~Authority~~**competent authority**. The test results in a comparison of a recording of the simulator's response with actual helicopter data

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
b Sound														
(1) Realistic engine and rotor sounds	**n/a~~N/A~~**									✓				**Statement of Compliance or demonstration of representative sounds**
(**2**~~1~~) Establish amplitude & frequency of ~~flight deck~~**cockpit** sounds	~~Not applicable~~**n/a**	On ground all engines on and Hover and Straight and **l**~~L~~evel flight	C T & M	C T & M	C T & M			C T & M	C T & M		**C T & M** ~~✓~~	**C T & M** ~~✓~~	**C T & M** ~~✓~~	Test results should show a comparison of the amplitude & frequency content of the sounds against data recorded at the initial FSTD qualification. No reference data are required for initial FSTD qualification.
(2) Establish amplitude & frequency of ~~flight deck~~**cockpit** sounds (continued)														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 second average should be taken at the location corresponding to the **h**~~H~~elicopter data set. The **h**~~H~~elicopter and ~~flight simulator~~ **FSTD** results should be produced using comparable data analysis techniques. See AMC ~~No.~~ 1**-** ~~to~~ CS**-**~~-~~FSTD (H).300 para 2.4.5
(i) 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.
(ii) All engines at idle a) rotor not turning (If applicable) b) rotor turning	± 5 dB per 1/3 octave band	Ground				✓								Normal condition prior to lift-off.
(iii) Hover	± 5 dB per 1/3 octave band	Hover				✓								
(iv) Climb	± 5 dB per 1/3 octave band	En-route climb				✓								Medium altitude.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(v) Cruise	± 5 dB per 1/3 octave band	Cruise				✓								Normal cruise configuration.
(vi) Final approach	± 5 dB per 1/3 octave band	Landing				✓								Constant airspeed, gear down.
(3) Special **c**~~C~~ases	~~Not Applicable~~**n / a**					**C T & M** ~~✓~~								Special cases identified as particularly significant to the pilot, important in training, or unique to a specific helicopter type or variant.
(4) ~~Flight Simulator~~**FSTD** **b**~~B~~ackground noise	Initial evaluation: ~~not applicable.~~**n / a** Recurrent evaluation: ± 3 dB 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~~ **should** be evaluated to ensure that the background noise does not interfere with training. Refer to AMC~~ No.~~ 1**-**~~ to ~~CS**-**~~-~~FSTD(H).300 para 2.4.5.6. The measurements are to be made with the simulation running, the sound muted and a dead cockpit.
(5) Frequency **r**~~R~~esponse	Initial evaluation: ~~not applicable.~~**n / a** 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(H).300 para 2.4.5.7. The results ~~shall~~ **should** be acknowledged by the **competent** authority at initial qualification.

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

2.4.1 Control dynamics

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 helicopter 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 helicopters 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 helicopters, hover, climb, cruise and autorotation may have like effects. Thus, one may suffice for another. If either or both considerations apply, engineering validation or helicopter 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 helicopter should show that the dynamic damping cycles (free response of the controls) match that of the helicopter 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~~.~~

(i) 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 helicopter control system and, consequently, ~~will~~ **should** enjoy the full tolerance specified for that period.

(ii) 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 $T(A_d)$ in Figure 1 is ± 5% of the initial displacement amplitude A_d from the steady state value of the oscillation. Only oscillations outside the residual band are considered significant. When comparing FSTD data to helicopter data, the process should begin by overlaying or aligning the FSTD and helicopter 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 helicopter 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 helicopter within ± 10%. Figure 2 illustrates the procedure.

c. Special considerations. Control systems, which 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.

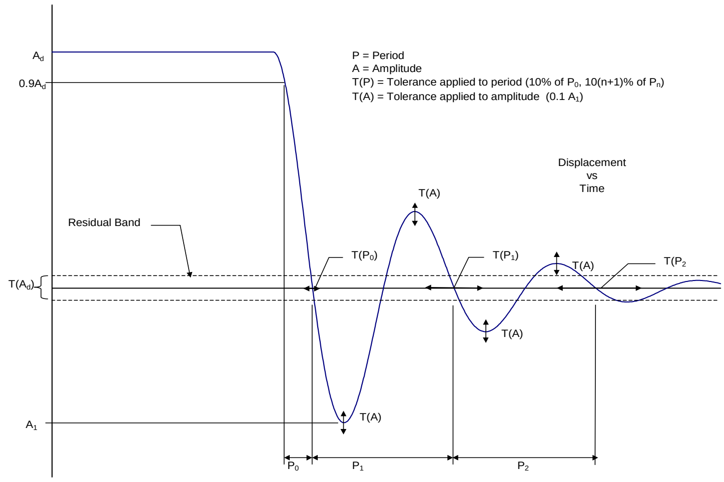

Figure 1: Underdamped step response

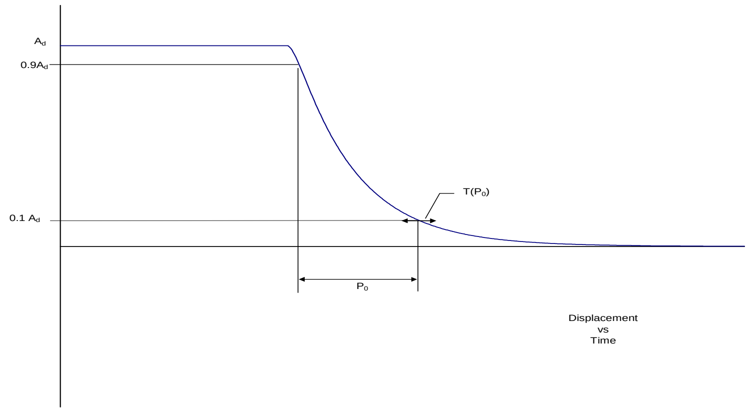

Figure 2: Critically damped step response

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 s~~econds~~ 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 table of ~~flight~~

~~simulator~~**FSTD** validation tests.

b. Dynamic test – ± 0.9 daN (2 lbs) or ± 10% on dynamic increment above static test.

The ~~Authority~~ **competent authority** is open to 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 aircraft with reversible control systems. Hence, each case should be considered on its own merit on an *ad hoc* basis. Should the ~~Authority~~ **competent authority** 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 lift-off and touch down it should faithfully reproduce the aerodynamic changes which occur in ground effect. The parameters chosen for FSTD validation should be indicative of these changes. **The primary validation parameters for characteristics in g~~G~~round e~~E~~ffect are:**

a. l~~L~~ongitudinal, lateral, directional and collective control positions;

b. t~~T~~orque required for hover;

c. h~~H~~eight;

d. a~~A~~irspeed;

e. p~~P~~itch angle; and

f. b~~B~~ank angle

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**:**~~.~~ **these**~~The level fly-bys~~ should be conducted at a minimum of three altitudes within the ground effect, including one at no more than 10% of the rotor diameter above the ground, one each at approximately 30% and 70% of the rotor diameter where height refers to main gear above the ground. In addition, one level-flight trim condition should be conducted out of ground effect, e.g. at 150% of rotor diameter. Level 2 / 3 FTD~~'~~s and II / III FNPT~~'~~s may use methods other than the level fly-by method.

b. Shallow approach landing**:**~~.~~ **this** ~~The shallow approach landing~~ 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 helicopter. In concert with the instruments and outside-world visual information, whole-body motion feedback is essential in assisting the pilot to control the helicopter'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 helicopter 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 in this paragraph 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. 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, paragraph 2.3 - 4.a**:**~~,~~ **m**~~M~~otion ~~Enveloppe~~**eEnvelope**, 4.b**:**~~,~~ **f**~~F~~requency **r**~~R~~esponse **b**~~B~~and, 4.c**:**~~,~~ **l**~~L~~eg **b**~~B~~alance and 4.d**:**~~,~~ **t**~~T~~urn **a**~~A~~round, 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 Cueing Performance Signature~~**Motion c**~~C~~**ue r**~~R~~**epeatability t**~~T~~**esting**

The motion system characteristics in the table of v~~V~~**alidation t**~~T~~**ests address basic system capability, but not pilot cueing capability. Until there is an objective procedure for determination of the motion cues necessary to support pilot tasks and stimulate the pilot response** ~~**which**~~**that occurs in an aircraft for the same tasks, mot-ion systems** ~~**will**~~**should continue to be "tuned" subjectively. Having tuned a motion system, however, it is important to demonstrate objectively that the system continues to perform as originally qualified. Any mot—ion performance change from the initially qualified baseline can be measured objectively. An objective assessment of motion performance change** ~~**will**~~**should be accomplished at least annually using the following testing procedure:**

a. **The current performance of the motion system should be assessed by comparison with the initial recorded data.**~~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 helicopter 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. **The parameters to be recorded should be the motion system drive algorithm acceleration command and the actual acceleration measured from the simulator accelerometers.**

~~List of tests. Table 1 delineates those tests that are important to pilot motion cueing and are general tests applicable to all types of helicopters 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 Authority prior to or during the initial qualification.~~

c. **The test input signals should be inserted at an appropriate point prior to the integration in the equations of motion (see figure 3).**

~~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 helicopter 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 helicopter simulation model.~~

d. **The characteristics of the test signal (see figure 4) should be set so that the acceleration command reaches 2/3 the motion system acceleration envelope as defined in section 4 a) for the linear axes. For the angular axes the velocity command should reach 2/3 of the angular velocity envelope as defined in section 4 a). The time T1 should be of sufficient duration to ensure steady initial conditions.**

~~Data Recording. 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;~~

~~4. actual platform acceleration at pilot reference point.~~

NOTE: If the simulator weight or CG~~C.G.~~ changes for any reason, (i.e. visual system change, or structural change) then the motion system baseline performance repeatability tests should be rerun and the new results used for future comparison.

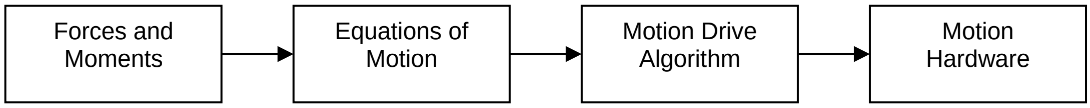

Figure 3~~Linear Accelerations~~

~~or~~

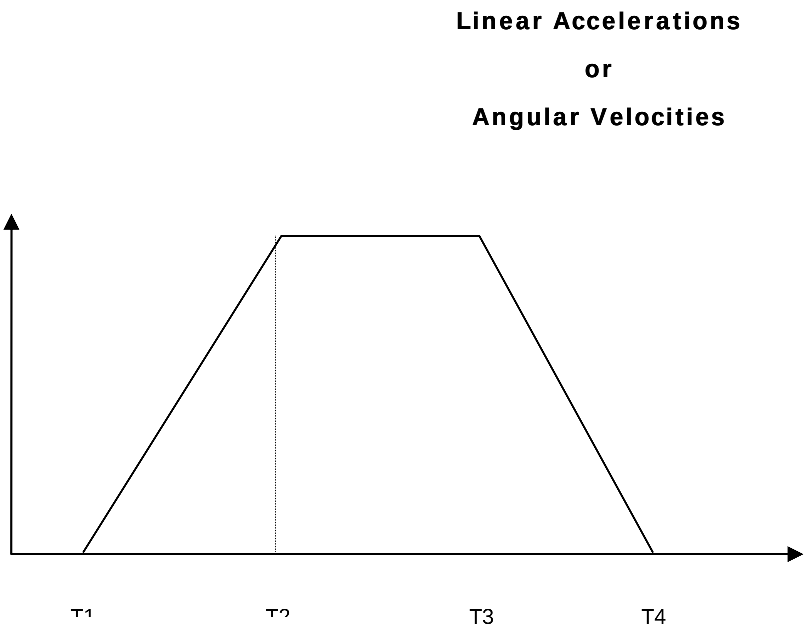

Figure 4

~~2.4.3.4 Motion System Repeatability.~~

~~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 will allow 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. Condition: One test case In-flight: to be determined by the operator.~~

~~b. Input: The inputs should be such that both rotational accelerations/rates and linear accelerations are inserted before the transfer from helicopter centre of gravity to pilot reference point with a minimum amplitude of 5deg/sec/sec, 10deg/sec 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;~~

~~Motion actuators position~~

~~No.~~	~~Associated validation test~~	~~Manoeuvre~~	~~Priority~~	~~Comments~~
~~1~~	~~1c1~~	~~Take-off~~	~~X~~	
~~2~~	~~1c2~~	~~Engine failure continued take-off~~	~~X~~	
~~3~~	~~1c3~~	~~Pitch change during rejected take-off~~	~~X~~	
~~4~~	~~1e~~	~~Vertical climb X Resulting effects of power changes~~	~~X~~	~~Resulting effects of power changes~~
~~5~~	~~1j2~~	~~Landing flare~~	~~X~~	
~~6~~	~~1j4~~	~~Touchdown autorotative landing~~	~~X~~	

~~Table 1 – Tests required for initial qualification~~

2.4.3.**4**~~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 helicopter 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 helicopter 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 helicopter 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 helicopter 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 $1x10^{-3}$ –grms^2/Hz would describe a heavy buffet. On the other hand, a $1x10^{-6}$ –grms^2/Hz buffet is almost 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 **display** system

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 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 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 2.3.5.b.(3) and paragraph 2.3.5.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 degree spot photometer. Lightpoints are not acceptable. Use of calligraphic capabilities to enhance raster brightness is acceptable. See paragraph 2.3.5.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 eye point. This should be confirmed by calculations in the statement of compliance. See paragraph 2.3.5.b.(5).

d. Light–point size (daylight systems) ~~–~~should be measured in a test pattern consisting of a single row of light–points reduced in length until modulation is just discernible. See paragraph 2.3.5.b.(6).

e. Light–point size (twilight and night systems) – of sufficient resolution so as to enable achievement of visual feature recognition tests according to paragraph 2.3.5.b.(6).

f. Field of **v**~~V~~iew **(FOV)**. A continuous field of view is a fundamental requirement. Any visual display solution would be considered as long as it fulfils this requirement. Deviations from the minimum required field of view would only be considered when associated with helicopter structural cockpit masking. Although the visual system has to meet the test requirements at the pilot's design eye reference point, the visual system should cater for nominal pilot(s) head movement in support of the training.

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 helicopter can be readily determined using approach/runway lighting and ~~flight deck~~**cockpit** instruments.

b. The QTG should indicate the source of data, i.e. ~~airport~~ **aerodrome** and runway used, ILS G/S antenna location (airport and helicopter), pilot eye reference point, ~~flight deck~~**cockpit** cut-off angle, helicopter pitch **angle**~~attitude~~ etc., used to make accurate~~ly~~ visual ground segment (VGS) scene content calculations.

c. Automatic positioning of the simulated helicopter on the ILS is encouraged. If such positioning is accomplished, diligent care should be taken to ensure the correct spatial position and helicopter 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 helicopter is very complex, and changes with atmospheric conditions, helicopter configuration, airspeed, altitude, power settings, etc. Thus, ~~flight deck~~**cockpit** sounds are an important component of the ~~flight deck~~**cockpit** 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~~**cockpit** sounds that are perceptible to the pilot during normal and abnormal operations, and that are comparable to those of the helicopter. 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 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 engine configurations any condition listed in ~~paragraph 2.3,~~ the table of FSTD validation tests ~~,~~**(paragraph 2.3)**– that is identified by the helicopter 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 contain calibration and frequency response data.

b. The system used to perform the tests listed in para. 2.3, within the table of FSTD validation tests, should comply with the following standards:

(i) ANSI S1.11-1986 - Specification for octave, half octave and third octave band filter sets; **and**

(ii) IEC 1094-4 - 1995 - measurement microphones - type WS2 or better.

2.4.5.4 Headsets. If headsets are used during normal operation of the helicopter 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~~,~~ **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 helicopter, and the extraneous noise from other locations in the building. Background noise can seriously impact the correct simulation of helicopter sounds, so the goal should be to keep the background noise below the helicopter 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 helicopter being represented. Background noise levels that fall below the lines defined by the following points, may be acceptable (refer to figure 3 **below**):

(i) 70 dB @ 50 Hz;

(ii) 55 dB @ 1 000 Hz;

(iii) 30 dB @ 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. Helicopter sounds~~,~~ ~~which~~ **that** fall below this limit require careful review and may require lower limits on the background noise.

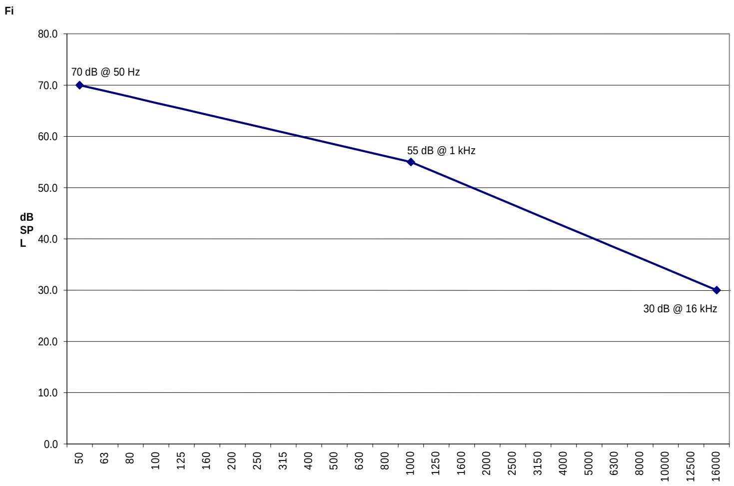

Figure 3. 1/3 Octave Band Frequency (Hz)

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 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 helicopter cases, then it is not required to rerun those cases during recurrent evaluations.

If helicopter cases are rerun during recurrent evaluations then the results may be compared against initial evaluation results rather than helicopter master data.

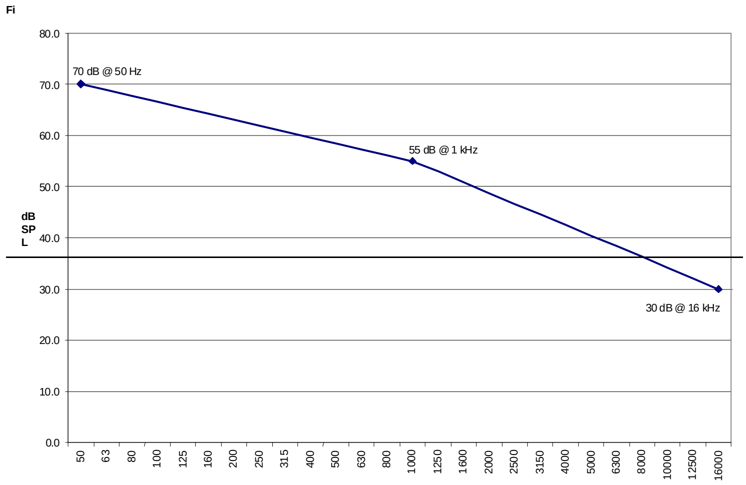

Figure 3. 1/3 Octave Band Frequency (Hz)

2.4.5.9 Validation testing. Deficiencies in helicopter recordings should be considered when applying the specified tolerances to ensure that the simulation is representative of the helicopter. 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.

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 helicopter systems functions ~~will~~ **should** be checked at each flight crew member position. This includes procedures using the operator's approved manuals, helicopter manufacturers**'** approved manuals and checklists. Handling qualities, performance, and FSTD systems operation ~~will~~ **should** 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 ~~Authority~~ **competent authority** responsible for the evaluation so that any skills, experience or expertise needed by the ~~Authority~~ **competent authority** 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 helicopter. 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 ~~Authority~~**competent authority**, 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 ~~will~~ **should** be run in a logical flight sequence at the same time as performance and handling assessments. This also permits real time FSTD running for **two**~~2~~ 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 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 helicopters and innovative training programmes.

3.2.3 All systems functions ~~will~~ **should** be assessed for normal and, where appropriate, alternate operations. Normal, abnormal, and emergency procedures associated with a flight phase ~~will~~ **should** 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 helicopter. 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**s** should be tailored only to the systems and flight conditions which have been simulated. Similarly, many tests ~~will~~ **should** be applicable for automatic flight. Where automatic flight is not possible and pilot manual handling is required, the FSTD 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~~

~~Notes~~

~~General: Motion and buffet cues will only be applicable to FSTD equipped with an appropriate motion system~~

~~(1) Limited to clear area profiles~~

~~(2) Limited to performance~~

~~* Check for the absence of negative effect~~

Functions and subjective tests

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS		FFS				FTD			FNPT			
		A	**B**	**C**	**D**	**1**	**2**	**3**	**I**	**II**	**III**	**MCC**
a	**PREPARATION FOR FLIGHT**											
	Pre-**f**~~F~~light: **a**~~A~~ccomplish a functions check of all switches, indicators, systems and equipment at crew members and instructors stations and determine that the ~~flight deck~~**cockpit** design and functions are identical to that of the helicopter within the scope of simulation.	✓	✓	✓	✓	✓	✓	✓				
	Pre-**f**~~F~~light: **a**~~A~~ccomplish a functions check of all switches, indicators, systems, and equipment at all crew members' and instructor's stations and determine that the ~~flight deck~~**cockpit** design and functions represents those of a helicopter								✓	✓	✓	✓
b	**SURFACE OPERATIONS**											
	(1) Engine **s**~~S~~tart **(a)** Normal **s**~~S~~tart	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(b) Alternate start procedures	✓	✓	✓	✓	✓	✓	✓	~~✓~~	~~✓~~	~~✓~~	~~✓~~
	(c) Abnormal starts and shutdowns (hot start, hung start, fire, etc)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(2) Rotor start/engagement and acceleration **(a) –Rotor start / engagement and acceleration**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	~~(b)~~ **(b)** Ground resonance (if applicable on type)~~.~~	✓	✓	✓	✓							
	(3)Ground taxi (wheeled aircraft only) **(a)** Power/cyclic input	*	✓	✓	✓		✓	✓		✓	✓	✓
	(b) Collective lever/cyclic friction	*	✓	✓	✓		✓	✓		✓	✓	✓
	(c) Ground handling	*	✓	✓	✓		✓	✓		✓	✓	✓
	(d) Brake operation	*	✓	✓	✓		✓	✓		✓	✓	✓
	(e) Tail-/nosewheel lock operation	*	✓	✓	✓		✓	✓		✓	✓	✓
	(f) Other	*	✓	✓	✓		✓	✓		✓	✓	✓
c	**HOVER**											
	(1) Lift-off	*	✓	✓	✓		~~✓~~	~~✓~~		~~✓~~	~~✓~~	~~✓~~
	(2) Hover	*	✓	✓	✓		✓	✓		✓	✓	✓
	(3) Instrument response											
	(a) Engine instruments	*	✓	✓	✓		✓	✓		✓	✓	✓
	(b) Flight instruments	*	✓	✓	✓		✓	✓		✓	✓	✓
	(4) Hovering turns	*	*	✓	✓		✓	✓		✓	✓	✓
	(5) Hover power checks											

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS		**FFS**				**FTD**			**FNPT**			
		A	**B**	**C**	**D**	**1**	**2**	**3**	**I**	**II**	**III**	**MCC**
	(a) In ground effect (IGE)	*	✓	✓	✓		✓	✓		✓	✓	✓
	(b) Out of ground effect (OGE)	*	✓	✓	✓		✓	✓		✓	✓	✓
	(6) Anti-torque effect	*		✓	✓		✓	✓		✓	✓	✓
	(7) Abnormal/emergency procedures:											
	(a) Engine failure(s)	*	✓	✓	✓		✓	✓		✓	✓	✓
	(b) Fuel governing system failure	*	✓	✓	✓		✓	✓		✓	✓	✓
	(c) Hydraulic system failure	*	✓	✓	✓		✓	✓		✓	✓	✓
	(d) Stability system failure	*	✓	✓	✓		✓	✓		✓	✓	✓
	(e) Directional control malfunctions	*	✓	✓	✓		✓	✓		✓	✓	✓
	(f) Other	*	✓	✓	✓		✓	✓		✓	✓	✓
	(8) Crosswind/tailwind hover	*	✓	✓	✓		✓	✓		✓	✓	✓
d	**AIR TAXI / TRANSIT**											
	(1) Forward	*	✓	✓	✓		✓	✓		✓	✓	✓
	(2) Sideways	*	✓	✓	✓		✓	✓		✓	✓	✓
	(3) Rearward	*	✓	✓	✓		✓	✓		✓	✓	✓
e	**TAKE-OFF**											
	(1) Cat. B or single engine helicopters											
	(a) Normal (**i**~~I~~) From hover	*	✓	✓	✓		✓	✓		✓	✓	✓
	(**ii**~~II~~) Crosswind/tailwind	*	✓	✓	✓		✓	✓		✓	✓	✓
	(**iii**~~III~~) MTOM	*	✓	✓	✓		✓	✓		✓	✓	✓
	(**iv**~~IV~~) Confined area	*	✓	✓	✓			✓			✓	✓
	(**v**~~V~~) Slope	*	✓	✓	✓			✓			✓	✓
	(**vi**~~VI~~) Elevated ~~heliport~~**FATO**/helideck	*	✓	✓	✓			✓			✓	✓
	(**vii**~~VII~~) Vertical	*	✓	✓	✓							
	(b) **A**~~a~~bnormal/emergency procedures**:**											
	(**i**~~I~~) Engine failure during take-off (**i**~~I~~f single engine, up to initiation of the flare)	*	✓	✓	✓		✓1	✓		✓1	✓	✓
	(**ii**~~II~~) Forced landing (**i**~~I~~f single engine, up to initiation of the flare)	*	✓	✓	✓		✓	✓		✓1	✓	✓
	(2) Cat A operation for all certified profiles	*	✓	✓	✓		✓1	✓		✓1	✓	✓
	Take-off with engine failure**:**											
	(i) **E**~~e~~ngine failure prior to TDP	*	✓	✓	✓		✓1	✓			✓	✓
	(ii) **E**~~e~~ngine failure at or after TDP	✓	✓	✓	✓		✓1	✓		✓1	✓	✓1

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS		FFS				FTD			FNPT			
		A	B	C	D	1	2	3	I	II	III	MCC
F	**CLIMB**											
	(1) Cat. B or single engine helicopters**:**											
	(a) ~~-~~Clear area	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(b) Obstacle clearance	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(c) Vertical	*	✓	✓	✓		✓	✓		✓	✓	✓
	(d) ~~-~~Engine failure	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(e) ~~-~~Other	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(2) Cat. A operation for all certified profiles											
	with engine failure up to 300 m (1 000 ft) above the level of the ~~heliport~~**aerodrome/operating site**	✓	✓	✓	✓		✓	✓		✓	✓	✓
G	**CRUISE**											
	(1) Performance characteristics	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(2) Flying qualities (including turns at **r**~~R~~ate 1 and 2)	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(3) Turns**:**											
	(a) Turns at **r**~~R~~ate 1 and 2	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	(b) Steep **t**~~T~~urns	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	(4) Acceleration and decelerations	✓	✓	✓	✓							
	(5) High airspeed vibration cues	✓	✓	✓	✓		~~✓~~	~~✓~~		~~✓~~	~~✓~~	~~✓~~
	(6) Abnormal/emergency procedures:											
	(a) Engine fire	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(b) Engine failure	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(c) In flight engine shutdown and restart	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(d) Fuel governing system failures	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(e) Hydraulic failure	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(f) Stability system failure	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(g) Directional control malfunction	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(h) Rotor vibration cues	✓	✓	✓	✓		~~✓~~	~~✓~~		~~✓~~	~~✓~~	~~✓~~
	(i) Other	✓	✓	✓	✓		✓	✓		✓	✓	✓
h	**DESCENT**											
	(1) Normal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(2) Maximum rate	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	(3) Autorotative (until flare initiation)**:**											

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS		**FFS**				**FTD**			**FNPT**			
		A	**B**	**C**	**D**	**1**	**2**	**3**	**I**	**II**	**III**	**MCC**
	(a) –Straight in	*	✓	✓	✓		✓	✓	✓	✓	✓	✓
	(b) With turn	*	✓	✓	✓		✓	✓	✓	✓	✓	✓
i	**VISUAL APPROACHES**											
	(1) Cat. B or single engine helicopters**:**											
	(a) Approach											
	(i) Normal	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(ii) Steep	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(iii) Shallow	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(iv) Vertical	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(b) Abnormal and emergency procedures:											
	(i) One engine inoperative	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(ii) Fuel governing failure	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(iii) Hydraulics failure	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(iv) Stability system failure	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(**v**~~V~~) Directional control failure	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(**vi**~~VI~~) Autorotation	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(**vii**~~VII~~)– Other	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(c) Balked landing**:**											
	(**i**~~I~~) All engines operating	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(**ii**~~II~~) One or more engines inoperative	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(2) Cat. A operation for all certified profiles**:**											
	(a) from 300 m (1 000 ft) above the level of the ~~heliport~~ **aerodrome/operating site** to or after LDP	✓	✓	✓	✓		✓	✓		✓	✓	✓
j	**INSTRUMENT APPROACHES**											
	Only those instrument approach tests relevant to the simulated helicopter type or system(s) and MCC training should be selected from the following list.											
	(1) Non-precision**:**											
	(a) All engines operating	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(b) One or more engines inoperative	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(c) Approach procedures:											
	(i) NDB	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(ii) VOR/DME, RNAV	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(iii) ARA (Airborne radar approach)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS		**FFS**				**FTD**			**FNPT**			
		A	**B**	**C**	**D**	**1**	**2**	**3**	**I**	**II**	**III**	**MCC**
	(iv) GPS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(v) Other	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(d) Missed approach**:**											
	(i) All engines operating	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(ii) One or more engines inoperative	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(iii) Auto-pilot failure**.**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(2) Precision**:**											
	(a) All engines operating	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(b) One or more engines inoperative	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(c) Approach procedures:	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(i) DGPS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(ii) ILS**:** **-** Manual without **f**~~F~~light **d**~~D~~irector, **-** Manual with **f**~~F~~light **d**~~D~~irector **-** Auto-pilot coupled **-** CAT I **-** CAT II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(iii) Other	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(d) –Missed approach**:**											
	(i) All engines operating	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(ii) One or more engines inoperative	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(iii) Auto pilot failure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
k	**APPROACH TO LANDING AND TOUCH DOWN**											
	(1) Cat**.** B or single engine helicopters											
	(a) –Normal approach											
	(i) To a hover	*	✓	✓	✓		✓1	✓		✓1	✓	✓
	(ii) Elevated ~~heliport~~**FATO**/helideck		✓	✓	✓			✓			✓	✓
	(iii) Confined area	*	✓	✓	✓			✓			✓	
	(iv) Crosswind/tailwind	*	✓	✓	✓		✓1	✓		✓1	✓	✓
	(v) Other	*	✓	✓	✓		✓1	✓		✓1	✓	✓
	(b) –Touch down**:**											
	(i) From a hover	*	✓	✓	✓		✓1	✓		✓1	✓	✓
	(ii) Running	*	✓	✓	✓		✓1	✓		✓1	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS		FFS				FTD			FNPT			
		A	**B**	**C**	**D**	**1**	**2**	**3**	**I**	**II**	**III**	**MCC**
	(iii) Slope	*	*	✓	✓			✓			✓	
	(c) —Abnormal and emergency procedures during approach to landing and touch down**:**											
	(i) **OEI**	✓~~*~~	✓	✓	✓		✓1	✓		✓1	✓	✓
	(ii) Fuel governing failure	✓~~*~~	✓	✓	✓		✓1	✓		✓1	✓	✓
	(iii) Hydraulics failure	✓~~*~~	✓	✓	✓		✓1	✓		✓1	✓	✓
	(iv) Stability system failure	✓~~*~~	✓	✓	✓		✓1	✓		✓1	✓	✓
	(v) Directional control failure	✓~~*~~	✓	✓	✓		✓1	✓		✓1	✓	✓
	(vi) Autorotation	*	✓	✓	✓		✓1	✓		✓1	✓	✓
	(vii) Other	✓~~*~~	✓	✓	✓		✓1	✓		✓1	✓	✓
	(2) Cat. A operation for all certified profiles											
	(a) Landing with engine failure**:**											
	(i) **E**~~e~~ngine failure prior to or at LDP	*	✓	✓	✓		✓1	✓		✓1	✓	✓
	(ii) ~~——~~**E**~~e~~ngine failure at or after LDP	*	✓	✓	✓		✓1	✓		✓1	✓	✓
I.	**ANY FLIGHT PHASE**											
	(1) Helicopter and powerplant systems operation (**a**~~A~~s applicable)											
	(a) Air conditioning	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(b) Anti-icing/de-icing	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(c) Auxiliary powerplant	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(d) Communications	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(e) Electrical	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(f) Lighting systems (internal and external)	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(g) Fire and smoke detection and suppression	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(h) Stabili**s**~~z~~er	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(i) Flight controls/antitorque systems	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(j) Fuel and oil	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(k) Hydraulic	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(l) Landing gear	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(m) Power plant	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(n) Transmission systems	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(o) Rotor systems	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(p) Flight control computers	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(q) Stability and control augmentation systems (SAS)	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(r) Voice activated systems	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS		FFS				FTD			FNPT			
		A	B	C	D	1	2	3	I	II	III	MCC
	(s) Other	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(2) Flight management and guidance systems (as applicable)											
	(a) ~~–~~Airborne radar	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(b) Automatic landing aids	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(c) Autopilot	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(d) Collision avoidance systems (GPWS, **ACAS,** ~~TCAS~~**.**~~,…~~)	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(e) Flight data displays	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(f) Flight management computers	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(g) Head-up displays	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(h) Navigation system	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(i) NVG	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(j) Other	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(3) Airborne procedures											
	(a) ~~–~~Quickstop	*	*	✓	✓		✓	✓		✓	✓	✓
	(b) Holding pattern	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	~~(c)~~ **(c)** Hazard avoidance (GPWS, TCAS, Weather radar~~, …~~)**.** As applicable, except for **w**~~W~~eather **r**~~R~~adar required for MCC training in FNPT.	*	*	✓	✓		✓	✓		✓	✓	✓
	(d) Retreating blade stall recovery (**a**~~A~~s applicable)	*	✓	✓	✓		✓	✓		✓	✓	✓
	(e) Rotor mast bumping (**a**~~A~~s applicable)	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(f) Vortex ring	*	✓	✓	✓		✓	✓		✓	✓	✓
m	**ENGINE SHUTDOWN AND PARKING**											
	(1) Engine and systems operation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(2) Parking brake operation	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(3) Rotor brake operation	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(4) Abnormal and emergency procedures	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
	(5) Other	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
n	**MOTION EFFECTS**											
	(1) Runway rumble, oleo deflections, effects of ground speed and uneven surface characteristics	*	✓	✓	✓							
	(2) Buffet due to translational lift	*	✓	✓	✓							
	(3) Buffet during extension and retraction of landing gear	*	✓	✓	✓							
	(4) Buffet due to high speed and retreating blade stall	*	✓	✓	✓							
	(5) Buffet due to vortex ring	*	✓	✓	✓							

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS		**FFS**				**FTD**			**FNPT**			
		A	**B**	**C**	**D**	**1**	**2**	**3**	**I**	**II**	**III**	**MCC**
	(6) Representative cues resulting from touch down	*	✓	✓	✓							
	(7) Rotor(s) vibrations (motion cues)	✓	✓	✓	✓							
	(8) Translational lift	*	✓	✓	✓							
	(9) Loss of anti-torque device effectiveness	*	✓	✓	✓							
o	**SOUND SYSTEM**											
	Significant helicopter noises should include:											
	(1) Engine, rotor and transmission to a comparable level found in the helicopter.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	(2) Sounds of a crash should be related to a logical manner to landing in an unusual attitude or in excess of structural limitations of the helicopter.	✓	✓	✓	✓		✓	✓	✓	✓	✓	~~✓~~
	(3) Significant ~~flight deck~~**cockpit** sounds and those which result from pilot's actions.	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
p	**SPECIAL EFFECTS**											
	(1) Effects of icing**:**											
	(a) Airframe	*	*	✓	✓		✓2	✓2		✓2	✓2	✓2
	—(b) Rotors	*	*	✓	✓		✓2	✓2		✓2	✓2	✓2
	(2) Effects of rotor contamination.			✓	✓							
q	**VISUAL SYSTEM**											
	(1) Accurate portrayal of environment relating to simulator attitudes and position.	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(2) **Aerodromes/operating sites:**											
	(a) The distances at which ~~heliport~~ **aerodrome/operating site** features are visible should not be less than those listed —below. Distances are measured from the FATO centre to a helicopter aligned with the FATO approach direction on an extended 3-degree glideslope.											
	(i) ~~—Heliport~~ **Aerodrome** definition, strobe lights, approach lights from 8 km	✓	✓	✓	✓		✓	✓		✓	✓	✓
	Visual approach **a**~~A~~ids and FATO/LOF edge lights should be visible from 5kmthrough approach angles up to 12 degrees	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(iii) -FATO/LOF edge lights and taxiway definition from 3 km	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(iv) -FATO and TLOF markings within range of landing lights for night scenes	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(v) –FATO and TLOF markings as required by surface resolution on day scenes	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(b) At least three different ~~heliport~~ **aerodrome/operating site** scenes which should be:											
	(i) –an airport	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(ii) -a surface level confined area and		✓	✓	✓			✓			✓	✓
	(iii) -an elevated ~~heliport~~**FATO**		✓	✓	✓			✓			✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS		FFS				FTD			FNPT			
		A	**B**	**C**	**D**	**1**	**2**	**3**	**I**	**II**	**III**	**MCC**
	(c) Representative ~~heliport~~ **aerodrome / operating site** scene content including the following:											
	(i) ~~–~~Surfaces and markings on runways, ~~heliport~~**operating sites**, taxiways and ramps	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(ii) ~~–~~Lighting for the FATO/TLOF, visual approach aids and approach lighting of appropriate colours	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(iii) ~~Heliport~~**Aerodrome / operating site** perimeter and taxiway lighting	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(iv) ~~-~~Ramps and terminal buildings and vertical objects which correspond to the operational requirements of an operator's LOFT scenario.	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(v) ~~–~~The directionality of strobe lights, approach lights, runway edge lights, visual landing aids, runway centre line lights, threshold lights, and touch down zone lights on the runway of intended landing should be realistically replicated	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(3) Representative visual effect of helicopter external lighting in reduced visibility, such as reflected glare, to include landing lights, strobes, and beacons		✓	✓	✓		✓	✓		✓	✓	✓
	(4) Instructor controls of the following:											
	(a) Cloud base/cloud tops;	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(b) Visibility in kilometres **or** ~~/~~nautical miles and RVR in meters **or** ~~/~~feet;	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(c) **Aerodrome / operating site** selection;	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(d) **Aerodrome / operating site** lighting;	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(e) **G**~~g~~round and flight traffic.			✓	✓		✓	✓				✓
	(5) Visual system compatibility with aerodynamic programming	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(6) Visual cues to assess sink rate displacements, rates and height AGL during landings (e.g. runways/~~heliports~~**operating sites**, taxiways, ramps and terrain features).	*	✓	✓	✓		✓	✓		✓	✓	✓
	(7) Visual scene capability**:**~~.~~											
	(a) Twilight and night	✓	✓									
	(b) Twilight, night and day			✓	✓		✓	✓		✓	✓	✓
	(8) General terrain characteristics~~.~~ Below 5 000 ft present realistic visual scene permitting navigation by sole reference to visual landmarks. Terrain contouring should be suitably represented.	*	✓	✓	✓		✓	✓			✓	✓
	(9) At and below 610 m (2 000 ft) height above the ~~airport/heliport~~**aerodrome / operating site** and within a radius of 16 ~~kilometres~~ **km** (9 NM) from the ~~airport/heliport~~**aerodrome / operating site**, weather representations, including the following**:**~~;~~											
	(a) Variable cloud density			✓	✓							
	~~(b)~~ **(b)** Partial obscuration of ground scenes; the effect of a scattered to broken cloud deck			✓	✓		✓	✓			✓	✓
	(c) Visual cues of speed through clouds				✓							

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS		**FFS**				**FTD**			**FNPT**			
		A	**B**	**C**	**D**	**1**	**2**	**3**	**I**	**II**	**III**	**MCC**
	(d) Gradual break out			✓	✓		✓	✓			✓	✓
	(e) Visibility and RVR measured in terms of distance~~.~~	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(f) Patchy fog			✓	✓							
	(g) The effect of fog on ~~airport~~**aerodrome**/~~heliport~~ **operating site** lighting.			✓	✓		✓	✓			✓	✓
	(10) A capability to present ground and air hazards such as another aircraft crossing the active runway and converging airborne traffic			✓	✓							✓
	(11) Operational visual scenes which provide a cue rich environment sufficient for precise low airspeed and low altitude manoeuvring and landing.			✓	✓		✓	✓			✓	✓
	(12) Operational visual scenes which portray representative physical relationships known to cause landing illusions such as short runways, landing approaches over water, uphill, downhill and sloping landing areas, rising terrain on the approach path, and unique topographic features.				✓							
	Note - ~~i~~Illusions may be demonstrated at a generic ~~airport~~ ***aerodrome*** *or specific aerodrome* ***/ operating site****.*											
	(13) Special weather representations of light, medium, heavy precipitation and lighting near a thunderstorm on take**-**off, approach and landing at and below an altitude of 610 m (2 000 ~~feet~~) above the ~~airport/heliport~~**aerodrome / operating site** surface and within a radius of 16 ~~kilometres~~ **km** (9 NM) from the ~~airport/heliport~~**aerodrome / operating site**.				✓							
	(14) Wet and snow-covered landing areas including runway/~~heliport~~ **operating site** lighting reflections for wet, partially obscured lights for snow or suitable alternative effects.				✓							
	(15) The effects of swell and wind on a 3**-**dimensional ocean model should be simulated.				✓							
	(16) The effects of own helicopter downwash upon various surfaces such as snow, sand, dirt and grass should be simulated including associated effects of reduced visibility.				✓							
	(17) Realistic colour and directionality of ~~airport/heliport~~**aerodrome / operating site** lighting.	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(18) The visual scene should correlate with integrated helicopter systems, where fitted (e.g. terrain, traffic and weather avoidance systems and **h**~~H~~ead-up **g**~~G~~uidance **s**~~S~~ystem (H**U**GS)) (For FTD and FNPT may be restricted to specific geographical areas.) Weather radar presentations in helicopters where radar information is presented on the pilot's navigation instruments. Radar returns should correlate to the visual scene.			✓	✓		✓	✓				✓
	(19) Dynamic visual representation of rotor tip path plane including effects of rotor start up and shut down as well as orientation of the rotor disc due to pilot control input.			✓	✓							
	(20) To support LOFT, the visual system should provide smooth transition to new operational scenes without flight through clouds.				✓			✓			✓	✓
	(21) The visual system should provide appropriate height and 3-D object collision detection feedback to support training.			✓	✓		✓	✓		✓	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS		FFS				FTD			FNPT			
		A	B	C	D	1	2	3	I	II	III	MCC
	(22) ~~—~~Scene quality											
	(a) surfaces and textural cues should be free from distracting quantis~~z~~ation (aliasing)	✓	✓	✓	✓		✓	✓		✓	✓	✓
	(b) the system light~~-~~points should be free from distracting jitter, smearing or streaking			✓	✓							
	(c) system capable of six discrete light step controls (0-5)	✓	✓	✓	✓		✓	✓		✓	✓	✓

Notes

General: Motion and buffet cues ~~will~~should only be applicable to FSTD equipped with an appropriate motion system

(1) Limited to clear area profiles

(2) Limited to performance

**** ~~-~~Check for the absence of negative effect***

Appendix 1 to AMC ~~No.~~ 1- ~~to~~ CS-FSTD(H).300 Validation t~~T~~est t~~T~~olerances

1 Background

1.1 The tolerances listed in AMC ~~No.~~ 1- ~~of~~ CS-FSTD(H).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 reasons, 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 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 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) **i**~~I~~nterpolation methods;

(ii) **d**~~D~~ata handling differences; **or**

(iii) **a**~~A~~uto-test trim tolerances, etc.

1.7 Any differences should, however, be small and the reasons for any differences, other than those listed above, should be clearly explained.

1.8 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 data.

1.9 The current rapid increase in the use and projected use of engineering simulation data is an important issue because:

a. **f**~~F~~light -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 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(H).300 Validation data roadmap

1. General

1.1 Helicopter 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 helicopter 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, and for qualification of alternate engine or avionics fits. A VDR should be submitted to the **competent** authority 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. ~~The United States Federal Aviation Administration's National Simulator Program Manager and the Agency have committed to maintain a list of agreed VDR's.~~

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 helicopter 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**'s** *Flight Simulator Design & Performance Data Requirements* ~~document~~. These illustrate the type of aircraft and avionics configuration information and descriptive engineering rationale used to describe data anomalies, provide alternative data, or provide an acceptable basis to the **competent** authority 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: Validation Data

Appendix 3 to AMC ~~No.~~ 1-~~to~~ CS-FSTD(H).300 Rotor a~~A~~erodynamic m~~M~~odelling t~~T~~echniques

1. Introduction

Several modelling choices are available to simulate rotor blade aerodynamics. These include rotor disks, rotor maps, and blade element rotor models. Cost, simulation fidelity, and training requirements are three factors that may determine the appropriate model to use.

2. Disk models

2.1 Rotor disk models typically approximate blade flapping by the first few terms of a Fourier series. The lift curve is assumed to be a linear function of angle of attack and inflow is usually assumed to be uniform over the entire disk. With these assumptions the forces and moments produced by the blades over the course of one complete revolution can be written analytically. Blade azimuthal position can then be ignored by the rest of the helicopter aerodynamic model**,** which sees normali**s**~~z~~ed forces as generated by a thrust producing disk. Disk models are usually easy to implement and tune, and require minimal computer resources to run. Disk models are best at matching static performance characteristics, and weakest in matching dynamic handling qualities and flight at extremes of the flight envelope where some of the underlying assumptions cease to be true. The risk is that these models may require an unmanageable accumulation of add-ons to simulate all the helicopter effects that do not flow naturally out of the model such as blade stall, dynamic stall, reverse flow, and cross coupling effects. For certain helicopter types, and for many tail rotors, some of these effects will be negligible or occur outside of the civil flight envelope and thus not impact the training requirements of the FSTD. Adding the effects of sharp wind gradients over the rotor disk, ~~that~~ **which** may occur in confined areas or in pinnacle training**,** is problematic**,** as the formulation assumes constant wind speed over the disk.

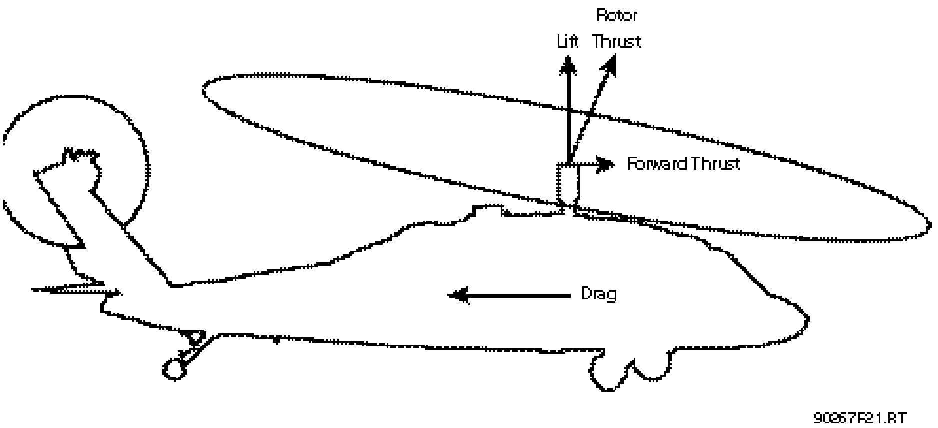

Figure 1

3. Rotor map models

3.1 Rotor map models, or coefficient models, are also not computationally demanding. ~~In~~ **With** this method a database of coefficients or stability and control derivatives is used to compute aircraft forces and moments. The simulation ~~will~~ **should** interpolate its performance from the nearest points in the database. This data~~-~~base can be generated from flight test data analysis or from an off-line blade element model. Steady state performance can in theory~~,~~ be easily tuned by simply adjusting data points in the database. However**,** if the database is generated from an off-line model blade element model then considerable effort could be spent tuning the off-line model that is one step removed from the simulation. The net result is a saving in real time execution, but development costs may be as high as a full blade element model. The blade element model that generates the database, since it runs off-line, is not limited by real time constraints and thus can be considerably more complex than real time blade element models.

FSTD fidelity may be limited by the overall size and coarseness of the database. Not every flight possibility ~~will~~ **should** be covered by the database and separate databases may need to be generated to simulate failure modes. As with the rotor disk model the incorporation of known air flows into the simulation at the blade elements is problematic and could effect for example, the realism of simulated turbulence, and the effectiveness of confined area landing training where the winds have large gradients such that they will not be constant over the entire rotor disk.

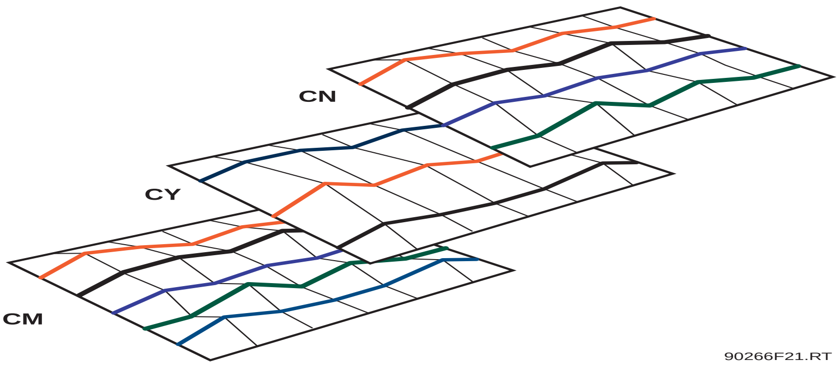

Figure 2

4. Blade **e**~~E~~lement **r**~~R~~otor **m**~~M~~odels

4.1 A blade element rotor model~~,~~ has at its core a division of the blade into discrete segments. Rotor speed and radial station as well as local winds at each segment are used to compute local angle of attack, sideslip and Mach number. Using the airfoil characteristics of airfoil at the blade segment aerodynamic forces are computed. Once all the forces and moments for all segments have been computed the equations of motion of each blade are solved. Real time constraints may limit the number of segments, and the degrees of freedom/flexibility of the blades and the complexity of the inflow model. A real time blade element model and its associated inflow model ~~is~~**are** significantly more complex than a rotor disk, but ~~offers~~**offer** a more rigorous simulation of a helicopter rotor blade dynamics. Blade motions even at very low rotor speeds are computed in the same manner, thus offering fidelity simulation of helicopter operations from rotor stopped, through start-up, to the full flight envelope including malfunctions and the effects of sharp wind gradients across the blade elements that occur in confined areas or in pinnacle training. The model can be used to provide helicopter vibrations amplitudes and trends.

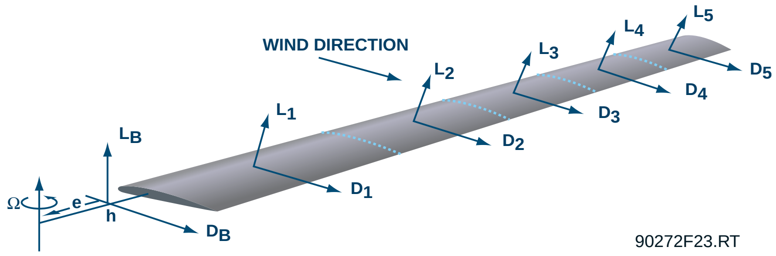

Figure 3

5. Conclusions

5.1 The modelling choice alone~~,~~ cannot ensure fidelity. The best guarantor of accurate simulation training remains validation with flight test data. A blade element rotor model reduces risk to simulation training by giving a more comprehensive rotor simulation, but comes at a price of increased complexity and computer resource requirements. This may be warranted where the training objectives of the simulation require a very high level of fidelity.

Appendix 4 to AMC~~ No.~~ 1-~~ to~~ CS-~~-~~FSTD(H).300 Vibration p~~P~~latforms for h~~H~~elicopter FSTDs

1 The role of vibrations in pilot cueing

1.1 Motion feedback in rotary wing aircraft has a wide bandwidth of frequencies and amplitudes consisting of cues ranging from large sustained accelerations up to high frequency vibrations generated by the rotor harmonics. Vibrations on helicopters, in addition to creating a harsh operating environment, provide pilots with rotor dynamic feedback critical to his/her ability to control the aircraft. Normal and abnormal flying conditions are therefore sensed by the pilots through the vibration levels/amplitudes and are integral to helicopter flying. Rotor malfunctions/conditions such as icing or damage are rapidly identified subjectively by sensing the increased vibration levels and change in characteristics.

1.2 The FSTD training environment should subject the pilot to high fidelity and realistic levels of vibration in order to enhance the transfer of training. Vibrations, when accurately simulated and harmonised with visual and sound system cues, ensure that the pilot develops proper control strategies while experiencing representative workloads.

1.3 Three characteristics of the vibrations must be accurately reproduced to create an authentic flying environment and stimulate pilots with representative aircraft vibrations: the trends, the axes and the levels of vibrations. For example, the vibration trends will inform the pilot that the helicopter has entered a transition stage between hover and low speed level flight. Helicopter vibrations are multidimensional, that is, they are perceived as occurring in more than one degree of freedom at a time. Simulating combinations of X, Y and Z vibrations has demonstrated to be significant for pilot training. Accurate reproduction of vibration levels provides subjective information on the stresses that certain manoeuvres exert on the helicopter.

2 Limitations of using a 6**-**~~-~~**d**~~D~~egree-of-**f**~~F~~reedom motion system to reproduce vibrations

2.1 The simulation of vibration cues for rotary wing aircraft as produced by a conventional six-degree-of-freedom (6-DOF) motion system is limited. While most motion systems are capable of reproducing vibrations, the dynamic range of helicopter vibration amplitudes and frequencies (3 Hz ~~to~~ **-** 50 Hz~~,~~ typically) exceed the limited bandwidth capability of synergistic motion systems (typically 0 Hz ~~to~~ **-** 10 Hz in the vertical axis and lower in the longitudinal and lateral axes).

2.2 Moreover, the application of representative vibrations to the entire simulator structure may adversely impact the life span of some simulator components such as the visual system.

3 Advantages of a dedicated 3**-**~~-~~**d**~~D~~egree-of-**f**~~F~~reedom vibration platform

3.1 To augment the performance of a 6**-**~~—~~DOF motion system and achieve accurate reproduction of vibrations while minimizing stresses on the simulator structure, it is proposed that the motion cueing frequency bandwidth be separated in two. Dedicated cueing devices would then be assigned to reproduce each specific frequency range. The lower frequency range is used to drive the motion system and the higher frequency range, with the majority of the vibration information, is used to drive the vibration platform.

3.2 Two solutions may be used for simulating the vibrations:

a. A vibration platform consisting of a 3**-**~~-degree of freedom~~**DOF** system tailored for vibrations and installed under the cockpit as illustrated in figure 1. This system combines high bandwidth, independent driving axes (to avoid crosstalk) and high stiffness.

b. A vibration platform consisting of a 3**-**~~-degree of freedom~~**DOF** system to make the seats, the controls and the main instrument board vibrate independently from the cockpit. This solution decreases the moving mass relatively to the payload and therefore minimi**s**~~z~~es the risk of resonance.

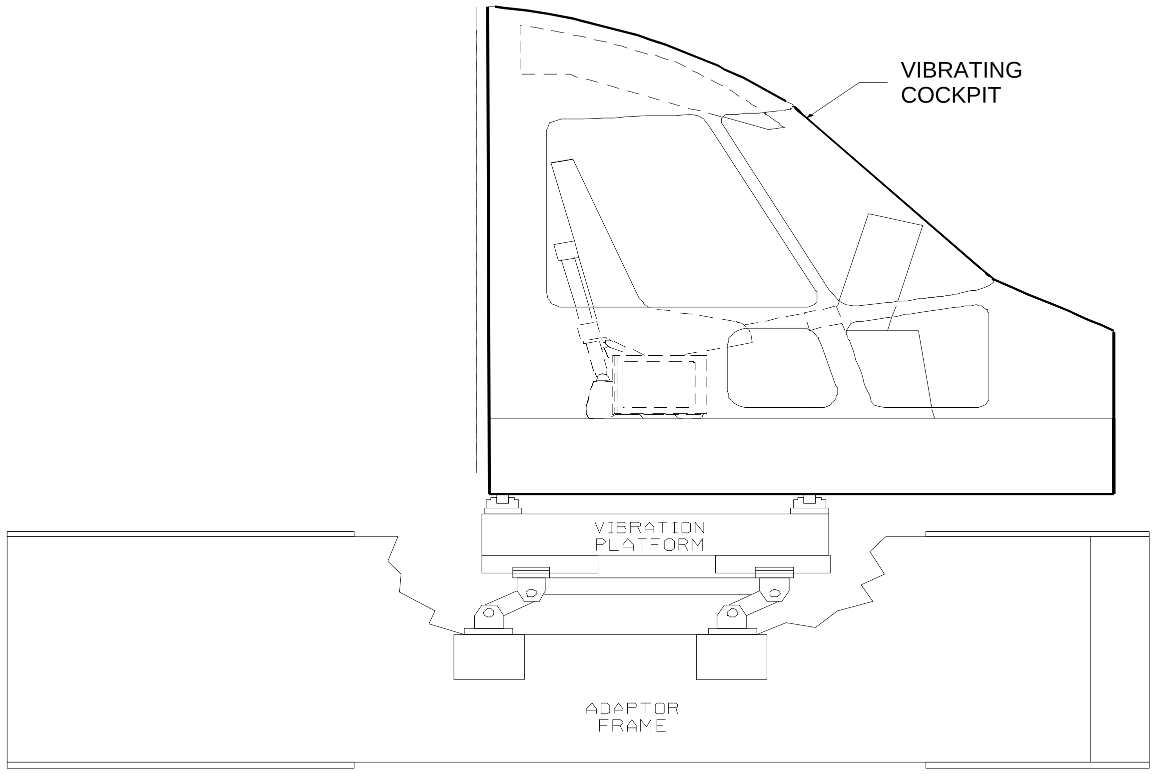

Figure 1: An Example of a ~~three~~**3**-degree-of-freedom cockpit vibration system

Appendix 5 to AMC ~~No.~~ 1 ~~to~~ CS-FSTD(H).300 Transport d~~D~~elay t~~T~~esting m~~M~~ethod

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.

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 (See 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 ~~msec~~ **ms** (**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~~ **should** 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 ~~msec~~ **ms** can be expected. Moreover, in some conditions, the host FSTD 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 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.

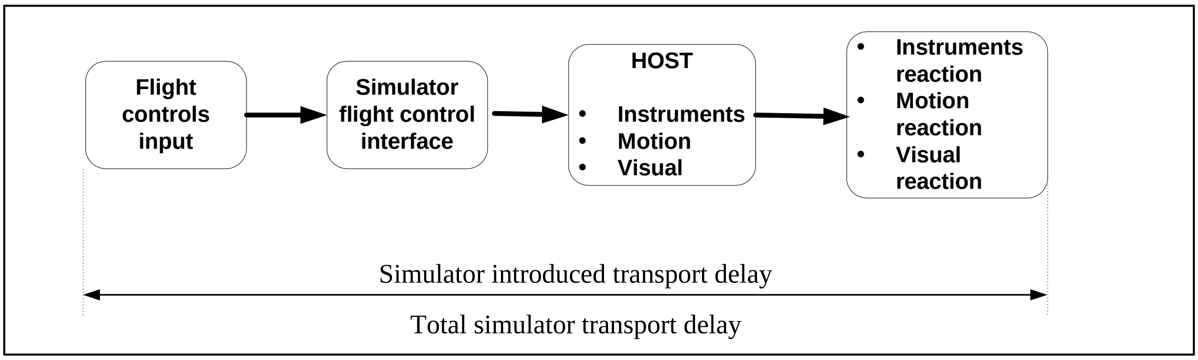

Figure 1: Transport **d**~~D~~elay for simulation of classic non-computer**-**~~-~~controlled aircraft

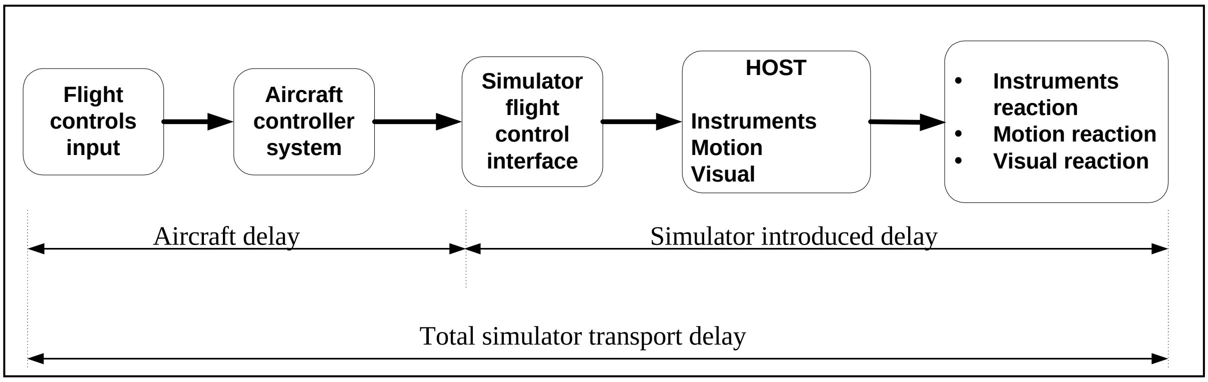

Figure 2: Transport **d**~~D~~elay for simulation of computer**-**~~-~~controlled aircraft using real aircraft equipment

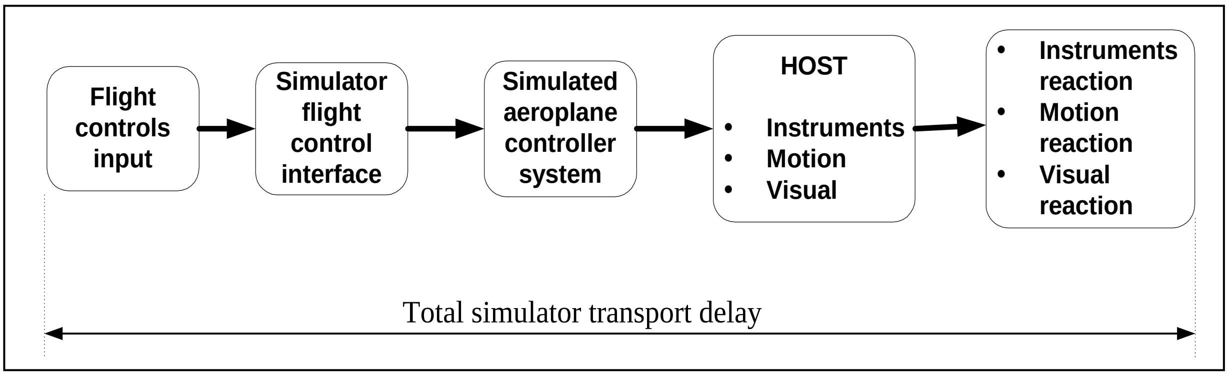

Figure 3: Transport **d**~~D~~elay for simulation of computer-–controlled aircraft using software emulation of aircraft equipment

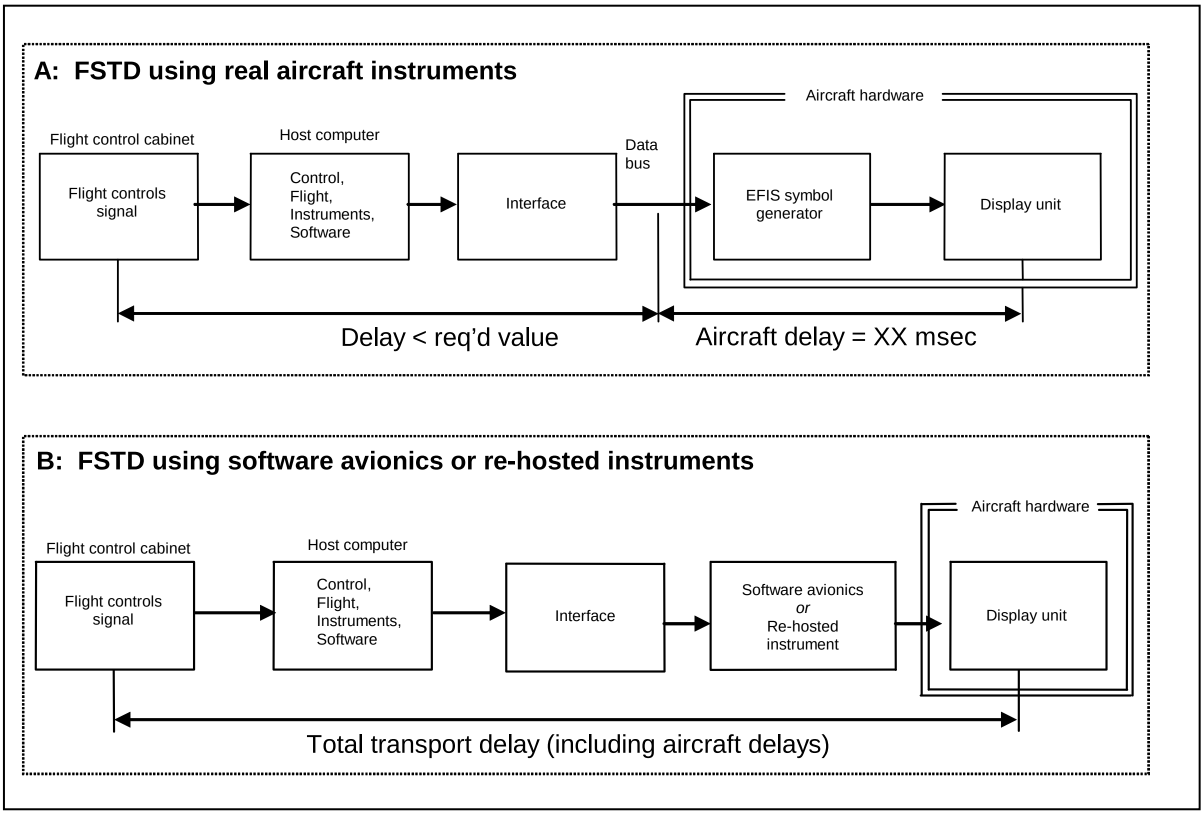

Figure 4A and 4B: Transport delay for simulation of aircraft using real or re-hosted instrument drivers

Appendix 6 to AMC~~ No.~~1-~~ to~~ CS-FSTD(H).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 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 **competent** authority 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 **For full flight simulators (FFSs) and flight training devices (FTDs:– when tests are not based on CT&M) there are no suggested tolerances between the recurrent test results and the MQTG validation test results of the initial evaluation. 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 results for the recurrent evaluation ~~will~~should be acceptable if they are within the tolerances to the MQTG test results as given in AMC1-CS-FSTD(H).300 2.3.**

~~There are no suggested tolerances between FSTD recurrent and MQTG validation test results. Investigation of any discrepancy between the MQTG and recurrent FSTD performance is left to the discretion of the FSTD operator and the authority.~~

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.

2.5 For FNPT special consideration for recurrent qualification is provided in AMC~~ No.~~ 5**-**~~ to~~ CS**-**FSTD (H).300 paragraph 5.4.

Appendix 7 to AMC ~~No.~~**1**-~~to~~ CS -FSTD(H).300 Applicability of CS-FSTD **a**~~A~~mendments to FSTD **d**~~D~~ata **p**~~P~~ackages for **e**~~E~~xisting **a**~~A~~ircraft

Except where specifically indicated otherwise within AMC ~~No~~ 1**-** ~~to~~ CS**-**-FSTD(H).300 para. 2.3, validation data for QTG objective tests are expected to be derived from helicopter flight -testing.

Ideally, data packages for all new FSTD ~~will~~ **should** fully comply with the current standards for qualifying FSTDs.

For types of helicopters first entering into service after the publication of a new amendment of CS-FSTD(H), the provision of acceptable data to support the FSTD qualification process is a matter of planning and regulatory agreement.

For helicopters certificated prior to the release of the current amendment of CS-FSTD(H), 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 aircraft 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 aircraft will still be available.

Notwithstanding the above discussion, except where other types of data are already acceptable (see, for example, AMC ~~No.~~ 1**-** and **AMC**2**-** ~~to~~ CS**-**-FSTD(H).300(c)(1)), the preferred source of validation data is flight test. 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 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:

~~(a)~~**first:** **f**~~F~~light test at an alternate but near equivalent condition/configuration**;**~~.~~

~~(b)~~**second:** **d**~~D~~ata from an audited engineering simulation as defined in AMC**1**- ~~to~~ CS**-**FSTD(H).200 para 1.1.e from an acceptable source (for example meets the guidelines laid out in AMC ~~No~~ 1**-** ~~to~~ CS**-**-FSTD(H).300(c)(1) para 2), or as used for aircraft certification**;**~~.~~

~~(c)~~**third:** **a**~~A~~ircraft **p**~~P~~erformance **d**~~D~~ata as defined in AMC**1**- ~~to~~ CS**-**-FSTD(H).200 para 1.1.b or other approved published sources (e.g., Production flight test schedule) for the following tests:-

(i) 1d **h**~~H~~over performance (IGE, OGE)**; and**

(ii) 1g **c**~~C~~limb performance (AEO, OEI)**;**

~~(d)~~**fourth:** **w**~~W~~here no other data is available then, in exceptional circumstances only, the following sources may be acceptable subject to a case-by-case review with the ~~Authorities~~ **competent authorities** concerned taking into consideration the level of qualification sought for the FSTD**:**~~.~~

(i~~ii~~) **u**~~U~~npublished but acceptable sources e.g., calculations, simulations, video or other simple means of flight test analysis or recording**; or**

(i**i**~~v~~) **f**~~F~~ootprint test data from the actual training FSTD requiring qualification validated by competent authority appointed pilot subjective assessment.

In certain cases, it may make good engineering sense to provide more than one test to support a particular objective test requirement.

For helicopters 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~~oad map (VDR) in accordance with and as defined in Appendix 2 to AMC ~~No.~~ 1**-** ~~to~~ CS**-**-FSTD(H).300.

It should be recogni**s**~~z~~ed that there may come a time when there are so little compatible flight test data available that new flight test **data** may be required ~~to be gathered~~.

Appendix 8 to AMC ~~No.~~ 1 ~~to~~ CS-FSTD(H).300 Visual d~~D~~isplay s~~S~~ystems

1. Introduction

1.1 When selecting a visual system configuration there are many compromises to be made dependent upon the helicopter cockpit geometry, crew complement and intended use of the training device. Some of these compromises and choices regarding display systems are discussed here.

2. Basic principles of a**n** FSTD collimated display

2.1 The essential feature of a collimated display is that light rays coming from a given point in a picture are parallel. There are two main implications of the parallel rays: first the viewer's eyes focus at infinity and have zero convergence thus providing a cue that the object is distant. Second, the angle to any given point in the picture does not change when viewed from a different position, and thus the object behaves geometrically as though it were located at a significant distance from the viewer. These cues are self-consistent, and are appropriate for any object which has been modelled as being at a significant distance from the viewer.

2.2 In an ideal situation the rays are perfectly parallel, but most implementations provide only an approximation to the ideal. Typically, a**n** FSTD display provides an image located not closer than about 6 - 10 m from the viewer, with the distance varying over the field of view. A schematic representation of a collimated display is provided in Figure 1 below.

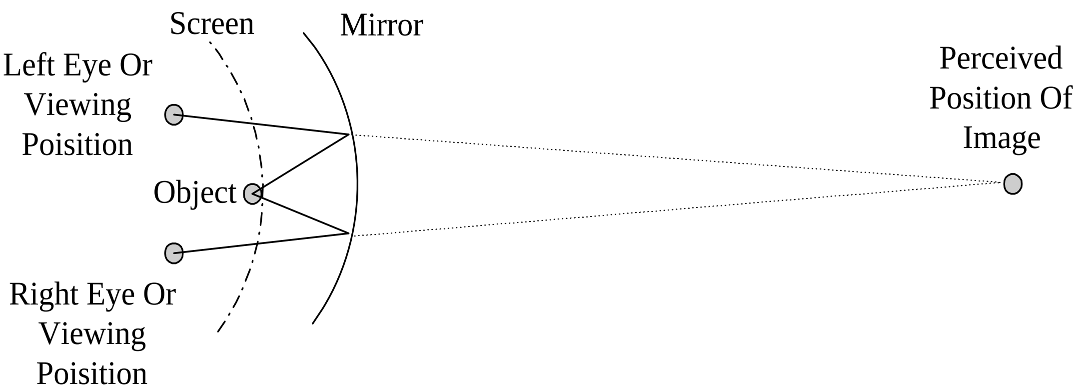

Figure 1: Collimated display

2.3 Collimated displays are well suited to many simulation applications as the area of interest is relatively distant from the observer, and so the angles to objects should remain independent of viewing position. Consider the view of the runway seen by the flight crew lined up on an approach. In the real world the runway is distant, and therefore light rays from the runway to the eyes are parallel. The runway therefore appears to be straight ahead to both crew members. This situation is well simulated by a collimated display and is presented in Figure 2. Note that the distance to the runway has been shortened for clarity. If drawn to scale the runway would be farther away and the rays from the two seats would be closer to being parallel.

2.4 While the horizontal **f**~~F~~ield of **v**~~V~~iew (FOV) of a collimated display can be extended to approximately 210-220°~~ degrees~~, the vertical FOV has normally been limited to about 40° - 45°~~ degrees~~. These limitations result from tradeoffs in optical quality as well as interference between the display components and cockpit structures, but were sufficient to meet FSTD regulatory approval for Helicopter FSTDs. More recently designs have been introduced with vertical FOVs of up to 60° ~~degrees~~ for helicopter applications.

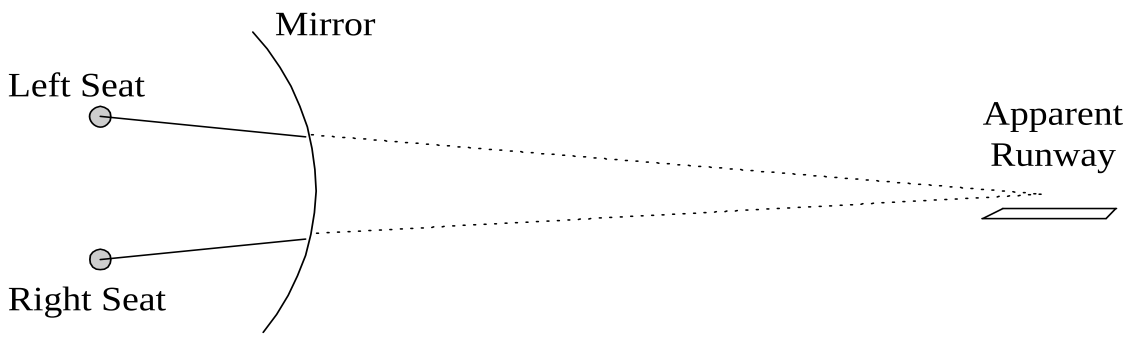

Figure 2: Runway view in a collimated display

3. Basic principles of a**n** FSTD dome display

3.1 The situation in a dome display is shown in Figure 3. As the angles can be correct for only one eye point at a time, the visual system has been calibrated for the right seat eye point position - the runway appears to this viewer to be straight ahead of the aircraft. To the left seat viewer, however, the runway appears to be somewhat to the right of the aircraft. As the aircraft is still moving towards the runway, the perceived velocity vector ~~will~~ **should** be directed towards the runway and this ~~will~~ **should** be interpreted as the aircraft having some yaw offset.

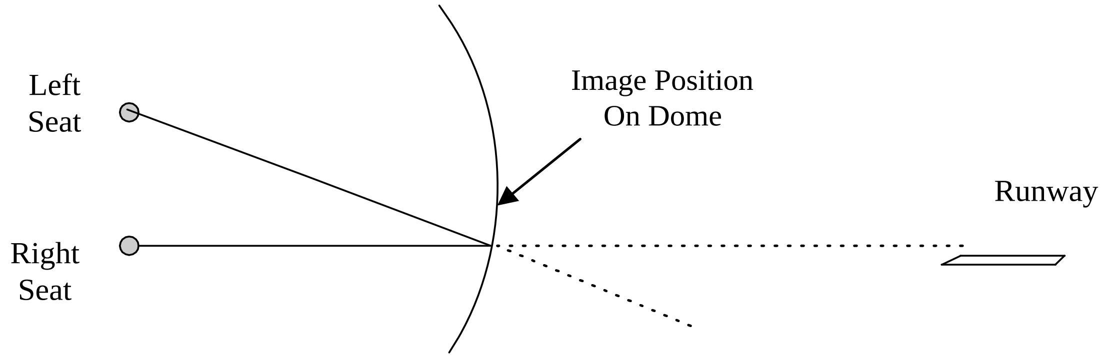

Figure 3: Runway view in a dome display

3.2 The situation is substantially different for near field objects such as are encountered in helicopter operations close to the ground. Here, objects that should be interpreted as being close to the viewer will be misinterpreted as being distant in a collimated display. The errors can actually be reduced in a dome display as shown in Figure 4 and Figure 5.

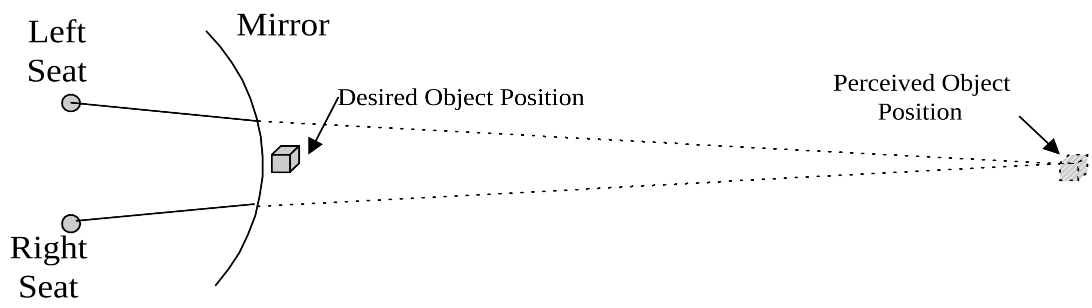

Figure 4: Near field object in a collimated display

3.3 The FOV possible with a dome display can be larger than that of a collimated display. Depending on the configuration, a FOV of 240° by 90° ~~degrees~~ is possible and can be exceeded.

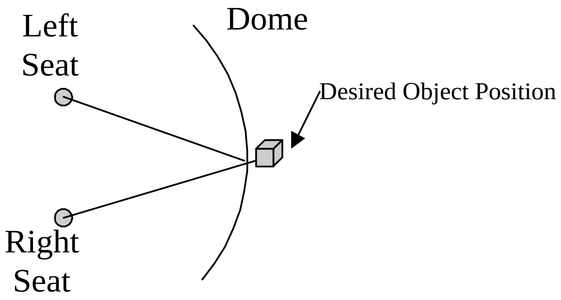

Figure 5: Near field object in a dome display

4. Additional display considerations

4.1 While the situations described above are for discrete viewing positions, the same arguments can be extended to moving eye points such as are produced by the viewer moving his**/her** head. In the real world, the parallax effects resulting from head movement– provide distance cues. The effect is particularly strong for relative movement of cockpit structure in the near field and modelled objects in the distance. Collimated displays ~~will~~ provide accurate parallax cues for distant objects, but increasingly inaccurate cues for near field objects. The situation is reversed for dome displays.

4.2 Stereopsis cues resulting from the different images presented to each eye for objects relatively close to the viewer also provide depth cues. Yet again, the collimated and dome displays provide more or less accurate cues depending on the modelled distance of the objects being viewed.

5. Training implications

5.1 In view of the basic principles described above, it is clear that neither display approach provides a completely accurate image for all possible object distances. It is therefore important when configuring a**n** FSTD display system to consider the training role of the FSTD. Depending on the training role, either display may be the optimum choice. Factors which should be considered when selecting a design approach should include relative importance of training tasks at low altitudes, the role of the two crew members in the flying tasks, and the FOV required for specific training tasks.

Appendix 9 to AMC~~ No.~~ 1-~~ to~~ CS–FSTD(H).300- General technical requirements for FSTD q~~Q~~ualification l~~L~~evels

This Appendix summari**s**~~z~~es the general technical requirements for FFS levels A, B, C and D, FTD levels 1, 2, and 3, FNPT levels I, II, II MCC, III and III MCC.

*Note: **f**~~F~~or FNPT, the term "the/a helicopter" is used to represent the aircraft being modelled which can be a specific helicopter type, a family of similar helicopter types or a totally generic helicopter.*

Table 1 – General technical requirements for l~~L~~evel A, B, C and D FFS

Qualification l~~L~~evel	General technical requirements
A	(See also AMC~~ No.~~2**-**~~ to~~ CS-~~-~~FSTD(H).300). The lowest level of FFS technical complexity. An enclosed full-scale replica of the helicopter ~~flight deck~~**cockpit** with representative pilots**'** seats, including simulation of all systems, instruments, navigational equipment, communications and caution and warning systems. An **i**~~I~~nstructor's station with seat ~~shall~~ **should** be provided and at least one additional seat for inspectors/observers. Static control forces and displacement characteristics ~~shall~~ **should** correspond to that of the replicated helicopter and they ~~shall~~ **should** reflect the helicopter under the same static flight conditions. Representative/generic aerodynamic data tailored to the specific helicopter type with fidelity sufficient to meet the **o**~~O~~bjective **t**~~T~~ests ~~shall~~ **should** be used. Generic **g**~~G~~round **e**~~E~~ffect and ground handling models are permitted. Motion, visual and sound systems sufficient to support the training, testing and checking credits sought are required. A motion system having a minimum of three degrees of freedom (pitch, roll, and heave) to accomplish the required training tasks ~~shall~~ **should** be provided. The visual system ~~shall~~ **should** provide at least 45° ~~degrees~~ horizontal and 30° ~~degrees~~ vertical field of view per pilot. A night/dusk scene is acceptable. The response to control inputs ~~shall~~ **should** not be greater than 150 ~~milliseconds~~ **ms** more than that experienced on the helicopter.
B	As for **l**~~L~~evel A plus: Validation **f**~~F~~light **t**~~T~~est **d**~~D~~ata ~~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 **f**~~F~~light **t**~~T~~est **d**~~D~~ata. A reduced six-axis motion performance envelope is acceptable. The visual system ~~shall~~ **should** provide at least 75° ~~degrees~~ horizontal and 40° ~~degrees~~ vertical field of view per pilot.
C	The second highest **l**~~L~~evel of simulator performance. As for **l**~~L~~evel B plus: A **d**~~D~~aylight/**d**~~D~~usk/**n**~~N~~ight **v**~~V~~isual system is required with a continuous field of view per pilot of not less than 150° ~~degrees~~ horizontal and 40° ~~degrees~~ vertical. The sound simulation ~~shall~~ **should** include the sounds of precipitation and significant helicopter noises perceptible to the pilot and ~~shall~~ **should** be able to reproduce the sounds of a crash landing. The response to control inputs ~~shall~~ **should** not be greater than 100 ~~milliseconds~~ **ms** more than that experienced on the helicopter. Turbulence and other atmospheric models ~~shall~~ **should** be provided to support the training, testing and checking credit sought.

D	The highest **l**~~L~~evel of simulator performance. As for **l**~~L~~evel C plus: A full **d**~~D~~aylight/**d**~~D~~usk/**n**~~N~~ight visual system is required with a continuous field of view per pilot of not less than 180° ~~degrees~~ horizontal and 60° ~~degrees~~ vertical and there ~~shall~~ **should** be complete fidelity of sounds and motion buffets**, validated through objective tests**.

Table 2 – General technical requirements for level 1, 2 and 3 FTDs

Qualification ~~l~~Level	**General technical requirements**
1	Type specific with at least one system fully represented to support the training task required. A ~~flight- deck~~**cockpit**, sufficiently closed off to exclude distractions. A full size panel of replicated system or systems with functional controls and switches. Lighting environment for panels and instruments sufficient for the operation being conducted. ~~Flight- deck~~**Cockpit** circuit breakers located as per the helicopter and functioning accurately for the system(s) represented. Aerodynamic and environment modelling sufficient to permit accurate systems operation and indication. Navigational data with corresponding approach facilities where replicated. Suitable seating arrangements for the instructor/examiner and **competent** ~~A~~**a**uthority's inspector. Proper system(s) operation resulting from management by the flight crew independent from instructor control inputs. Instructor's controls to insert abnormal or emergency conditions into the helicopter systems. Independent freeze and reset facilities. Appropriate control forces and control travel. Appropriate ~~flight deck~~**cockpit** sounds.
2	As for level 1 with the following additions or amendments: - **a**~~A~~ll systems fully represented**;**~~.~~ - **l**~~L~~ighting environment as per helicopter**;**~~.~~ - **r**~~R~~epresentative / generic aerodynamic data tailored to the specific helicopter with the fidelity to meet the objective tests**;**~~.~~ - **a**~~A~~djustable crew member seats~~.~~**;** - **f**~~F~~light control characteristics representative of the helicopter~~.~~**;** - **a**~~A~~ visual system (night/dusk and day) capable of providing a field-of-view of a minimum of 150° ~~degrees~~ horizontally from the middle eye point and 40° ~~degrees~~ vertically**;** - **a**~~A~~ visual data base sufficient to support the training requirements**;** - **s**~~S~~ignificant ~~flight deck~~**cockpit** sounds~~.~~**;** - **o**~~O~~n board **i**~~I~~nstructor station with control of atmospheric conditions and freeze and reset.
3	As for level 2 with the following additions or amendments: - **v**~~V~~alidation flight test data as the basis for objective testing of flight, performance and systems characteristics - **v**~~V~~isual system (night/dusk/day) capable of providing a field of view of a minimum of 150° ~~degrees~~ horizontally from the middle eye point and 60° ~~degrees~~ vertically.

Table 3A - General technical requirements for level I FNPTs

Qualification ~~l~~**L**evel	General technical requirements
I	The lowest level of FNPT technical complexity. A ~~flight deck~~**cockpit** that is sufficiently closed off to exclude distractions, that replicates the helicopter. Instruments, equipment, panels, systems, primary and secondary flight controls sufficient for the training events to be accomplished ~~shall~~ **should** be located in a spatially correct position. Suitable arrangements for an instructor ~~shall~~ **should** be provided allowing an adequate view of the crew members' panels and station. Effects of aerodynamic and environment changes for various combinations of airspeed and power normally encountered in flight. Navigation and communication equipment corresponding to that of a helicopter. Navigational data, including en**-**route aids and appropriate ~~heliports~~**aerodromes/operating sites**, with corresponding approach procedures. Control forces and control travel ~~shall~~ **should** broadly correspond to those of a helicopter. Appropriate ~~flight deck~~**cockpit** sounds ~~shall~~ **should** be available. Variable effects of wind and turbulence**.**~~;~~ Hard copy of map and approach plot**.** Instructor's controls to insert abnormal or emergency conditions into the basic flight instruments and navigation equipment and to vary environmental conditions. Independent freeze and reset facilities

Table 3B - General technical requirements for level II FNPTs

Qualification ~~l~~**L**evel	General technical requirements
II	As for **l**~~L~~evel I with the following additions or amendments: Circuit breakers ~~shall~~ **should** function correctly when involved in procedures or malfunctions requiring or involving flight crew response. Crew members**'** seats with adequate adjustment. An additional observer seat. Generic ground handling and aerodynamic ground effects models. Systems ~~shall~~ **should** be operative to the extent that it ~~shall~~ **should** be possible to perform normal, abnormal and emergency operations. Adjustable cloud base and visibility. Control forces and control travels which respond in the same manner under the same flight conditions as in a helicopter. A more complex aerodynamic model**.** Significant ~~flight deck~~**cockpit** sounds, responding to pilot actions A **d**~~D~~aylight **/**~~, D~~**d**usk **/**~~ and N~~**n**ight **v**~~V~~isual system is required with a continuous field of view per pilot of not less than 150° ~~degrees~~ horizontal and 40° ~~degrees~~ vertical. A visual data base ~~shall~~ **should** be provided sufficient to support the training requirements, including at least**:** **- s**~~S~~pecific areas within the database with higher resolution to support landings, take-offs and ground cushion exercises and training away from a**n** ~~heliport~~**aerodrome/operating site; and**~~.~~ **- s**~~S~~ufficient scene details to allow for ground to map navigation over a sector length equal to 30 minutes at an average cruise speed.

Table 3C - General technical requirements for level III FNPTs

Qualification ~~l~~**L**evel	General technical requirements
III	As for ~~Type~~ **level** II with the following additions or amendments: **- a**~~A~~ **d**~~D~~aylight, **d**~~D~~usk and **n**~~N~~ight **v**~~V~~isual system is required with a continuous field of view per pilot of not less than 150° ~~degrees~~ horizontal and 60° ~~degrees~~ vertical**; and**~~.~~ **- d**~~D~~etailed high resolution visual data bases as required to support advanced training.

Table 3D - General t~~T~~echnical r~~R~~equirements for~~-~~ level IIMCC, IIIMCC FNPTs

Qualification l~~L~~evel	General technical requirements
II MCC and III MCC	For use in **m**~~M~~ulti-**c**~~C~~rew **c**~~C~~o~~-~~operation (MCC) training - as for **l**~~L~~evels II or III with additional systems, instrumentation and indicators as required for MCC training and operation. Reference Appendix 1 to CS FSTD(H).300~~-~~.

AMC~~ No.~~ 2~~-~~ ~~to~~ CS~~-~~-FSTD(H).300 Guidance on d~~D~~esign and q~~Q~~ualification of l~~L~~evel 'A' h~~H~~elicopter 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) environmental~~,~~

(b) safety~~,~~

(c) accuracy~~,~~

(d) repeatability~~,~~

(e) quality and depth of training~~,~~

(f) weather 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 helicopter used by the general aviation community.

1.3 The significant cost drivers associated with the production of any FSTD are~~-~~:

(a) **t**~~T~~ype**-**~~-~~**s**~~S~~pecific **d**~~D~~ata **p**~~P~~ackage~~,~~

(b) QTG **f**~~F~~light **f**~~T~~est **d**~~D~~ata~~,~~

(c) **m**~~M~~otion **s**~~S~~ystem~~,~~

(d) **v**~~V~~isual **s**~~S~~ystem~~,~~

(e) **f**~~F~~light **c**~~C~~ontrols~~, and~~

(f) **a**~~A~~ircraft **p**~~P~~arts~~.~~

*Note: **t**~~T~~o 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 **f**~~F~~light **t**~~T~~est **d**~~D~~ata sufficient to provide a complete model of the aerodynamics, engines and flight controls can be significant. In the absence of type**-**specific data packages the use of a class specific data package ~~which~~ **that** could be tailored to represent a specific type of helicopter is acceptable. This may enable a well engineered baseline data package to be carefully tuned to adequately represent any one of a range of similar helicopters. Such work including justification and the rationale for the changes would have to 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 **g**~~G~~round **e**~~E~~ffect models is allowed.

2.2 However specific **f**~~F~~light **t**~~T~~est **d**~~D~~ata 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 **f**~~F~~light **t**~~T~~est **d**~~D~~ata.

(c) The use of CT&M is not to be taken as a indication that certain areas of simulation can be ignored. Indeed in the class of helicopter FSTD 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 helicopter 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 not been 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 in no way providing~~**never provides** 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 ~~in no way providing~~**never provide** negative training.

4 Visual

4.1 Other than field of view (FOV) technical criteria for the visual systems are not specified. The emergence of lower cost ‘raster only’ day light 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. "**v**~~V~~isual cueing sufficient to support changes in approach path by using runway perspective".

4.2 A single channel direct viewing system would be acceptable for this level of FFS.

4.3 The vertical field of view FOV specified (30°) may be insufficient for certain tasks. Some smaller helicopters have large downward viewing angles which cannot be accommodated by the ±15° vertical FOV. This can lead to two limitations:

(a) at the CAT 1 decision height, the appropriate visual ground segment may not be "seen"**;**~~,~~ and

(b) during an approach, where the helicopter 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 controls

The specific requirements for flight controls remain unchanged. Because the handling qualities of smaller helicopters are inextricably intertwined with their flight controls, there is little scope for relaxation of the tests and tolerances. It could be argued that with **r**~~R~~eversible **c**~~C~~ontrol **s**~~S~~ystems that the “on 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 Aircraft parts

As with any level of FSTD, the components used within the cockpit area need not be helicopter 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 look, feel and have the same functionality as in the helicopter.

AMC ~~No.~~ 3 - ~~to~~ CS-FSTD(H).300 Guidance on d~~D~~esign and q~~Q~~ualification of h~~H~~elicopter flight training devices (FTDs)

1 Basic **p**~~P~~hilosophy

1.1 The basic premises in defining FTDs were to follow the prescribed CS-FSTD practices but to reflect the unique training requirements of rotary wing aircraft. It was recognised, from the outset, that the training requirements and the operating/training economics of the average helicopter operator were rather different from those of the majority of fixed wing operators. The helicopter FTD was envisaged as a training device that could be justified both for systems training and secondarily for some type training, testing and checking. Finally, it was accepted that there could not be two differing sets of criteria for the qualification of FSTD**s** that are approved for type testing & checking. If a technical criterion has been set as the minimum necessary for the type accreditation of a manoeuvre or training event in the FFS, the same criterion shall apply to the FTD in order that a two tier checking philosophy is not introduced.

1.2 Following upon these premises, it was decided to define three levels of helicopter FTD.

1.3 The FTD **l**~~L~~evel 1 would be to cater only for systems training and would be used by those operators who had helicopters including complex systems. In this role it could be utilised both in ground school technical training as well as operations type training. It would be without motion or visual systems and requires aerodynamic and environmental modelling (using design data that might be generic but tailored to represent the helicopter) of sufficient fidelity to provide accurate systems operation & indications. The validation of the simulation would be confirmed by objective tests designed to meet the training task for the systems for which accreditation was to be sought. The FTD **l**~~L~~evel 1 could prove to be a reasonably inexpensive and cost effective training solution but this level would not necessarily meet the criteria to enable its additional qualification as an FNPT.

1.4 The second and third level of FTD were designed to provide type**-**~~–~~specific devices with visual systems but no motion which can be offered for varying levels of credits.

1.5 The helicopter FTD **l**~~L~~evel 2 would require the use of design & validation data similar to that for FTD **l**~~L~~evel 1 but all systems would have to be represented as well as a visual system meeting the requirements of an FNPT II. The FTD **l**~~L~~evel 2 criteria would permit the device to be used for part of the type rating training syllabus, for recency flying and **instrument rating (**IR**)** revalidation.

1.6 The FTD **level** 3 would require the use of the same quality of flight test data as the basis for flight & performance and system characteristics and validation flight test data for the objective testing, as is required for a FFS. A visual system meeting the criteria of that fitted to an FNPT III would be the minimum requirement. The FTD **l**~~L~~evel 3 should be capable of being approved for many of the type training, testing & checking manoeuvres and events awarded to a FFS, the exceptions would include those events for which motion cueing is considered necessary.

2 Design **s**~~S~~tandards

There are three sets of FTD design standards specified within ~~JAR~~**CS**-FSTD**(**~~-~~H**)**, FTD **l**~~L~~evels 1, 2 and 3, the most demanding being those for FTD **l**~~L~~evel 3.

2.1 The ~~Flight Deck.~~**cockpit**

The ~~flight deck~~**cockpit** should be representative of the "helicopter". The controls, instruments and avionics controllers should be representative in touch, feel, layout, colour and lighting to create a positive learning environment and good transfer of training to the helicopter. For good training ambience the ~~flight deck~~**cockpit** of the FTD **1**~~I~~ should be sufficiently enclosed to exclude any distractions. For both FTD **l**~~L~~evel**s** 2 and 3 the ~~flight deck~~ **cockpit** should be fully enclosed. Distractions arising from external sources, which may affect the student's concentration or that may denigrate the effects of the simulation, should be avoided. Thus in the case of an FTD **l**~~L~~evel 1, if the rear of the device is open, it would be inappropriate to install this type of device in a~~n~~ non-enclosed room or in an area where several such devices are located. Where this is to be permitted, the activities in one device may affect those in an adjacent one. If the device is to be installed in an area shared by other devices then the rear of the ~~flight deck~~**cockpit** including the instructors' station**,** should be fully enclosed, and this enclosure should extend to include the roof. In the case of ~~the~~ FTD **levels** 2 and 3 the same interpretations should apply but an additional consideration is that the performance of the visual system will be adversely affected by any light ingress or reflections. It follows that it would not be necessary to have a fully enclosed structure at the rear of the ~~flight deck~~**cockpit** were the FTD to be installed in a separate room.

2.2 ~~Flight Deck Components.~~**Cockpit components**

As with any training device, the components used within the ~~flight deck~~**cockpit** area do not need to be helicopter parts**.**~~;~~ **H**~~h~~owever, any parts used should be representative and should be robust enough to endure the training tasks. The use of CRTs or "**f**~~F~~lat **p**~~P~~anel" displays with physical overlays incorporating operational switches/knobs/buttons replicating a helicopter instrument panel would 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.

3 Latency and **v**~~V~~isual

3.1 There are two methods of establishing latency**,** which is the relationship between the controls and the visual system, ~~flight deck~~**cockpit** instruments response and initial motion system response, if fitted. These should be coupled closely to provide integrated sensory cues.

3.2 Either transport delay or response time tests are acceptable. Response time tests check that the 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 helicopter 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 if fitted).

3.3 The transport delay test should measure all the delay encountered by a step signal migrating from the pilot's control through the control loading electronics (if applicable) and interfacing through all the simulation software modules in the correct order, using a handshaking protocol, finally through the normal output interfaces 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.

3.4 The **t**~~T~~ransport **d**~~D~~elay of the system is the time between control input and the individual hardware responses. It need only be measured once in each axis.

4 Motion

Although motion is not a requirement for an FTD, should the FSTD operator choose to have one fitted, it ~~will~~ **should** be evaluated to ensure that its contribution to the overall fidelity of the device is not negative. Unless otherwise stated in this document, the motion requirements are as specified for a **l**~~L~~evel A FFS, see AMC~~ No.~~ 2**-**~~ to~~ CS**-**~~-~~FSTD(H).300**.**

4.1 For **l**~~L~~evel A ~~flight simulators~~**FFSs**, 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 ~~flight simulator~~**FFS**, it is felt appropriate that the simulator 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 the piloting task, including engine failures, and is in no way providing negative cueing.

4.2 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 in no way providing negative training.

4.3 The motion system transport delay should meet the standards prescribed for the visual display and cockpit instrument response.

5 Testing / **e**~~E~~valuation

5.1 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 and objective testing methodology should be similar to that in use for FFS.

5.2 The validation tests specified under AMC~~ No. ~~1**-**~~ to ~~CS**-**~~ ~~FSTD(H).300, para 2**,** can 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.

5.3 The tolerances specified are designed to ensure that the device meets its original target criteria year after year. It is therefore important that any such target data ~~is~~ **are** carefully derived and values are agreed with the ~~Authority~~ **competent authority** in advance of any formal qualification process.

5.4 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 helicopter configuration and should under no circumstances 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.

5.5 The subjective tests listed under "Functions and **m**~~M~~anoeuvres" in AMC~~ No. ~~1**-**~~ to ~~CS**-**FSTD(H).300, para 3, should be flown out by a suitably qualified and experienced pilot. Subjective testing ~~will~~ **should** review not only the interaction of all of the systems but the integration of the FTD with:

(a) **the t**~~T~~raining environment**,**

(b) **f**~~F~~reezes and repositions**,**

(c) **n**~~N~~av-aid 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 ~~Quality Assurance Programme~~**compliance monitoring programme** shall be in place. Such arrangements ~~will~~ **should** cover routine maintenance, the provision of satisfactory spares holdings and personnel and may be subject to a regulatory audit.

6 Additional features

6.1 Any additional features in excess of the minimum design requirements added to any FTD **l**~~L~~evel 1, 2 and 3 ~~will~~ **should** be subject to evaluation and should meet the appropriate standards in CS**-**~~ ~~FSTD(H).

AMC ~~No.~~ 4 - ~~to~~ CS-FSTD(H).300 Use of d~~D~~ata for h~~H~~elicopter flight training devices (FTDs)

1. Two types of data are required for the development and qualification of a**n** FSTD; namely, design data, which are used to develop simulation models, and the second, termed validation data, **which** are used to objectively confirm that the simulation models reflect the static as well as the dynamic performance characteristics of the helicopter. Some levels of FTD to be qualified under CS-FSTD(H) require that their design data be based upon helicopter type**-**specific data and/or that the validation tests have a similar baseline. It is not always intended that such design and validation data must be the helicopter manufacturer**'**s~~'~~ flown test data in the same manner as are required for FFS. Whilst this is the preferred source, cost and availability can preclude their use. Acceptable alternatives can be data obtained from research laboratories or other data procurement agencies and companies as well as preliminary data from a helicopter manufacturer's engineering simulator.

2. For the FTD **l**~~L~~evel 1 & 2 much of the flight test data could be gathered from helicopter maintenance, performance, flight manuals, and system user guides supplemented by data gathered and recorded, in flight, by simple means, e.g. video, stopwatch, pencil & paper. However for the latter, comprehensive details of test methods and initial and ambient conditions should be presented. In addition, this data may also be supplemented with theoretically calculated results.

3. For FTD **l**~~L~~evel 3 it is necessary to use validation flight test data, such as is required for higher level FFS but limited only to the validation of flight, performance, handling qualities and systems characteristics.

4. The substitution of ~~Correct Trend & Magnitude (~~CT&M~~)~~ for defined tolerances also reduces the reliance upon specific flight test data, but this must not be taken as an indication that certain areas of simulation can be ignored. It is imperative that the specific characteristics of the helicopter are present and incorrect effects would be unacceptable.

5. The Agency ~~will~~ expect**s** any FTD manufacturer who wishes to take advantage of the use of an alternative type of data to helicopter manufacturer's flown data, to demonstrate a sound engineering basis for his**/her** proposed approach. Such demonstration ~~will need to~~**should** show the predicted simulation effects and that they are easily understood and defined. The Agency will constitute a team to review any applications for the substitution of data other than that of the helicopter manufacturer's flown data.

AMC ~~No.~~ 5 - ~~to~~ CS-FSTD(H).300 Guidance on d~~D~~esign and q~~Q~~ualification of h~~H~~elicopter flight and navigation procedures trainers (FNPTs)

1 Basic philosophy

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 helicopter. 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 a basic fit and one very close to the target helicopter. 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 ~~authority~~ inspector **of the competent authority**.

1.2 The FNPT I is essentially a replacement for the traditional instrument flight ground training device. The FNPT II and FNPT III are~~-~~ more sophisticated standards and each fulfil 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 technology enables such devices to have much greater capabilities and lower life-cycle costs than was previously possible. A more objective design basis encourages better understanding and therefore better modelling of helicopter systems, handling and performance. These advances combined with the costs of flying and with the environmental pressures all point towards the need for FNPT standards.

2 ~~2~~ Design **s**~~S~~tandards

~~There are five~~**Five** sets of design standards **are** specified within ~~JAR~~**CS**-FSTD**(**-H**)**~~,~~**:** FNPT I, II, II MCC, III and III MCC.

2.1 Simulated **h**~~H~~elicopter **c**~~C~~onfiguration

Unlike FFS**s** and FTD**s**~~-~~, FNPTs~~-~~ are not primarily intended to be representative of a specific type of helicopter~~-~~ (although they may in fact be type**-**~~-~~specific if desired).

The configuration chosen should sensibly represent the helicopter or helicopters 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 helicopters or the helicopter itself.

Note: throughout this document, the term “helicopter” is used to represent the aircraft being modelled which can be a specific helicopter type, a family of similar helicopter types or a totally generic helicopter.

It would be beneficial for all parties involved in the acquisition of an FNPT to engage in early discussions with the ~~Authority~~ **competent authority** to broadly agree a suitable device configuration. Ideally any such discussion would take place in time to avoid any delays in the design/build/acceptance process thereby ensuring a smooth entry into service.

The configuration chosen should be sensibly representative of the “helicopter” likely to be used as part of the overall training package, especially in areas such as general ~~flight deck~~**cockpit** layout, seating, instruments and avionics, flying controls control forces and positions, performance, handling and powerplant.

2.2 The ~~Flight Deck~~**cockpit**

The ~~flight deck~~**cockpit** should be representative of the “helicopter”. The controls, instruments and avionics controllers should be representative in touch, feel, layout, colour and lighting to create a positive learning environment and good transfer of training to the helicopter. For good training ambience the ~~flight deck~~**cockpit** of the FNPT I should be sufficiently enclosed to exclude any distractions. For both FNPT IIs and IIIs the ~~flight deck~~**cockpit** should be fully enclosed. Distractions arising from external sources, which may affect the student’s concentration or ~~that~~ may denigrate the effects of the simulation, should be avoided. Thus in the case of an FNPT I, if the rear of the device is open, it would be inappropriate to install this type of device in a non-enclosed room or in an area where several such devices are located. Were this to be permitted, the activities in one device may affect those in an adjacent one. If the device is to be installed in an area shared by other devices then the rear of the ~~flight deck~~**cockpit** including the instructor’s station should be fully enclosed, and this enclosure should extend to include the roof. In the case of the FNPT II and III the same interpretations should apply but an additional consideration is that the performance of the visual system will be adversely affected by any light ingress or reflections. It follows that it would not be necessary to have a fully enclosed structure at the rear of the ~~flight deck~~**cockpit** were the FNPT to be installed in a separate room.

2.3 ~~Flight Deck~~**Cockpit** ~~Components~~**components**

As with any training device, the components used within the ~~flight deck~~**cockpit** area do not need to be aircraft parts: however, any parts used should be representative and should be robust enough to endure the training tasks. With the current state of technology the use of simple CRT/LCD monitor**-**~~-~~based representations and touch screen controls would 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.

The use of CRT/LCDs with physical overlays incorporating operational switches/knobs/buttons replicating a helicopter 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 a helicopter. 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 potential credits available. Validation data may be derived from a specific helicopter within a family of helicopters that the FNPT is intended to represent, or it may be based on information from several helicopters within a family. It is recommended that the intended validation data together with a substantiation report be submitted to the ~~Authority~~ **competent authority** for review.

2.4.1 Data **c**~~C~~ollection and **m**~~M~~odel **d**~~D~~evelopment

Recognising the cost and complexity of flight simulation models, it should be possible to generate generic family "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 designated helicopter configuration simulated. Data to tune the generic model to represent a more specific helicopter can be obtained from many sources without recourse to expensive flight test such as:

(a) **h**~~H~~elicopter design data**;**

(b) **f**~~F~~light and **m**~~M~~aintenance **m**~~M~~anuals**; or**

(c) **o**~~O~~bservations 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) **v**~~V~~ideo**;**

(b) **p**~~P~~encil and paper**;**

(c) **s**~~S~~topwatch**;**

(d) **n**~~N~~ew technologies**.**

Any such data gathering should take place at representative masses and centres of gravity. Development of such a data set including justification and the rationale for the design and intended performance, the measurement methods and recorded parameters (e.g. mass, CG, atmospheric conditions) should be carefully documented and available for inspection by the ~~Authority~~ **competent authority** as part of the qualification process.

2.5 Limitations

In helicopters, varied and different flight control configurations can be found: with and without servo-control assistance, with and without artificial feel trim control forces, trim control release and automatic trim. As a consequence, simulation of the flight control forces should take into account user requirements in order to define the optimum solution in an effort to simplify the control loading requirements.

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 ~~3~~ Latency and **v**~~V~~isual

3.1 There are two methods of establishing latency**,** which is the relationship between the controls and the visual system, **cockpit**~~flight deck~~ instruments **response** ~~(~~and initial motion system **response,** if fitted~~) response~~. These should be coupled closely to provide integrated sensory cues.

3.2 For a generic FNPT, a **t**~~T~~ransport **d**~~D~~elay test is the only suitable test which demonstrates that the FNPT system does not exceed the permissible delay. If the FNPT is based upon a particular helicopter type, either **t**~~T~~ransport **d**~~D~~elay or **r**~~R~~esponse **t**~~T~~ime tests are acceptable. Response time tests check that the 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 "helicopter" 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 if fitted).

3.3 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 (if applicable) and interfacing through all the simulation software modules in the correct order, using a handshaking protocol, finally through the normal output interfaces 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~~-~~.

3.4 **The transport delay of the system is the time between control input and the individual hardware responses. It need only to be measured once in each axis.**

~~The **t**Transport **d**Delay of the system is the time between control input and the individual hardware responses.~~

~~It need only be measured once in each axis.~~

3.**5**~~2~~ Care should be taken when using the limited processing power of the lower cost visual systems to concentrate on the key areas ~~which~~ **that** 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/~~Heliport~~ **operating site** surface**;**

(b) **r**~~R~~unway/~~Heliport~~ **operating site** lighting systems**;**

(c) **a**~~A~~pproach guidance aids and lighting systems**;**

(d) **touch down and lift-off (**TLOF**)** and **final approach and take-off (**FATO**) areas;**

(e) **d**~~D~~etailed ground features where credits are required for navigation training**; and**

(f) **b**~~B~~asic environmental lighting (night/dusk)**.**

4 Motion

Although motion is not a requirement for ~~either~~ an FNPT, should the FSTD operator choose to have one fitted, it ~~will~~ **should** be evaluated to ensure that its contribution to the overall fidelity of the device is not negative. Unless otherwise stated in this document, the motion requirements are as specified for a **l**~~L~~evel A FFS, see AMC~~ No.~~ 2**-**~~ to~~ CS**-**~~-~~FSTD(H).300**.**

4.1 For level A ~~flight simulators~~FFSs, 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 simulator 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 the piloting task, including engine failures, and is in no way providing negative cueing.

4.2 Buffet simulation is important to add realism to the overall simulation; for level A, the effects can be simple but they should be appropriate, in harmony with the sound cues and in no way providing negative training.

4.3 The motion system transport delay should meet the standards prescribed for the visual display and cockpit instrument response.

5 Testing / **e**~~E~~valuation

5.1. General

The FNPT should be assessed in those areas ~~which~~ **that** are essential to completing the pilot training, testing and checking process. This includes the FNPT's longitudinal and lateral directional responses, specific operations, control checks, ~~flight deck~~**cockpit**, and instructor station functions checks, and certain additional requirements depending on the complexity or **q**~~Q~~ualification **l**~~L~~evel of the FNPT. The visual system (where applicable) ~~will~~ **should** be evaluated against tests contained in the table of validation tests (AMC~~ No.~~1**-**~~ to~~ CS**-**~~-~~FSTD(H).300)~~-~~.

To ensure that any device meets its design criteria**,** initially and periodically throughout its life a system of objective and subjective testing ~~will~~ **should** be used. The subjective and objective testing methodology should be similar to that in use for FFS.

The validation tests specified (AMC~~ No~~ 1**-**~~ to~~ CS**-**~~-~~FSTD(H).300**,** ~~section~~ 2.3) can 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 but any such automatic test shall be capable of being rerun by manually flying the test.

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 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, however unlike the tolerances specified for FFS, the tolerances contained within this document are specifically intended to be used to ensure repeatability during the life of the device and in particular at each recurrent regulatory inspection.

5.2. Validation tests

The intent is to evaluate the FNPT as objectively as possible. Pilot acceptance, however, is also an important consideration. Therefore, the FNPT ~~will~~ **should** be subjected to **v**~~V~~alidation, and **f**~~F~~unctions and **s**~~S~~ubjective **t**~~T~~ests listed in (AMC~~ No.~~1**-**~~ to~~ CS**-**FSTD(H).300). Validation **t**~~T~~ests are used to compare objectively FNPT performances against **v**~~V~~alidation **d**~~D~~ata to ensure that they agree within design tolerances acceptable to the ~~Authority~~**competent authority**. Functions and **s**~~S~~ubjective **t**~~T~~ests provide a basis for evaluating FNPT capability to perform over a typical training period**,** determining that the FNPT ~~will~~ satisfactorily meet**s** each stated training objective and competently simulate**s** each training manoeuvre or procedure and to verify correct operation of the FNPT.

The design data may be derived from flight test data, manufacturer's design data, information from a**n** ~~helicopter~~ **aircraft f**~~F~~light **m**~~M~~anual and **m**~~M~~aintenance **m**~~M~~anuals, results of approved or commonly accepted simulations or predictive models, recognised theoretical results, information from the public domain, or other sources as deemed necessary by the FNPT manufacturer to be representative of a helicopter.

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 “helicopter” configuration and should under no circumstances 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.

5.3 Subjective tests

The subjective tests listed under "Functions and **s**~~S~~ubjective tests" (AMC~~ No.~~1**-**~~ to ~~CS**-**FSTD(H).300) should be flown out by a suitably qualified and experienced pilot.

Subjective testing ~~will ~~**should** review not only the interaction of all of the systems but the integration of the FNPT with~~-~~:

(a) **the t**~~T~~raining environment**;**

(b) **f**~~F~~reezes and repositions**;**

(c) **n**~~N~~av**-**aid environment**;**

(d) **c**~~C~~ommunications**;**

(e) **w**~~W~~eather and visual scene contents**.**

5.4. Initial qualification

For initial qualification testing of FNPTs **v**~~V~~alidation **d**~~D~~ata ~~will ~~**should** be used. They may be derived from a specific helicopter or they may be based on information from several helicopters within the group of helicopters. The substantiation of the set of data used to build the validation data should be in the form of an engineering report and should show that the proposed validation data are representative of a helicopter. With the concurrence of the ~~Authority~~**competent authority**, it may be in the form of a manufacturer's previously approved set of **v**~~V~~alidation **d**~~D~~ata for the applicable FNPT. Once the set of data for a specific FNPT has been accepted and approved by the ~~Authority~~**competent authority**, it ~~will ~~**should** become the **v**~~V~~alidation **d**~~D~~ata ~~that will~~**to** be used as reference for subsequent recurrent evaluations.

For FNPT initial qualification, the tolerances listed for parameters in the validation list table (AMC~~ No. ~~1**-**~~ to ~~CS**-**~~-~~FSTD(H).300) should be replaced by '**c**~~C~~orrect **t**~~T~~rend and **m**~~M~~agnitude' (CT~~-~~&~~-~~M) and the FNPT should be tested and assessed as representative of a helicopter to the satisfaction of the ~~Authority~~**competent authority**.

Tolerances listed for parameters in the validation tests table (AMC~~ No. ~~1**-**~~ to ~~CS**-**FSTD(H).300) should not be confused with FNPT design tolerances. Validation test tolerances are the maximum acceptable for FNPT recurrent qualification testing.

FSTD operators seeking initial or upgrade evaluation of an FNPT should be aware that performance and handling data for older helicopters 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 FSTD operator to acquire additional design and/or validation data.

During FNPT evaluation, if a problem is encountered with a particular FSTD **v**~~V~~alidation **t**~~T~~est, 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 during initial FNPT evaluation an FSTD operator should be prepared to offer alternative test results which relate to the test in question.

Validation **t**~~T~~ests ~~which ~~**that** do not meet the test criteria should be addressed to the satisfaction of the ~~Authority~~**competent authority**.

5.5. Maintenance

In parallel with this objective/subjective testing process it is envisaged that suitable maintenance arrangements as part of a ~~Compliance ~~**compliance** ~~Monitoring~~ **monitoring** ~~System ~~**programme** ~~shall ~~**should** be in place. Such arrangements ~~will~~ **should** cover routine maintenance, the provision of satisfactory spares holdings and personnel and may be subject to a regulatory audit.

6 Additional features

Any additional features in excess of the minimum design requirements added to an FNPT I, II & III ~~will ~~**should** be subject to evaluation and should be assessed to avoid negative training.

AMC ~~No.~~ 1-~~to~~ CS-FSTD(H).300(c)(1) Engineering s~~S~~imulator v~~V~~alidation d~~D~~ata

1. When a fully flight test validation simulation is modified as a result of changes to the simulated helicopter configuration, a qualified helicopter manufacturer may choose, with the prior agreement of the ~~Authority~~**competent authority**, to supply validation data from an "audited" engineering simulator/simulation to supplement selectively flight test data.

   This arrangement is confined to changes ~~which~~ **that** are incremental in nature and ~~which~~ are both easily understood and well -defined.

2. To be qualified to supply engineering simulator validation data, a~~n~~ helicopter manufacturer should:

   (a) have a proven track record of developing successful data packages**;**~~:~~

   (b) have demonstrated high quality prediction methods through comparisons of predicted and flight test validated data;

   (c) have an engineering simulator ~~which~~**that:**

   - has models ~~which~~ **that** run in an integrated manner**;**~~,~~
   - uses the same models as released to the training community (which are also used to produce stand/alone proof-of-match and checkout documents)**;**~~,~~
   - is used to support helicopter development and certification;

   (d) use the engineering simulation to produce a representative set of integrated proof-of-match cases; **and**

   (e) have an acceptable configuration control system in place covering the engineering simulator and all other relevant engineering simulations.

3. Helicopter manufacturers seeking to take advantage of this alternative arrangement ~~shall~~ **should** contact the ~~Authority~~ **competent authority** 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 corresponding AMC ~~No.~~ 2**-** ~~to~~ CS**-**FSTD(H).300(c)(1).

AMC ~~No.~~ 2-~~to~~ CS-FSTD(H).300(c)(1) Engineering s~~S~~imulator v~~V~~alidation d~~D~~ata – a~~A~~pproval g~~G~~uidelines

1. Background

   1.1. In the case of fully 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 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 validation models are often quite small.

   1.4. The major 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 work station 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-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 ~~Authority~~**competent authority**, to supply validation data from an engineering simulator/simulation to supplement selectively flight test data.

2.3. In cases where data from an engineering simulator is used, the engineering simulation process would have to be audited by the ~~Authority~~**competent authority**.

2.4 In all cases a data package verified to current standards against flight test should be developed for the aircraft "entry-into-service" configuration of the baseline aircraft.

2.5 Where engineering simulator data ~~is~~ **are** used as part of a QTG, an essential match is expected as described in Appendix 1 to AMC ~~No.~~ 1**-** ~~to~~ CS**-**-FSTD(H).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)~~**competent authorities**. Such a proposal would 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~~ **that** 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 **C**~~The~~ **ompetent a**~~A~~uthorities ~~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 **sh**~~w~~ould:

(a) **h**~~H~~ave to exist as a physical entity, complete with a ~~flight deck~~**cockpit** 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 ~~Authority~~**competent authority**.

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 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 FSTDs utilising these baseline simulation models should be currently qualified to at least internationally recognised standards.

2.14 The type of modifications covered by this alternative procedure ~~will~~ **should** 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**;**

(d) ~~C~~**c**ontrol system gearing, rigging, deflection limits**;**

(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 show that the predicted effects of the change(s) were incremental in nature and both were easily understood and well defined, confirming that additional flight test data were not required. In the event that the predicted effects were 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 a team established by the Agency.

Appendix B - Cross-reference table EASA CS-FSTD(H) to JAR-FSTD H

Cross-reference table EASA CS-FSTD(H) to JAR-FSTD H		
EASA reference	Subject	JAA reference
	BOOK 1 – QUALIFICATION CODE	
Subpart A	**Applicability**	
CS-FSTD(H).001	Applicability	JAR-FSTD H.001
Subpart B	**Terminology**	
CS-FSTD(H).200	Terminology	JAR-FSTD H.005
Subpart C	**Helicopter flight simulation training devices**	
CS-FSTD(H).300	Qualification basis	JAR-FSTD H.030
Appendix		
Appendix 1 to CS-FSTD(H).300	Flight simulation training device Standards	Appendix 1 to JAR-FSTD H.030
	BOOK 2 – ACCEPTABLE MEANS OF COMPLIANCE	
Subpart B	**Terminology**	
AMC1-CS-FSTD(H).200	Terminology and abbreviations	ACJ to JAR-FSTD H.005
Subpart C	**Helicopter flight simulation training devices**	
AMC1-CS-FSTD(H).300	Qualification basis	ACJ No. 1 to JAR-FSTD H.030
Appendix 1 to AMC1-CS-FSTD(H).300	Validation test tolerances	Appendix 1 to ACJ No. 1 to JAR-FSTD H.030
Appendix 2 to AMC1-CS-FSTD(H).300	Validation data roadmap	Appendix 2 to ACJ No. 1 to JAR-FSTD H.030
Appendix 3 to AMC1-CS-FSTD(H).300	Rotor aerodynamic modelling techniques	Appendix 3 to ACJ No. 1 to JAR-FSTD H.030, para 2.1
Appendix 4 to AMC1-CS-FSTD(H).300	Vibration platforms for helicopter FSTDs	Appendix 4 to ACJ No. 1 to JAR-FSTD H.030, para 2.2

CROSS-REFERENCE TABLE EASA CS-FSTD(H) TO JAR-FSTD H		
EASA REFERENCE	SUBJECT	JAA REFERENCE
Appendix 5 to AMC1-CS-FSTD(H).300	Transport delay testing method	Appendix 5 to ACJ No. 1 to JAR-FSTD H.030
Appendix 6 to AMC1-CS-FSTD(H).300	Recurrent evaluations – validation test data presentation	Appendix 6 to ACJ No. 1 to JAR-FSTD H.030
Appendix 7 to AMC1-CS-FSTD(H).300	Applicability of CS-FSTD amendments to FSTD data packages for existing aircraft	Appendix 7 to ACJ No. 1 to JAR-FSTD H.030
Appendix 8 to AMC1-CS-FSTD(H).300	Visual display systems	Appendix 8 to ACJ No. 1 to JAR-FSTD H.030
Appendix 9 to AMC1-CS-FSTD(H).300	General technical requirements for FSTD qualification levels	Appendix 9 to ACJ No. 1 to JAR-FSTD H.030
AMC2-CS-FSTD(H).300	Guidance on design and qualification of level “A” helicopter full flight simulators (FFSs)	ACJ No. 2 to JAR-FSTD H.030
AMC3-CS-FSTD(H).300	Guidance on design and qualification of helicopter flight training devices (FTDs)	ACJ No. 3 to JAR-FSTD H.030
AMC4-CS-FSTD(H).300	Use of data for helicopter flight training devices (FTDs)	ACJ No. 4 to JAR-FSTD H.030
AMC5-CS-FSTD(H).300	Guidance on design and qualification of helicopter flight and navigation procedures trainers (FNPTs)	ACJ No. 5 to JAR-FSTD H.030
AMC1-CS-FSTD(H).300(c)(1)	Engineering simulator validation data	ACJ No. 1 to JAR-FSTD H.030(c)(1)
AMC2-CS-FSTD(H).300(c)(1)	Engineering simulator validation data – approval guidelines	ACJ No. 2 to JAR-FSTD H.030(c)(1)

Appendix C - Attachments

Lettre report EASA FNAM.pdf
Attachment #1 to comment #60