Transportstyrelsens författningssamling

Transportstyrelsens föreskrifter och allmänna råd om utbildningshjälpmedel för flygsimulering (FSTD);

TSFS 2009:87

Utkom från trycket
den 15 oktober 2009

LUFTFART

Serie PEL/FSTD

beslutade den 24 september 2009.

Transportstyrelsen föreskriver[1] följande med stöd av 32, 84 och 92 §§ luftfartsförordningen (1986:171) och beslutar följande allmänna råd.

Inledande bestämmelser

Tillämpningsområde

1 § Utbildningshjälpmedel för flygsimulering ska, för att erhålla ett kvalificeringsbevis, uppfylla Joint Aviation Requirements – Flight Simulation Training Devices Aeroplane (JAR-FSTD A) eller Joint Aviation Requirements – Flight Simulation Training Devices Helicopter (JAR-FSTD H) som antogs av Joint Aviation Authorities (JAA) den 1 maj 2008. JAR-FSTD A och JAR-FSTD H finns i bilaga 1 och bilaga 2 till dessa föreskrifter. Bilagorna innehåller även Advisory Circulars Joint (ACJ) som utgör allmänna råd till dessa föreskrifter.

Dessa föreskrifter ska även tillämpas när utbildningshjälpmedel för flygsimulering ska godkännas för att användas vid flygutbildning och flygprov för certifikat och behörigheter samt vid kompetenskontroller.

Definitioner och förkortningar

2 § I dessa föreskrifter avses med

behörighet	anteckning i ett certifikat som fastställer speciella villkor, befogenheter eller begränsningar för certifikatet

[1] Anmälan har gjorts enligt Europaparlamentets och rådets direktiv 98/34/EG av den 22 juni 1998 om ett informationsförfarande beträffande tekniska standarder och föreskrifter (EGT L 204, 21.7.1998, s. 37, Celex 31998L0034, ändrat genom Europaparlamentets och rådets direktiv 98/48/EG (EGT L 217, 5.8.1998, s. 18, Celex 31998L0048).

flygplan	luftfartyg tyngre än luften, som framdrivs av en kraftkälla och som får sin lyftkraft huvudsakligen genom luftens reaktioner mot ytor, vilka förblir fasta under givna flygtillstånd och som inte definieras som ultralätta flygplan
flygprov	uppvisande av färdigheter vid utfärdande av certifikat eller behörigheter, inbegripet sådana muntliga prov som kontrollanten kan kräva
flygsimulator	utbildningshjälpmedel för flygsimulering som har rörelsesystem, visuellt system och möjlighet till realistisk återgivning av viss typ av luftfartyg
FSTD	(Flight Simulation Training Devices) utbildningshjälpmedel för flygsimulering
FSTD A	(Flight Simulation Training Devices Aeroplane) utbildningshjälpmedel för flygsimulering flygplan
FSTD H	(Flight Simulation Training Devices Helicopter) utbildningshjälpmedel för flygsimulering helikopter
helikopter	luftfartyg tyngre än luften som får lyftkraft under flygning genom luftens reaktioner mot en eller flera motordrivna rotorer
JAR	(Joint Aviation Requirement) gemensamma luftfartsbestämmelser
kompetens-kontroll	uppvisande av färdigheter för att förlänga eller förnya behörigheter, inbegripet sådana muntliga prov som kontrollanten kan kräva
OPC	(Operator Proficiency Check) operatörens kompetenskontroll
PC	(Proficiency Check) kompetenskontroll
utbildnings-hjälpmedel för flygsimulering	teknisk utrustning som i olika grad och funktion återger ett luftfartygs förarutrymme.

3 § När det i bilaga 1 (JAR-FSTD A) eller i bilaga 2 (JAR-FSTD H) hänvisas till en JAR-publikation som har ersatts av en EG-förordning eller en certifieringsspecifikation från EASA, får JAR-publikationen inte tillämpas, såvida inte annat anges i den berörda EG-förordningen eller certifieringsspecifikationen från EASA.

Ömsesidigt erkännande

4 § En produkt som är lagligen tillverkad eller saluförs enligt regelverk i andra medlemsstater inom Europeiska unionen, Turkiet eller Europeiska ekonomiska samarbetsområdet (EES) jämställs med produkter som uppfyller kraven i dessa föreskrifter, under förutsättning att en likvärdig säkerhetsnivå uppnås genom dessa staters regelverk. Likvärdigheten på produkten ska kunna styrkas.

Indelning av utbildningshjälpmedel för flygsimulering (FSTD)

5 § Utbildningshjälpmedel för flygsimulering som i olika grad och funktion återger ett luftfartygs förarutrymme ska användas vid utbildning, träning, prov och kompetenskontroller med flygbesättningsmedlemmar. Utbildningshjälpmedel för flygsimulering får helt eller delvis ersätta övningar i luftfartyg. Utbildningshjälpmedel för flygsimulering indelas med hänsyn till utförande och utbildningsändamål i följande kategorier:

1. flygsimulator (FFS, Full Flight Simulator),
2. flygutbildningshjälpmedel (FTD, Flight Training Device),
3. utbildningshjälpmedel för flygträning och navigationsprocedurer (FNPT, Flight and Navigation Procedures Trainer),
4. utbildningshjälpmedel för grundläggande instrumentutbildning (BITD, Basic Instrument Training Device),
5. andra utbildningshjälpmedel (OTD, Other Training Device) än FFS, FTD, FNPT eller BITD.

Godkännande

6 § Utbildningshjälpmedel för flygsimulering ska ha ett kvalificeringsbevis utfärdat eller godkänt av Transportstyrelsen enligt kraven i bilaga 1 (JAR-FSTD A) eller bilaga 2 (JAR-FSTD H).

7 § Den som använder ett utbildningshjälpmedel för flygsimulering vid utbildning, träning, prov eller kompetenskontroll ska inneha ett användargodkännande utfärdat av Transportstyrelsen.

Den som ansöker om ett användargodkännande ska dokumentera att de utbildningshjälpmedel för flygsimulering som används kan simulera de funktioner och manövrar som ingår i utbildningen på ett realistiskt sätt.

8 § Simulerad flygträning får ersätta övningar i luftfartyg endast i den omfattning som anges i användargodkännandet eller i Transportstyrelsens föreskrifter.

Funktionskrav

9 § Den som innehar ett godkännande av ett utbildningshjälpmedel för flygsimulering ska säkerställa att hjälpmedlet underhålls så att det kontinuerligt uppfyller kraven enligt dessa föreskrifter med bilagor.

10 § För att utbildningstid i ett utbildningshjälpmedel för flygsimulering ska få tillgodoräknas krävs att hjälpmedlet uppfyller kraven i dessa föreskrifter med bilagor samt att övningarna kan genomföras på ett tillfredsställande sätt.

Undantag

11 § Transportstyrelsen kan medge undantag från dessa föreskrifter.

Ikraftträdande- och övergångsbestämmelser

1. Denna författning träder i kraft den 1 november 2009.
2. Genom denna författning upphävs

Luftfartsverkets föreskrifter om ändring i Bestämmelser för Civil Luftfart – certifikatbestämmelser (BCL-C) 1.5 (LFS 1999:98), Syntetisk flygträning,

Luftfartsverkets föreskrifter om ändring i Bestämmelser för Civil Luftfart – certifikatbestämmelser (BCL-C) 8.1 (LFS 1998:14), Kompletterande bestämmelser till JAR-STD 1A aeroplane flight simulators,

Luftfartsverkets föreskrifter om ändring i Bestämmelser för Civil Luftfart – certifikatbestämmelser (BCL-C) 8.2 (LFS 2001:28), Kompletterande bestämmelser till JAR-STD 2A aeroplane flight training devices,

Luftfartsverkets föreskrifter om ändring i Bestämmelser för Civil Luftfart – certifikatbestämmelser (BCL-C) 8.3 (LFS 1999:99), Kompletterande bestämmelser till JAR-STD 3A aeroplane flight and navigation procedures trainers,

Luftfartsverkets föreskrifter om ändring i Bestämmelser för Civil Luftfart – certifikatbestämmelser (BCL-C) 8.4 (LFS 2004:7), Kompletterande bestämmelser till JAR-STD 4A basic instrument training devices,

Luftfartsverkets föreskrifter om ändring i Bestämmelser för Civil Luftfart – certifikatbestämmelser (BCL-C) 8.5 (LFS 2004:8), Kompletterande bestämmelser till JAR-STD 1H helicopter flight simulators,

Luftfartsverkets föreskrifter om ändring i Bestämmelser för Civil Luftfart – certifikatbestämmelser (BCL-C) 8.6 (LFS 2004:9), Kompletterande bestämmelser till JAR-STD 2H helicopter flight training devices,

Luftfartsverkets föreskrifter om ändring i Bestämmelser för Civil Luftfart – certifikatbestämmelser (BCL-C) 8.7 (LFS 2004:10), Kompletterande bestämmelser till JAR-STD 3H helicopter flight and navigation procedures trainers,

Luftfartsverkets föreskrifter om Gemensamma luftfartsbestämmelser (JAR), JAR-STD 1A Aeroplane Flight Simulators (LFS 2004:11),

Luftfartsverkets föreskrifter om Gemensamma luftfartsbestämmelser (JAR), JAR-STD 2A Aeroplane Flight Training Devices (LFS 2001:31),

Luftfartsverkets föreskrifter om Gemensamma luftfartsbestämmelser (JAR), JAR-STD 3A Aeroplane Flight and Navigation Procedures Trainers (LFS 2001:32),

Luftfartsverkets föreskrifter om Gemensamma luftfartsbestämmelser (JAR), JAR-STD 4 A Basic Instrument Traning Devices (LFS 2004:12),

Luftfartsverkets föreskrifter om Gemensamma luftfartsbestämmelser (JAR), JAR-STD 1H Helicopter Flight Simulators (LFS 2004:13), Luftfartsverkets föreskrifter om Gemensamma luftfartsbestämmelser (JAR), JAR-STD 2H Helicopter Flight Training Devices (LFS 2004:14),

Luftfartsverkets föreskrifter om Gemensamma luftfartsbestämmelser (JAR), JAR-STD 3H Helicopter Flight and Navigation Procedures Trainers (LFS 2004:15).

3. Äldre föreskrifter gäller fortfarande vid förlängning och förnyelse av kvalificeringsbevis för utbildningshjälpmedel som har beviljats före den 1 november 2009, under förutsättning att utbildningshjälpmedlet inte ändras till en ny kvalificeringsnivå enligt dessa föreskrifter med bilagor.

På Transportstyrelsens vägnar

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JAR-FSTD A

Utbildningshjälpmedel för flygsimulering (flygplan)

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FOREWORD

1 The Civil Aviation Authorities of certain European countries have agreed common comprehensive and detailed aviation requirements, referred to as Joint Aviation Requirements (JARs), with a view to minimising Type Certification problems on joint ventures, to facilitate the export and import of aviation products, to make it easier for maintenance carried out in one European country to be accepted by the Civil Aviation Authority in another European country and to regulate commercial air transport operations.

2 JARs are recognised by the Civil Aviation Authorities of participating countries as an acceptable basis for showing compliance with their national codes.

3 The content has been prepared using the expertise available in this field as well as the ICAO Document 9625, the 'Manual for the Qualification of Flight Simulators' and added to where necessary by making use of existing European regulations and the Federal Aviation Requirements of the United States of America where acceptable.

4 JAR–FSTD A is issued with no National Variants. It may be felt that the document does not contain all of the detailed compliance and interpretative information which some Civil Aviation Authorities and Industry organisations would like to see. However, it is accepted that JAR–FSTD A should be applied in practice and the lessons learned embodied in future amendments. The Civil Aviation Authorities of the JAA are therefore committed to early amendment in the light of experience.

5 Future development of the requirements of JAR–FSTD A, including the commitment in Paragraph 4, will be in accordance with the JAA's Notice of Proposed Amendment (NPA) procedures. These procedures allow for the amendment of JAR–FSTD A to be proposed by any organisation or person.

6 The Civil Aviation Authorities have agreed they should not unilaterally initiate amendment of their national codes without having made a proposal for amendment of JAR–FSTD A in accordance with the agreed procedure.

7 Definitions and abbreviations of terms used in JAR–FSTD A that are considered generally applicable are contained in JAR–1, Definitions and Abbreviations. However, definitions and abbreviations of terms used in JAR–FSTD A that are specific to a Subpart of JAR–FSTD A are normally given in the Subpart concerned or, exceptionally, in the associated compliance or interpretative material.

8 Amendments to the text in JAR–FSTD A are issued as Replacement Pages. These show an effective date and have the same status and applicability as JAR–FSTD A from that date.

9 New, amended and corrected text will be enclosed within heavy brackets until a subsequent 'Amendment' is issued.

10 Comment/Response documents developed following Notices of Proposed Amendment (NPA) consultation have been produced by the JAA and are published on the JAA Internet Site: www.jaa.nl. Readers can also apply to JAA for copies of specific Comment/Response Documents as required.

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SECTION 1 – REQUIREMENTS

1 GENERAL

1.1 This Section contains the requirements for aeroplane Flight Simulation Training Devices.

2 PRESENTATION

2.1 The requirements of JAR–FSTD A are presented in two columns on loose pages, each page being identified by the date of issue and the Amendment number under which it is amended or reissued.

2.2 Sub-headings are in italic typeface.

2.3 Explanatory Notes not forming part of the requirements appear in smaller typeface.

2.4 New, amended and corrected text will be enclosed within heavy brackets until a subsequent ‘Amendment’ is issued.

2.5 After each paragraph, the various changes and amendments, if any since the initial issue, are indicated together with their date of issue.

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SUBPART A – APPLICABILITY

JAR–FSTD A.001 Applicability

JAR–FSTD A as amended applies to those persons, organisations or enterprises (Flight Simulation Training Devices (FSTD) operators) or, in the case of BITDs only, manufacturers seeking initial qualification of FSTDs.

The version of JAR-FSTD A agreed by the Authority and used for issue of the initial qualification shall be applicable for future recurrent qualifications of the FSTD unless recategorised.

FSTD users shall also gain approval to use the FSTD as part of their approved training programmes despite the fact that the FSTD has been previously qualified.

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SUBPART B - GENERAL

JAR–FSTD A.005 Terminology
(See ACJ to FSTD A.005)

Because of the technical complexity of FSTD qualification, it is essential that standard terminology is used throughout. The following principal terms and abbreviations shall be used in order to comply with JAR–FSTD (A). Further terms and abbreviations are contained in ACJ to FSTD A.005.

(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) , or a Basic Instrument Training Device (BITD).

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

(c) *Flight Training Device (FTD).* A full size replica of a specific aeroplane type's instruments, equipment, panels and controls in an open flight deck area or an enclosed aeroplane flight deck, including the assemblage of equipment and computer software programmes necessary to represent the aeroplane 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). A training device which represents the flight deck or cockpit environment including the assemblage of equipment and computer programmes necessary to represent an aeroplane or class of aeroplane in flight operations to the extent that the systems appear to function as in an aeroplane. It is in compliance with the minimum standards for a specific FNPT Level of Qualification.

(e) *Basic Instrument Training Device (BITD).* A ground based training device which represents the student pilot's station of a class of aeroplanes. It may use screen based instrument panels and springloaded flight controls, providing a training platform for at least the procedural aspects of instrument flight.

(f) *Other Training Device (OTD).* A training aid other than FFS, FTD, FNPT or BITD which provides

(JAR-FSTD A.005 continued)

for training where a complete flight deck environment is not necessary.

(g) *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 Authority. It takes account of aeroplane to FSTD differences and the operating and training ability of the organisation.

(h) *Flight Simulation Training Device Operator (FSTD operator).* That person, organisation or enterprise directly responsible to the Authority for requesting and maintaining the qualification of a particular FSTD.

(i) *Flight Simulation Training Device User (FSTD User).* The person, organisation or enterprise requesting training, checking and testing credits through the use of an FSTD.

(j) *Flight Simulation Training Device Qualification (FSTD Qualification).* The level of technical ability of an FSTD as defined in the compliance document.

(k) *BITD Manufacturer*. That organisation or enterprise being directly responsible to the Authority for requesting the initial BITD model qualification.

(l) *BITD Model*. A defined hardware and software combination, which has obtained a qualification. Each BITD will equate to a specific model and be a serial numbered unit.

(m) *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 aeroplane and that all applicable regulatory requirements have been met. The QTG includes both the aeroplane and FSTD data used to support the validation.

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SUBPART C – AEROPLANE FLIGHT SIMULATION TRAINING DEVICES

JAR–FSTD A.015 Application for FSTD Qualification
(See ACJ No. 1 to JAR-FSTD A.015)
(See ACJ No. 2 to JAR-FSTD A.015)

(a) The FSTD operator requiring evaluation of a FFS, FTD or FNPT shall apply to the Authority giving 3 months notice. In exceptional cases this period may be reduced to one month at the discretion of the Authority.

(b) An FSTD Qualification Certificate will be issued following satisfactory completion of an evaluation of the FFS, FTD or FNPT by the Authority.

(c) For BITDs the manufacturer of a new BITD model which requires evaluation shall apply to the Authority giving 3 months notice. In exceptional cases this period may be reduced to one month at the discretion of the Authority.

(d) A BITD Qualification Certificate will be issued for the BITD model to the manufacturer following satisfactory completion of an initial evaluation by the Authority. This qualification certificate is valid for any devices manufactured to this standard without the need for the device to be subjected to further technical evaluation. The BITD model must clearly be identified by a BITD model number.

(e) The numbering of the BITD model must clearly define the hardware and software configuration of the qualified BITD model. A running serial number shall follow the BITD model identification number.

JAR–FSTD A.020 Validity of FSTD Qualification
(See ACJ to JAR-FSTD A.020)

(a) An FSTD qualification is valid for 12 months unless otherwise specified by the Authority.

(b) An FSTD qualification revalidation can take place at any time within the 60 days prior to the expiry of the validity of the qualification document. The new period of validity shall continue from the expiry date of the previous qualification document.

(c) The Authority shall refuse, revoke, suspend or vary an FSTD qualification, if the provisions of JAR–FSTD A are not satisfied.

JAR-FSTD A.020(d) (continued)

(d) The qualification of each BITD model serial number is valid for 36 months from the commencement of operation, unless reduced by the Authority. It is the operator‘s responsibility to apply for the revalidation of the qualification.

JAR–FSTD A.025 Rules Governing FSTD Operators
(See ACJ No. 1 to JAR-FSTD A.025)
(See ACJ No. 2 to JAR-FSTD A.025)
(See ACJ No. 3 to JAR-FSTD A.025)

The FSTD operator shall demonstrate his capability to maintain the performance, functions and other characteristics specified for the FSTD Qualification Level as follows:

(a) Quality System

(1) A Quality System shall be established and a Quality Manager designated to monitor compliance with, and the adequacy of, procedures required to ensure the maintenance of the Qualification Level of FSTDs. Compliance monitoring shall include a feedback system to the Accountable Manager to ensure corrective action as necessary.

(2) The Quality System shall include a Quality Assurance Programme that contains procedures designed to verify that the specified performance, functions and characteristics are being conducted in accordance with all applicable requirements, standards and procedures.

(3) The Quality System and the Quality Manager shall be acceptable to the Authority.

(4) The Quality System shall be described in relevant documentation.

(b) Updating. A link shall be maintained between the operator’s organization, the Authority and the relevant manufacturers to incorporate important modifications, especially:

(1) Aeroplane modifications that are essential for training and checking shall be introduced into all affected FSTDs whether or not enforced by an airworthiness directive.

(2) Modification of FSTDs, including motion and visual systems (where applicable):

JAR-FSTD A.025(b) (continued)

(i) When essential for training and checking, FSTD operators shall update their FSTDs (for example in the light of data revisions). Modifications of the FSTD hardware and software that affect handling, performance and systems operation or any major modifications of the motion or visual system shall be evaluated to determine the impact on the original qualification criteria. FSTD operators shall prepare amendments for any affected validation tests. The FSTD operator shall test the FSTD to the new criteria.

(ii) The Authority shall be advised in advance of any major changes to determine if the tests carried out by the FSTD operator are satisfactory. A special evaluation of the FSTD may be necessary prior to returning it to training following the modification.

(3) BITD operators shall maintain a link between their own organisation, the Authority and the BITD manufacturer to incorporate important modifications.

(c) Installations. Ensure that the FSTD is housed in a suitable environment that supports safe and reliable operation.

(1) The FSTD operator shall ensure that the FSTD and its installation comply with the local regulations for health and safety. However, as a minimum all FSTD occupants and maintenance personnel shall be briefed on FSTD safety to ensure that they are aware of all safety equipment and procedures in the FSTD in case of emergency.

(2) The FSTD safety features such as emergency stops and emergency lighting shall be checked at least annually and recorded by the FSTD operator.

(d) Additional Equipment. Where additional equipment has been added to the FSTD, even though not required for qualification, it will be assessed to ensure that it does not adversely affect the quality of training. Therefore any subsequent modification, removal or unserviceability could affect the qualification of the device.

JAR–FSTD A.030 Requirements for FSTD qualified on or after 1 August 2008

(See Appendix 1 to JAR–FSTD A.030)
(See ACJ No. 1 to JAR-FSTD A.030)
(See ACJ No. 2 to JAR-FSTD A.030)
(See ACJ No. 3 to JAR-FSTD A.030)
(See ACJ No. 4 to JAR-FSTD A.030)
(See ACJ No. 1 to JAR-FSTD A.030(c)(1))
(See ACJ No. 2 to JAR-FSTD A.030(c)(1))

(a) Any FSTD submitted for initial evaluation on or after 1 August 2008 will be evaluated against applicable JAR–FSTD A criteria for the Qualification Levels applied for. Recurrent evaluations of a FSTD will be based on the same version of JAR-FSTD A that was applicable for its initial evaluation. An upgrade will be based on the currently applicable version of JAR-FSTD A.

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

(c) The FSTD shall be subjected to:

(1) Validation tests and

(2) Functions & subjective tests

(d) Data shall be of a standard that satisfies the Authority before the FSTD can gain a Qualification Level.

(e) The FSTD operator shall submit a QTG in a form and manner that is acceptable to the Authority.

(f) The QTG will only be approved after completion of an initial or upgrade evaluation, and when all the discrepancies in the QTG have been addressed to the satisfaction of the Authority. After inclusion of the results of the tests witnessed by the Authority, the approved QTG becomes the Master QTG (MQTG), which is the basis for the FSTD qualification and subsequent recurrent FSTD evaluations. A copy of the MQTG shall be delivered by the BITD manufacteurer together with any BITD model delivered to an Operator.

(g) The FSTD operator shall:

(1) Run the complete set of tests contained within the MQTG progressively between each annual evaluation by the Authority. Results shall be dated and retained in

JAR-FSTD A.030(g) (continued)

order to satisfy both the FSTD operator and the Authority that FSTD standards are being maintained; and

(2) Establish a Configuration Control System to ensure the continued integrity of the hardware and software of the qualified FSTD.

JAR-FSTD A.031 Requirements for FFS qualified on or after 1 April 1998 and before 1 August 2008

Any FFS submitted for initial evaluation on or after 1 April 1998 and before 1 August 2008, shall automatically be granted an equivalent qualification under JAR-FSTD A with effect from the re-evaluation conducted at the end of the current validity period. This re-evaluation, and all future re-evaluations, will be conducted in accordance with the requirements of the same version of JAR-STD 1A, which was applicable for its last evaluation prior to implementation of JAR-FSTD A. Any upgrade will be based on the currently applicable version of JAR-FSTD A.

JAR-FSTD A.032 Requirements for Flight Training Devices (FTD) qualified on or after 1 July 2000 and before 1 August 2008

Any FTD submitted for initial evaluation on or after 1 January 2000 and before 1 August 2008, shall automatically be granted an equivalent qualification under JAR-FSTD A with effect from the re-evaluation conducted at the end of the current validity period. This re-evaluation, and all future re-evaluations, will be conducted in accordance with of the same version of JAR-STD 2A, which was applicable for its last evaluation prior to implementation of JAR-FSTD A. Any upgrade will be based on the currently applicable version of JAR-FSTD A.

JAR-FSTD A.033 Requirements for Flight & Navigation Procedures Trainers (FNPT) qualified on or after 1 July 1999 and before 1August 2008

Any FNPT submitted for initial evaluation on or after 1 July 1999 and before 1 August 2008, shall automatically be granted an equivalent qualification under JAR-FSTD A with effect from the re-evaluation conducted at the end of the

JAR-FSTD A.033 (continued)

current validity period. This re-evaluation, and all future re-evaluations, will be conducted in accordance with the requirements of the same version of JAR-STD 3A, which was applicable for its last evaluation prior to implementation of JAR-FSTD A. Any upgrade will be based on the currently applicable version of JAR-FSTD A.

JAR-FSTD A.034 Requirements for Basic Instrument Training Devices (BITD) qualified on or after 1 January 2003 and before 1 August 2008

Any BITD submitted for initial evaluation on or after 1 January 2003 and before 1 August 2008, shall automatically be granted an equivalent qualification under JAR-FSTD A with effect from the re-evaluation conducted at the end of the current validity period. This re-evaluation, and all future re-evaluations, will be conducted in accordance with the requirements of the same version of JAR-STD 4A, which was applicable for its last evaluation prior to implementation of JAR-FSTD A. Any upgrade will be based on the currently applicable version of JAR-FSTD A.

JAR–FSTD A.035 Requirements for Full Flight Simulators approved or qualified before 1 April 1998
(See ACJ to JAR-FSTD A.035)

(a) FFS approved or qualified in accordance with national regulations of JAA Member States before 1 April 1998 will either be recategorised or will continue to maintain their approval under the Grandfather Rights provision, in accordance with sub-paragraphs (c) and (d) below. For FFS that are not re-categorized, maximum credit shall under no circumstances exceed originally issued National credits.

(b) FFS's, neither previously recategorised nor with an approval maintained under the Grandfather Rights provision, will be qualified in accordance with JAR–FSTD A.030.

(c) FFS that are not recategorised but that have a primary reference document used for their testing, may be qualified by the Authority to an equivalent JAR–FSTD A Qualification Level, either AG, BG, CG or DG. An upgrade requires the recategorisation of the FFS.

(1) To gain and maintain an equivalent Qualification Level, these FFS shall be assessed

JAR-FSTD A.035 (continued)

in those areas that are essential to completing the flight crewmember training and checking process, as applicable.

(2) The FFS shall be subjected to:

(i) Validation tests; and

(ii) Functions and subjective tests.

(d) FFS that are not recategorised and that do not have a primary reference document used for their testing shall be qualified by special arrangement. Such FFS will be issued with a Special Category and shall be subjected to functions and subjective tests corresponding to those detailed in this document. In addition any previously recognised validation test shall be used.

JAR–FSTD A.036 Requirements for Flight Training Devices approved or qualified before 1 July 2000
(See ACJ to JAR-FSTD A.036)

(a) FTDs approved or qualified in accordance with national regulations of JAA Members States before 1 July 2000 either will be recategorised or will continue to maintain their approval under the Grandfather Rights provision, in accordance with JAR–FSTD A.036(c) and JAR–FSTD A.036 (d).

(b) FTDs, neither previously recategorised nor with an approval maintained under the Grandfather Rights provision, will be qualified in accordance with JAR–FSTD A.030.

(c) FTDs that are not recategorised but that have a primary reference document used for their testing may be qualified by the Authority to an equivalent JAR–FSTD Qualification Level, either 1G or 2G. These Qualification Levels refer to similar credits achieved by JAR–FSTD A Level 1 and 2.

(1) To gain and maintain an equivalent Qualification Level, these FTDs shall be assessed in those areas which are essential to completing the flight crew member training and checking process, including:

(i) Longitudinal, lateral and directional handling qualities (where applicable);

(ii) Performance on the ground and in the air;

(iii) Specific operations where applicable;

(iv) Flight deck configuration;

JAR-FSTD A.036 (continued)

(v) Functioning during normal, abnormal, emergency and, where applicable non normal operation;

(vi) Instructor station function and FTD control, and

(vii) Certain additional requirements depending on the Qualification Level and the installed equipment.

(2) The FTD shall be subjected to:

(i) Validation Tests, and

(ii) Functions and Subjective Tests.

(d) FTDs that are not recategorised and that do not have a primary reference document used for their testing shall be qualified by special arrangement.

(1) Such FTDs will be issued with Special Categories.

(2) These FTDs shall be subjected to the same Functions and Subjective Tests referred to in JAR–FSTD A.036(c) (2) (ii).

(3) In addition any previously recognised Validation Test shall be used.

JAR–FSTD A.037 Requirements for Flight Navigation and Procedures Trainers approved or qualified before 1 July 1999
(See ACJ to JAR-FSTD A.037)

(No Longer Applicable)

JAR–FSTD A.040 Changes to qualified FSTD

(a) *Requirement to notify major changes to a FSTD.* The operator of a qualified FSTD shall inform the Authority of proposed major changes such as:

(1) Aeroplane modifications, which could affect FSTD qualification.

(2) FSTD hardware and or software modifications that could affect the handling qualities, performances or system representations.

(3) Relocation of the FSTD; and

(4) Any deactivation of the FSTD.

JAR-FSTD A.040 (continued)

The Authority may complete a special evaluation following major changes or when a FSTD appears not to be performing at its initial Qualification Level.

(b) *Upgrade of a FSTD.* A FSTD may be upgraded to a higher Qualification Level. Special evaluation is required before the award of a higher Level of Qualification.

(1) If an upgrade is proposed the FSTD operator shall seek the advice of the Authority and give full details of the modifications. If the upgrade evaluation does not fall upon the anniversary of the original qualification date, a special evaluation is required to permit the FSTD to continue to qualify even at the previous Qualification Level.

(2) In the case of a FSTD upgrade, an FSTD operator shall run all validation tests for the requested Qualification Level. Results from previous evaluations shall not be used to validate FSTD performance for the current upgrade.

(c) Relocation of a FSTD

(1) In instances where a FSTD is moved to a new location, the Authority shall be advised before the planned activity along with a schedule of related events.

(2) Prior to returning the FSTD to service at the new location, the FSTD operator shall perform at least one third of the validation tests and, functions and subjective tests to ensure that the FSTD performance meets its original qualification standard. A copy of the test documentation shall be retained together with the FSTD records for review by the Authority.

(3) An evaluation of the FSTD in accordance with its original JAA qualification criteria shall be at the discretion of the Authority.

(d) Deactivation of a currently qualified FSTD

(1) If a FSTD operator plans to remove a FSTD from active status for prolonged periods, the Authority shall be notified and suitable controls established for the period during which the FSTD is inactive.

(2) The FSTD operator shall agree a procedure with the Authority to ensure that the FSTD can be restored to active status at its original Qualification Level.

JAR–FSTD A.045 Interim FSTD Qualification
(See ACJ to FSTD A.045)

(a) In case of new aeroplane programmes, special arrangements shall be made to enable an interim Qualification Level to be achieved.

(b) For Full Flight Simulators, an Interim Qualification Level will only be granted at levels A, B or C.

(c) Requirements, details relating to the issue, and the period of validity of an interim Qualification Level will be decided by the Authority.

JAR–FSTD A.050 Transferability of FSTD Qualification

When there is a change of FSTD operator:

(a) The new FSTD operator shall advise the Authority in advance in order to agree upon a plan of transfer of the FSTD.

(b) At the discretion of the Authority, the FSTD shall be subject to an evaluation in accordance with its original JAA qualification criteria.

(c) Provided that the FSTD performs to its original standard, its original Qualification Level shall be restored. Revised user approval(s) may also be required.

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Appendix 1 to JAR-FSTD A.030
Flight Simulation Training Device Standards

This appendix describes the minimum Full Flight Simulator (FFS), Flight Training Device (FTD), Flight and Navigation Procedures Trainer (FNPT) and Basic Instrument Training Devices (BITD) requirements for qualifying devices to the required Qualification Levels. Certain requirements included in this section shall be supported with a statement of compliance (SOC) and, in some designated cases, an objective test. The SOC will describe how the requirement was met. The test results shall 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 Multi-Crew Co-operation (MCC) training the general technical requirement are expressed in the MCC column with additional systems, instrumentation and indicators as required for MCC training and operation.

For MCC (Multi Crew Co-operation) minimum technical requirements are as for Level II, with the following additions or amendments:

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

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FLIGHT SIMULATOR TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	
1.1 General		A	B	C	D	1	2	I	II	MCC		COMPLIANCE
a.1	A fully enclosed flight deck	✓	✓	✓	✓							
a.2	A cockpit/flight deck sufficiently enclosed to exclude distraction, which will replicate that of the aeroplane or class of aeroplane simulated						✓	✓	✓	✓	✓	
a.3	Flight deck, a full scale replica of the aeroplane simulated. Equipment for operation of the cockpit windows shall be included in the FSTD, but the actual windows need not be operable. The flight deck, for FSTD purposes, consists of all that space forward of a cross section of the fuselage at the most extreme aft setting of the pilots' seats. Additional required flight crewmember duty stations and those required bulkheads aft of the pilot seats are also considered part of the flight deck and shall replicate the aeroplane.	✓	✓	✓	✓							Flight deck observer seats are not considered to be additional flight crewmember duty stations and may be omitted. Bulkheads containing items such as switches, circuit breakers, supplementary radio panels, etc. to which the flight crew may require access during any event after pre-flight cockpit preparation is complete are considered essential and may not be omitted. Bulkheads containing only items such as landing gear pin storage compartments, fire axes or extinguishers, spare light bulbs, aircraft document pouches etc. are not considered essential and may be omitted. Such items, or reasonable facsimile, shall still be available in the FSTD but may be relocated to a suitable location as near as practical to the original position. Fire axes and any similar purpose instruments need only be represented in silhouette.
a.4	Direction of movement of controls and switches identical to that in the aeroplane.	✓	✓	✓	✓							

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	
1.1 General		A	B	C	D	1	2	I	II	MCC		COMPLIANCE
a.5	A full size panel of replicated system(s) which will have actuation of controls and switches that replicate those of the aeroplane simulated.					✓	✓					The use of electronically displayed images with physical overlay incorporating operable switches, knobs, buttons replicating aeroplane instruments panels may be acceptable.
a.6	Cockpit/flight deck switches, instruments, equipment, panels, systems, primary and secondary flight controls sufficient for the training events to be accomplished shall be located in a spatially correct flight deck area and will operate as, and represent those in, that aeroplane or class of aeroplane.							✓	✓	✓	✓	For Multi-Crew Co-operation (MCC) qualification additional instrumentation and indicators may be required. See table at start of this appendix.. For BITDs the switches and controls size and shape and their location in the cockpit shall be representative.
a.7	Crew members seats shall be provided with sufficient adjustment to allow the occupant to achieve the design eye reference position appropriate to the aeroplane or class of aeroplane and for the visual system to be installed to align with that eye position.						✓		✓	✓		
b.1	Circuit breakers that affect procedures and/or result in observable cockpit indications properly located and functionally accurate.	✓	✓	✓	✓	✓	✓		✓	✓		

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
1.1 General		A	B	C	D	1	2	I	II	MCC		
c.1	Flight dynamics model that accounts for various combinations of drag and thrust normally encountered in flight corresponding to actual flight conditions, including the effect of change in aeroplane attitude, sideslip, thrust, drag, altitude, temperature, gross weight, moments of inertia, centre of gravity location, and configuration.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	For FTD Levels 1 and 2 aerodynamic modelling sufficient to permit accurate systems operation and indication is acceptable. For FNPTs and BITDs class specific modelling is acceptable.
d.1	All relevant instrument indications involved in the simulation of the applicable aeroplane shall automatically respond to control movement by a flight crewmember or induced disturbance to the simulated aeroplane; e.g., turbulence or wind shear.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	For FNPTs instrument indications sufficient for the training events to be accomplished. Reference ACJ No. 3 to JAR-FSTD A.030. For BITDs instrument indications sufficient for the training events to be accomplished. Reference ACJ No. 4 to JAR-FSTD A.030.
d.2	Lighting environment for panels and instruments shall be sufficient for the operation being conducted.					✓	✓	✓	✓	✓	✓	For FTD Level 2 lighting environment shall be as per aeroplane.
e.1	Communications, navigation, and caution and warning equipment corresponding to that installed in the applicant's aeroplane with operation within the tolerances prescribed for the applicable airborne equipment.	✓	✓	✓	✓	✓	✓					For FTD 1 applies where the appropriate systems are replicated.
e.2	Navigation equipment corresponding to that of the replicated aeroplane or class of aeroplanes, with operation within the tolerances prescribed for the actual airborne equipment. This shall include communication equipment (interphone and air/ground communications systems).							✓	✓	✓	✓	

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
1.1 General		A	B	C	D	1	2	I	II	MCC		
e.3	Navigational data with the corresponding approach facilities. Navigation aids should be usable within range without restriction.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	For FTD 1 applies where navigation equipment is replicated. For all FFSs and FTDs 2 where used for area or airfield competence training or checking, navigation data should be updated within 28 days. For FNPTs and BITDs complete navigational data for at least 5 different European airports with corresponding precision and non-precision approach procedures including current updating within a period of 3 months.
f.1	In addition to the flight crewmember duty stations, three suitable seats for the instructor, delegated examiner and Authority inspector. The Authority will consider options to this standard based on unique cockpit configurations. These seats shall provide adequate vision to the pilot's panel and forward windows. Observer seats need not represent those found in the aeroplane but in the case of FSTDs fitted with a motion system, the seats shall be adequately secured to the floor of the FSTD, fitted with positive restraint devices and be of sufficient integrity to safely restrain the occupant during any known or predicted motion system excursion.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	For FTDs and FNPT's suitable seating arrangements for the Instructor and Examiner or Authority's Inspector should be provided. For BITDs suitable viewing arrangements for the Instructor should be provided.

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS	FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
1.1 General	A	B	C	D	1	2	I	II	MCC		
g.1 FSTD systems shall simulate applicable aeroplane system operation, both on the ground and in flight. Systems shall be operative to the extent that all normal, abnormal, and emergency operating procedures can be accomplished.	✓	✓	✓	✓	✓	✓		✓	✓		For FTD Level 1, applies where system is simulated. For FNPTs systems shall be operative to the extent that it shall be possible to perform all normal, abnormal and emergency operations as may be appropriate to the aeroplane or class of aeroplanes being simulated and as required for the training.
h.1 Instructor controls shall enable the operator to control all required system variables and insert abnormal or emergency conditions into the aeroplane systems.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Where applicable and as required for training the following shall be available : - Position and flight freeze. - A facility to enable the dynamic plotting of the flight path on approaches, commencing at the final approach fix, including the vertical profile - Hard copy of map and approach plot

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS	FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
1.1 General	A	B	C	D	1	2	I	II	MCC		
i.1 Control forces and control travel shall correspond to that of the replicated aeroplane. Control forces shall react in the same manner as in the aeroplane under the same flight conditions.	✓	✓	✓	✓		✓	✓	✓	✓	✓	For FTD Level 2 Control forces and control travel should correspond to that of the replicated aeroplane with CT&M. It is not intended that the device should be flown manually other than for short periods when the autopilot is temporarily disengaged. For FNPT Level I and BITDs control forces and control travel shall broadly correspond to that of the replicated aeroplane or class of aeroplane. Control force changes due to an increase/decrease in aircraft speed are not necessary. In addition for FNPT Level II and MCC control forces and control travels shall respond in the same manner under the same flight conditions as in the aeroplane or class of aeroplane being simulated.

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS	FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	
1.1 General	A	B	C	D	1	2	I	II	MCC		COMPLIANCE
j.1 Ground handling and aerodynamic programming shall include: (1) Ground Effect. For example: round-out, flare, and touchdown. This requires data on lift, drag, pitching moment, trim, and power ground effect. (2) Ground reaction – reaction of the aeroplane upon contact with the runway during landing to include strut deflections, tyre friction, side forces, and other appropriate data, such as weight and speed, necessary to identify the flight condition and configuration. (3) Ground handling characteristics – steering inputs to include crosswind, braking, thrust reversing, deceleration and turning radius.	✓	✓	✓	✓				✓	✓		Statement of Compliance required. Tests required. For Level 'A' FFS, generic ground handling to the extent that allows turns within the confines of the runway, adequate control on flare, touchdown and roll-out (including from a cross -wind landing) only is acceptable. For FNPTs a generic ground handling model need only be provided to enable representative flare and touch down effects.

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS	FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
1.1 General	A	B	C	D	1	2	I	II	MCC		
k.1 Windshear models shall provide training in the specific skills required for recognition of wind shear phenomena and execution of recovery manoeuvres. Such models shall be representative of measured or accident derived winds, but may include simplifications which ensure repeatable encounters. For example, models may consist of independent variable winds in multiple simultaneous components. Wind models shall be available for the following critical phases of flight: (1) Prior to take-off rotation (2) At lift-off (3) During initial climb (4) Short final approach			✓	✓							Tests required. See ACJ No 1 to JAR-FSTD A.030, Para 2.3, g.
l.1 Instructor controls for environmental effects including wind speed and direction shall be provided.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	For FTDs environment modelling sufficient to permit accurate systems operation and indication.

	FLIGHT SIMULATOR TRAINING DEVICE STANDARDS	FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
	1.1 General	A	B	C	D	1	2	I	II	MCC		
m.1	Stopping and directional control forces shall be representative for at least the following runway conditions based on aeroplane related data: (1) Dry (2) Wet (3) Icy (4) Patchy wet (5) Patchy icy (6) Wet on rubber residue in touchdown zone.			✓	✓							Statement of Compliance required. Objective Tests required for (1), (2), (3), Subjective check for (4), (5), (6).
n.1	Brake and tyre failure dynamics (including antiskid) and decreased brake efficiency due to brake temperatures shall be representative and based on aeroplane related data.			✓	✓							Statement of Compliance required. Subjective test is required for decreased braking efficiency due to brake temperature, if applicable.
o.1	A means for quickly and effectively conducting daily testing of FSTD programming and hardware shall be available.			✓	✓							Statement of Compliance required.
p.1	Computer capacity, accuracy, resolution, and dynamic response shall be sufficient to fully support the overall fidelity, including its evaluation and testing.	✓	✓	✓	✓	✓	✓					Statement of Compliance required.

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

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS	FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
1.1 General	A	B	C	D	1	2	I	II	MCC		
r.1 One of the following two methods is acceptable as a means to prove compliance: (1) Transport Delay: A transport delay test may be used to demonstrate that the FSTD system response does not exceed 150 milliseconds. This test shall measure all the delay encountered by a step signal migrating from the pilot's control through the control loading electronics and interfacing through all the simulation software modules in the correct order, using a handshaking protocol, finally through the normal output interfaces to the motion system, to the visual system and instrument displays. (see next page)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Tests required. For Level 'A' & 'B' FFSs, and applicable systems for FTDs, FNPTs and BITDs the maximum permissible delay is 300 milliseconds.

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS	FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
1.1 General	A	B	C	D	1	2	I	II	MCC		
(continued) (2) Latency: The visual system, flight deck instruments and initial motion system response shall respond to abrupt pitch, roll and yaw inputs from the pilot's position within 150 milliseconds of the time, but not before the time, when the aeroplane would respond under the same conditions.											

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS		FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
	1.1 General	A	B	C	D	1	2	I	II	MCC		
s.1	Aerodynamic modelling shall be provided. This shall include, for aeroplanes issued an original type certificate after June 1980, low altitude level flight ground effect, Mach effect at high altitude, normal and reverse dynamic thrust effect on control surfaces, aeroelastic representations, and representations of non-linearities due to sideslip based on aeroplane flight test data provided by the manufacturer.			✓	✓							Statement of Compliance required. Mach effect, aeroelastic representations, and non-linearities due to sideslip are normally included in the FSTD aerodynamic model. The Statement of Compliance shall address each of these items. Separate tests for thrust effects and a Statement of Compliance are required.
t.1	Modelling that includes the effects of airframe and engine icing.			✓	✓				✓	✓		Statement of Compliance required. SOC shall describe the effects that provide training in the specific skills required for recognition of icing phenomena and execution of recovery.
u.1	Aerodynamic and ground reaction modelling for the effects of reverse thrust on directional control shall be provided.		✓	✓	✓							Statement of Compliance required. (page 2–C–44).
v.1	Realistic aeroplane mass properties, including mass, centre of gravity and moments of inertia as a function of payload and fuel loading shall be implemented.	✓	✓	✓	✓							Statement of Compliance required at initial evaluation. SOC shall include a range of tabulated target values to enable a demonstration of the mass properties model to be conducted from the instructor's station.
w.1	Self-testing for FSTD hardware and programming to determine compliance with the FSTD performance tests shall be provided. Evidence of testing shall include FSTD number, date, time, conditions, tolerances, and the appropriate dependent variables portrayed in comparison with the aeroplane standard.			✓	✓							Statement of Compliance required. Tests required.

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS	FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
1.1 General	A	B	C	D	1	2	I	II	MCC		
x.1 Timely and permanent update of hardware and programming subsequent to aeroplane modification sufficient for the Qualification Level sought.	✓	✓	✓	✓	✓	✓					
y.1 Daily pre-flight documentation either in the daily log or in a location easily accessible for review is required.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS	FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
2. Motion system	A	B	C	D	1	2	I	II	MCC		
a.1 Motion cues as perceived by the pilot shall be representative of the aeroplane, e.g. touchdown cues shall be a function of the simulated rate of descent.	✓	✓	✓	✓							For FSTDs where motion systems are not specifically required, but have been added, they will be assessed to ensure that they do not adversely affect the qualification of the FSTD.
b.1 A motion system shall:											Statement of Compliance required. Tests required.
(1) Provide sufficient cueing, which may be of a generic nature to accomplish the required tasks.	✓										
(2) Have a minimum of 3 degrees of freedom (pitch, roll & heave).		✓									
(3) Produce cues at least equivalent to those of a six-degrees-of-freedom synergistic platform motion system.			✓	✓							
c.1 A means of recording the motion response time as required.	✓	✓	✓	✓							

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS	FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
2. Motion system	A	B	C	D	1	2	I	II	MCC		
d.1 Motion effects programming shall include: (1) Effects of runway rumble, oleo deflections, groundspeed, uneven runway, centreline lights and taxiway characteristics. (2) Buffets on the ground due to spoiler/speedbrake extension and thrust reversal. (3) Bumps associated with the landing gear. (4) Buffet during extension and retraction of landing gear. (5) Buffet in the air due to flap and spoiler/speedbrake extension. (6) Approach to stall buffet. (7) Touchdown cues for main and nose gear. (8) Nose wheel scuffing. (9) Thrust effect with brakes set. (See next page)	✓	✓	✓	✓							For Level ‘A’FFS: Effects may be of a generic nature sufficient to accomplish the required tasks.

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS	FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
2. Motion system	A	B	C	D	1	2	I	II	MCC		
d.1 (continued) (10) Mach and manoeuvre buffet. (11) Tyre failure dynamics. (12) Engine malfunction and engine damage. (13) Tail and pod strike.	✓	✓	✓	✓							
e.1 Motion vibrations: Tests with recorded results that allow the comparison of relative amplitudes versus frequency are required. Characteristic motion vibrations that result from operation of the aeroplane in so far as vibration marks an event or aeroplane state that can be sensed at the flight deck shall be present. The FSTD shall be programmed and instrumented in such a manner that the characteristic vibration modes can be measured and compared with aeroplane data.				✓							Statement of Compliance required. Tests required.

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS		FS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
3 Visual System		A	B	C	D	1	2	I	II	MCC		
a.1	The visual system shall meet all the standards enumerated as applicable to the level of qualification requested by the applicant.	✓	✓	✓	✓				✓	✓		For FTDs, FNPT 1s and BITDs, when visual systems have been added by the FSTD operator even though not attracting specific credits, they will be assessed to ensure that they do not adversely affect the qualification of the FSTD. For FTDs if the visual system is to be used for the training of manoeuvring by visual reference (such as route and airfield competence) then the visual system should at least comply with that required for level A FFS.
b.1	Continuous minimum collimated visual field-of-view of 45 degrees horizontal and 30 degrees vertical field of view simultaneously for each pilot.	✓	✓									SOC is acceptable in place of this test.
b.2	Continuous, cross-cockpit, minimum collimated visual field of view providing each pilot with 180 degrees horizontal and 40 degrees vertical field of view. Application of tolerances require the field of view to be not less than a total of 176 measured degrees horizontal field of view (including not less than ±88 measured degrees either side of the centre of the design eye point) and not less than a total of 36 measured degrees vertical field of view from the pilot's and co-pilot's eye points.			✓	✓							Consideration shall be given to optimising the vertical field of view for the respective aeroplane cut-off angle. SOC is acceptable in place of this test.

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS	FS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
3 Visual System	A	B	C	D	1	2	I	II	MCC		
b.3 A visual system (night/dusk or day) capable of providing a field-of-view of a minimum of 45 degrees horizontally and 30 degrees vertically, unless restricted by the type of aeroplane, simultaneously for each pilot, including adjustable cloud base and visibility.								✓	✓		The visual system need not be collimated but shall be capable of meeting the standards laid down in Part 3 and 4 (Validation, Functions and Subjective Tests - See ACJ No.1 to JAR-FSTD A.030). SOC is acceptable in place of this test.
c.1 A means of recording the visual response time for visual systems.	✓	✓	✓	✓				✓	✓		
d.1 System Geometry. The system fitted shall be free from optical discontinuities and artefacts that create non-realistic cues.	✓	✓	✓	✓				✓	✓		Test required. A Statement of Compliance is acceptable in place of this test.
e.1 Visual textural cues to assess sink rate and depth perception during take-off and landing shall be provided.	✓	✓	✓	✓							For Level 'A' FFS visual cueing shall be sufficient to support changes in approach path by using runway perspective.
f.1 Horizon, and attitude shall correlate to the simulated attitude indicator.	✓	✓	✓	✓							Statement of Compliance required.
g.1 Occulting - A minimum of ten levels shall be available.	✓	✓	✓	✓							Occulting shall be demonstrated. Statement of Compliance required.
h.1 Surface (Vernier) resolution shall occupy a visual angle of not greater than 2 arc minutes in the visual display used on a scene from the pilot's eyepoint.			✓	✓							Test and Statement of Compliance required containing calculations confirming resolution.

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS		FS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
3 Visual System		A	B	C	D	1	2	I	II	MCC		
i.1	Surface contrast ratio shall be demonstrated by a raster drawn test pattern showing a contrast ratio of not less than 5:1			✓	✓							Test and Statement of Compliance required.
j.1	Highlight brightness shall be demonstrated using a raster drawn test pattern. The highlight brightness shall not be less than 20 cd/m^2 (6ft-lamberts).			✓	✓							Test and Statement of Compliance required. Use of calligraphic lights to enhance raster brightness is acceptable.
k.1	Light point size – not greater than 5 arc minutes.			✓	✓							Test and Statement of Compliance required. This is equivalent to a light point resolution of 2.5 arc minutes.
l.1	Light point contrast ratio – not less than 10:1	✓	✓									Test and Statement of compliance required.
l.2	Light point contrast ratio – not less than 25:1.			✓	✓							Test and Statement of compliance required.
m.1	Daylight, twilight and night visual capability as applicable for level of qualification sought.	✓	✓	✓	✓							Statement of Compliance required for system capability. System objective and scene content tests are required.
m.2	The visual system shall be capable of meeting, as a minimum, the system brightness and contrast ratio criteria as applicable for level of qualification sought	✓	✓	✓	✓							

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS	FS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
3 Visual System	A	B	C	D	1	2	I	II	MCC		
m.3 Total scene content shall be comparable in detail to that produced by 10000 visible textured surfaces and (in day) 6000 visible lights or (in twilight or night) 15000 visible lights, and sufficient system capacity to display 16 simultaneously moving objects.			✓	✓							
m.4 The system, when used in training, shall provide in daylight, full colour presentations and sufficient surfaces with appropriate textural cues to conduct a visual approach, landing and airport movement (taxi). Surface shading effects shall be consistent with simulated (static) sun position.			✓	✓							

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS	FS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
3 Visual System	A	B	C	D	1	2	I	II	MCC		
m.5 The system, when used in training, shall provide at twilight, as a minimum, full colour presentations of reduced ambient intensity, sufficient surfaces with appropriate textural cues that include self-illuminated objects such as road networks, ramp lighting and airport signage, to conduct a visual approach, landing and airport movement (taxi). Scenes shall include a definable horizon and typical terrain characteristics such as fields, roads and bodies of water and surfaces illuminated by representative ownship lighting (e.g. landing lights). If provided, directional horizon lighting shall have correct orientation and be consistent with surface shading effects.			✓	✓							
m.6 The system, when used in training, shall provide at night, as a minimum, all features applicable to the twilight scene, as defined above, with the exception of the need to portray reduced ambient intensity that removes ground cues that are not self-illuminating or illuminated by ownship lights (e.g. landing lights).	✓	✓	✓	✓							

FLIGHT SIMULATOR TRAINING DEVICE STANDARDS **4 Sound System**	FFS LEVEL				FTD LEVEL		FNPT LEVEL			BITD	COMPLIANCE
	A	B	C	D	1	2	I	II	MCC		
a.1 Significant flight deck sounds which result from pilot actions corresponding to those of the aeroplane or class of aeroplane.	✓	✓	✓	✓		✓	✓	✓	✓	✓	For FNPT Level I and BITD engine sounds only need be available
b.1 Sound of precipitation, rain removal equipment and other significant aeroplane noises perceptible to the pilot during normal and abnormal operations and the sound of a crash when the FSTD is landed in excess of limitations.			✓	✓							Statement of Compliance required.
c.1 Comparable amplitude and frequency of flight deck noises, including engine and airframe sounds. The sounds shall be co-ordinated with the required weather.				✓							Tests required.
d.1 The volume control shall have an indication of sound level setting which meets all qualification requirements.	✓	✓	✓	✓							

SECTION 2 – ADVISORY CIRCULARS JOINT (ACJ)

1 GENERAL

1.1 This Section contains Advisory Circulars Joint (ACJ) providing acceptable means of compliance and/or interpretative/explanatory material that have been agreed for inclusion in JAR–FSTD A.

1.2 Where a particular JAR paragraph does not have an Advisory Circular Joint (ACJ), it is considered that no supplementary material is required.

2 PRESENTATION

2.1 The ACJs are presented in full-page width on loose pages, each page being identified by the date of issue and the Amendment number under which it is amended or reissued.

2.2 A numbering system has been used in which the Advisory Circular Joint (ACJ) uses the same number as the JAR paragraph to which it refers. The number is introduced by the letters ACJ to distinguish the material from the JAR itself.

2.3 The acronym ACJ also indicates the nature of the material and for this purpose the type of material is defined as follows:

Advisory Circulars Joint (ACJ) illustrate a means, or several alternative means, but not necessarily the only possible means by which a requirement can be met. It should however be noted that where a new ACJ is developed, any such ACJ (which may be additional to an existing ACJ) will be amended into the document following consultation under the NPA procedure. Such ACJ will be designated by (acceptable means of compliance).

An ACJ as interpretative/explanatory material may contain material that helps to illustrate the meaning of a requirement. Such ACJ will be designated by (interpretative/explanatory material).

2.4 New ACJ material may, in the first place, be made available rapidly by being published as a Temporary Guidance Leaflet (TGL). FSTD TGLs (JAR–FSTD) can be found in the Joint Aviation Authorities Administrative & Guidance Material, Section 6 – Flight Simulation Training Devices (FSTD), Part Three: Temporary Guidance Leaflet (JAR–FSTD). The procedures associated with Temporary Guidance Leaflets are included in the FSTD Joint Implementation Procedures, Section 6 – Flight Simulation Training Devices (FSTD), Part Two: Procedures (JAR–FSTD) Chapter 9.

Note: Any person who considers that there may be alternative ACJ to those published should submit details to the Operations Director, with a copy to the Regulation Director, for alternatives to be properly considered by the JAA. Possible alternative ACJ may not be used until published by the JAA as ACJ or TGLs.

2.5 Explanatory Notes not forming part of the ACJ text appear in a smaller typeface.

2.6 New, amended or corrected text is enclosed within heavy brackets.

2.7 After each ACJ, the various changes and amendments, when any since the initial issue, are indicated together with their date of issue.

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ACJ B – GENERAL

ACJ to JAR-FSTD A.005
Terminology, Abbreviations
See JAR–FSTD A.005

1 Terminology

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

a Acceptable Change. A change to configuration, software etc., which qualifies as a potential candidate for alternative approach to validation.

b Aircraft Performance Data. Performance data published by the aircraft manufacturer in documents such as the Aeroplane or Rotorcraft Flight Manual, Operations Manual, Performance Engineering Manual, or equivalent.

c Airspeed. Calibrated airspeed unless otherwise specified (knots).

d Altitude. Pressure altitude (metres or feet) unless specified otherwise.

e Audited Engineering Simulation. An aircraft manufacturer's engineering simulation which has undergone a review by the appropriate regulatory Authorities and been found to be an acceptable source of supplemental validation data.

f Automatic Testing. Flight Synthetic Training Device (FSTD) testing wherein all stimuli are under computer control.

g Bank. Bank/Roll angle (degrees)

h Baseline. A fully flight-test validated production aircraft simulation. May represent a new aircraft type or a major derivative.

i Breakout. The force required at the pilot's primary controls to achieve initial movement of the control position.

j Closed Loop Testing. 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 Controlled Aircraft. An aircraft where the pilot inputs to the control surfaces are transferred and augmented via computers.

l Control Sweep. A movement of the appropriate pilot's control from neutral to an extreme limit in one direction (Forward, Aft, Right, or Left), a continuous movement back through neutral to the opposite extreme position, and then a return to the neutral position.

m Convertible FSTD. An 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 Engine Parameter. The engine parameter which is the most appropriate measure of propulsive force.

o Damping (critical). 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 Damping ratio of 1:0

p Damping (over-damped). An OVER-DAMPED response is that Damping of a second order system such that it has more Damping than is required for Critical Damping, as described above. This corresponds to a relative Damping ratio of more than 1:0.

q Damping (under-damped). An UNDER-DAMPED response is that Damping 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 Damping ratio of less than 1:0.

r Daylight Visual. 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. The 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 in Nautical Miles unless specified otherwise.

u Driven**.** 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 Engineering Simulation. An 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 to generate data for checkout, proof-of-match/validation and other training FSTD data documents.

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

x Engineering Simulator Data. Data generated by an engineering simulation or engineering simulator, depending on the aircraft manufacturer's processes.

y Engineering Simulator Validation Data. Validation data generated by an engineering simulation or engineering simulator.

z Entry into Service. Refers 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 Essential Match. A comparison of two sets of computer-generated results for which the differences should be negligible because essentially the same simulation models have been used. Also known as a virtual match.

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

cc FSTD Data. The various types of data used by the FSTD manufacturer and the applicant to design, manufacture, test and maintain the FSTD.

dd FSTD Evaluation. A detailed appraisal of an FSTD by the Authority to ascertain whether or not the standard required for a specified Qualification Level is met.

ee FSTD Operator. That person, organisation or enterprise directly responsible to the authority for requesting and maintaining the qualification of a particular FSTD.

ff FSTD Qualification Level. The level of technical capability of a FSTD.

gg Flight Test Data. Actual aircraft data obtained by the aircraft manufacturer (or other supplier of acceptable data) during an aircraft flight test programme.

hh Free Response. The response of the aircraft after completion of a control input or disturbance.

ii Frozen/Locked. A state where a variable is held constant with time.

jj Fuel used. Mass of fuel used (kilos or pounds)

kk Full Sweep. Movement 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 Functional Performance. An operation or performance that can be verified by objective data or other suitable reference material that may not necessarily be flight test data.

ACJ to JAR-FSTD A.005 (continued)

mm Functions Test. 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 Flight Test Data.

nn Grandfather Rights. The right of an FSTD operator to retain the Qualification Level granted under a previous regulation of a JAA 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 JAA member state.

oo Ground Effect. The change in aerodynamic characteristics due to modification of the air flow past the aircraft caused by the presence of the ground.

pp Hands-off Manoeuvre. A test manoeuvre conducted or completed without pilot control inputs.

qq Hands-on Manoeuvre. A test manoeuvre conducted or completed with pilot control inputs as required.

rr Heavy. Operational mass at or near maximum for the specified flight condition.

ss Height. Height above ground = AGL (meters or feet)

tt Highlight Brightness. The maximum displayed brightness, which satisfies the appropriate brightness test.

uu Icing Accountability. 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 takeoff, climb (enroute, 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 Integrated Testing. Testing 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 Irreversible Control System. A control system in which movement of the control surface will not backdrive the pilot’s control on the flight deck.

xx Latency. The additional time, beyond that of the basic perceivable response time of the aircraft due to the response time of the FSTD.

yy Light. Operational mass at or near minimum for the specified flight condition.

zz Line Oriented Flight Training (LOFT). Refers to aircrew 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 Manual Testing. FSTD testing wherein the pilot conducts the test without computer inputs except for initial setup. All modules of the simulation should be active.

bbb Master Qualification Test Guide (MQTG). The Authority approved QTG which incorporates the results of tests witnessed by the Authority. The MQTG serves as the reference for future evaluations.

ccc Medium. Normal operational weight for flight segment.

ddd Night Visual. 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 Nominal. Normal operational weight, configuration, speed etc. for the flight segment specified.

fff Non-normal Control. A term used in reference to Computer Controlled Aircraft. Non-normal Control is the state where one or more of the intended control, augmentation or protection functions are not fully available.

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

ggg Normal Control. A term used in reference to Computer Controlled Aircraft. Normal Control is the state where the intended control, augmentation and Protection Functions are fully available.

hhh Objective Test (Objective Testing). A quantitative assessment based on comparison with data.

iii One Step. Refers 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. A person, organisation or enterprise engaging in or offering to engage in an aircraft operation.

kkk Power Lever Angle. The angle of the pilot's primary engine control lever(s) on the flight deck. This may also be referred to as PLA, THROTTLE, or POWER LEVER.

lll Predicted Data. Data derived from sources other than type specific aircraft flight tests.

mmm Primary Reference Document. Any regulatory document which has been used by an Authority to support the initial evaluation of a FSTD.

nnn Proof-of-Match (POM). A document which shows agreement within defined tolerances between model responses and flight test cases at identical test and atmospheric conditions.

ooo Protection Functions. Systems functions designed to protect an aircraft from exceeding its flight and manoeuvre limitations.

ppp Pulse Input. An 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 Reversible Control System. A partially powered or unpowered control system in which movement of the control surface will backdrive the pilot's control on the flight deck and/or affect its feel characteristics.

sss Robotic Test. A basic performance check of a system's hardware and software components. Exact test conditions are defined to allow for repeatability. The components are tested in their normal operational configuration and may be tested independently of other system components.

ttt Sideslip. Sideslip Angle (degrees)

uuu Snapshot. A presentation of one or more variables at a given instant of time.

vvv Statement of Compliance (SOC). A declaration that specific requirements have been met.

www Step Input. An abrupt input held at a constant value.

xxx Subjective Test (Subjective Testing). A qualitative assessment based on established standards as interpreted by a suitably qualified person.

yyy Throttle Lever Angle (TLA). The angle of the pilot's primary engine control lever(s) on the flight deck.

zzz Time History. A presentation of the change of a variable with respect to time.

aaaa Transport Delay. The 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 Twilight (Dusk/Dawn) Visual. 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 Update. The improvement or enhancement of an FSTD.

dddd Upgrade. The improvement or enhancement of an FSTD for the purpose of achieving a higher qualification.

eeee Validation Data. Data used to prove that the FSTD performance corresponds to that of the aircraft.

ffff Validation Flight Test Data. Performance, 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 Validation Test. A test by which FSTD parameters can be compared with the relevant validation data.

hhhh Visual Ground Segment Test. 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.

iiii Visual System Response Time. The interval from an abrupt control input to the completion of the visual display scan of the first video field containing the resulting different information.

jjjj Well-Understood Effect. An 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	=	Aeroplane
AC	=	Advisory Circular
ACJ	=	Advisory Circular Joint
A/C	=	Aircraft
A_d	=	Total initial displacement of pilot controller (initial displacement to final resting amplitude)
AFM	=	Aeroplane Flight Manual
AFCS	=	Automatic Flight Control System
AGL	=	Above Ground Level (metres or feet)
A_n	=	Sequential amplitude of overshoot after initial X axis crossing, e.g. A1 = 1st overshoot.
AEO	=	All Engines Operating
AOA	=	Angle of Attack (degrees)
BC	=	ILS localizer back course
CAT I/II/III	=	Landing category operations
CCA	=	Computer Controlled Aeroplane
cd/m^2	=	Candela/metre^2, 3.4263 candela/m^2 = 1 ft-Lambert
CG	=	Centre of gravity
cm(s)	=	Centimetre, centimetres
CT&M	=	Correct Trend and Magnitude
daN	=	DecaNewtons
dB	=	Decibel
deg(s)	=	Degree, degrees
DGPS	=	Differential Global Positioning System
DH	=	Decision Height
DME	=	Distance Measuring Equipment
DPATO	=	Defined Point After Take-off
DPBL	=	Define Point Before Landing

EGPWS	=	Enhanced Ground Proximity Warning System
EPR	=	Engine Pressure Ratio
EW	=	Empty Weight
FAA	=	United States Federal Aviation Administration (U.S.)
FD	=	Flight Director
FOV	=	Field Of View
FPM	=	Feet Per Minute
FTO	=	Flying Training Organisation
ft	=	Feet, 1 foot = 0.304801 metres
ft-Lambert	=	Foot-Lambert, 1 ft-Lambert = 3.4263 candela/m^2
g	=	Acceleration due to gravity (metres or feet/sec^2), 1g = 9.81 m/sec^2 or 32.2 feet/sec^2
G/S	=	Glideslope
GPS	=	Global Positioning System
GPWS	=	Ground Proximity Warning System
H	=	Helicopter
HGS	=	Head-up Guidance System
IATA	=	International Air Transport Association
ICAO	=	International Civil Aviation Organisation
IGE	=	In Ground Effect
ILS	=	Instrument Landing System
IMC	=	Instrument Meteorological Conditions
in	=	Inches 1 in = 2.54 cmIOS = Instructor Operating Station
IPOM	=	Integrated proof of match
IQTG	=	International Qualification Test Guide (RAeS Document)
JAA	=	Joint Aviation Authorities
JAR	=	Joint Aviation Requirement
JAWS	=	Joint Airport Weather Studies
km	=	Kilometres 1 km = 0.62137 Statute Miles
kPa	=	KiloPascal (Kilo Newton/Metres2). 1 psi = 6.89476 kPa
kts	=	Knots calibrated airspeed unless otherwise specified, 1 Knot = 0.5148 m/sec or 1.689 ft/sec
lb	=	Pounds
LOC	=	Localizer
LOFT	=	Line oriented flight training
LOS	=	Line oriented simulation
LDP	=	Landing Decision Point
m	=	Metres, 1 Metre = 3.28083 feet
MCC	=	Multi-Crew Co-operation
MCTM	=	Maximum certificated take-off mass (kilos/pounds)
MEH	=	Multi-engine Helicopter
min	=	Minutes
MLG	=	Main landing gear
mm	=	Millimetres
MPa	=	MegaPascals [1 psi = 6894.76 pascals]
MQTG	=	Master Qualification Test Guide
ms	=	Millisecond(s)
MTOW	=	Maximum Take-off Weight
n	=	Sequential period of a full cycle of oscillation

ACJ to JAR-FSTD A.005 (continued)

N	=	NORMAL CONTROL Used in reference to Computer Controlled Aircraft
N/A	=	Not Applicable
N1	=	Engine Low Pressure Rotor revolutions per minute expressed in percent of maximum
N1/Ng	=	Gas Generator Speed
N2	=	Engine High Pressure Rotor revolutions per minute expressed in percent of maximum
N2/Nf	=	Free Turbine Speed
NAA	=	National Aviation Authority
NDB	=	Non-directional beacon
NM	=	Nautical Mile, 1 Nautical Mile = 6 080 feet = 1 852m
NN	=	Non-normal control a state referring to computer controlled aircraft
NR	=	Main Rotor Speed
NWA	=	Nosewheel Angle (degrees)
OEI	=	One Engine Inoperative
OGE	=	Out of Ground Effect
OM-B	=	Operations Manual – Part B (AFM)
OTD	=	Other Training Device
P0	=	Time from pilot controller release until initial X axis crossing (X axis defined by the resting amplitude)
P1	=	First full cycle of oscillation after the initial X axis crossing
P2	=	Second full cycle of oscillation after the initial X axis crossing
PANS	=	Procedure for air navigation services
PAPI	=	Precision Approach Path Indicator System
PAR	=	Precision approach radar
Pf	=	Impact or Feel Pressure
PLA	=	Power Lever Angle
PLF	=	Power for Level Flight
Pn	=	Sequential period of oscillation
POM	=	Proof-of-Match
PSD	=	Power Spectral Density
psi	=	pounds per square inch. (1 psi = 6·89476 kPa)
PTT	=	Part-Task Trainer
QTG	=	Qualification Test Guide
R/C	=	Rate of Climb (metres/sec or feet/min)
R/D	=	Rate of Descent (metres/sec or feet/min)
RAE	=	Royal Aerospace Establishment
RAeS	=	Royal Aeronautical Society
REIL	=	Runway End Identifier Lights
RNAV	=	Radio navigation
RVR	=	Runway Visual Range (metres or feet)
s	=	second(s)
sec(s)	=	second, seconds
sm	=	Statute Mile 1 Statute Mile = 5280 feet = 1609m
SOC	=	Statement of Compliance
SUPPS	=	Supplementary procedures referring to regional supplementary procedures
TCAS	=	Traffic alert and Collision Avoidance System
TGL	=	Temporary Guidance Leaflet
T(A)	=	Tolerance applied to Amplitude
T(p)	=	Tolerance applied to period
T/O	=	Take-off
Tf	=	Total time of the flare manoeuvre duration

Ti	=	Total time from initial throttle movement until a 10% response of a critical engine parameter
TLA	=	Throttle lever angle
TLOF	=	Touchdown and Lift Off
TDP	=	Take-off Decision Point
Tt	=	Total time from Ti to a 90% increase or decrease in the power level specified
VASI	=	Visual Approach Slope Indicator System
VDR	=	Validation Data Roadmap
VFR	=	Visual Flight Rules
VGS	=	Visual Ground Segment
Vmca	=	Minimum Control Speed (Air)
Vmcg	=	Minimum Control Speed (Ground)
Vmcl	=	Minimum Control Speed (Landing)
VOR	=	VHF omni-directional range
Vr	=	Rotate Speed
Vs	=	Stall Speed or minimum speed in the stall
V1	=	Critical Decision Speed
VTOSS	=	Take-off Safety Speed
Vy	=	Optimum Climbing Speed
Vw	=	Wind Velocity
WAT	=	Weight, Altitude, Temperature
1st Segment	=	That portion of the take-off profile from lift-off to completion of gear retraction (JAR 25)
2nd Segment	=	That portion of the take-off profile from after gear retraction to end of climb at V2 and initial flap/slat retraction (JAR 25)
3rd Segment	=	That portion of the take-off profile after flap/slat retraction is complete (JAR 25)

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ACJ C – AEROPLANE FLIGHT SIMULATION TRAINING DEVICES

ACJ No. 1 to JAR-FSTD A.015 (acceptable means of compliance)
FSTD Qualification – Application and Inspection
See JAR–FSTD A.015

1 Letter of Application

A sample of letter of application is provided overleaf.

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LETTER OF APPLICATION FOR INITIAL JAA EVALUATION OF A FLIGHT SIMULATION TRAINING DEVICE (except BITD).

Part A

To be submitted not less than 3 months prior to requested qualification date

(Date)

PRINCIPAL INSPECTOR
(JAA NAA OFFICE)
(Address)……………………………………………
…………………………………………………………
(City)…………………………………………………
(Country)……………………………………………

Type of FSTD		Aircraft Type/Class	Qualification Level Sought			
Flight Simulator	FFS		A	B	C	D
Flight Training Device	FTD		1	2		
Flight and Navigation Procedures Trainer	FNPT		I	II	II MCC	
Basic Instrument Training Device	BITD					

Dear,

.... (Name of Applicant)........................... requests the evaluation of its Flight Simulation Training Device for JAR-FSTD A qualification. The ……..(FSTD Manufacturer Name) FSTD with its ……………. (Visual System Manufacturer Name, if applicable) Visual System is fully defined on page .... of the accompanying Qualification Test Guide (QTG) which was run on........... (date)........... at ....(place).......

Evaluation is requested for the following configurations and engine fits as applicable:
e.g. 767 PW/GE and 757RR
1……………..
2…………….
3…………….

Dates requested are:……………………….. and the FSTD will be located at ……………………………………………………………………………………………………
The QTG will be submitted by……(Date)………… and in any event not less than 30 days before the requested evaluation date unless otherwise agreed with the Authority.

Comments:
………
………
……………………………………………

Signed

………………………
Print name……………..
position/appointment held……………….
e mail address…………….
telephone number…………

ACJ No 1 to JAR FSTD A.015 (continued)

Part B

To be completed with attached QTG results

(Date)…………

We have completed tests of the FSTD and declare that it meets all applicable requirements of the JAR–FSTD A (Aeroplane) except as noted below. Appropriate hardware and software configuration control procedures have been established and these are appended for your inspection and approval.

The following MQTG tests are outstanding:

Tests	Comments

(Add boxes as required)

It is expected that they will be completed and submitted 3 weeks prior to the evaluation date.

Signed

………………………

Print name…..............................
position/appointment held……………….
E-mail address…………….
Telephone number…………

Part C

To be completed not less than 7 days prior to initial evaluation

(Date)…………

The FSTD has been assessed by the following evaluation team:

....	(name)	Qualification	....
....	(name)	Qualification	....
....	(name)	Qualification	....
....	(name)	Pilot's Licence Nr................	
....	(name)	Flight Engineer's Licence Nr (if applicable)	....

This team attest(s) that it conforms to the aeroplane flight deck configuration of ....(Name of FSTD operator)..........(type of aeroplane) aeroplane and that the simulated systems and subsystems function equivalently to those in that aeroplane. This pilot has also assessed the performance and the flying qualities of the FSTD and finds that it represents the designated aeroplane.

(Additional comments as required)

…………………………………………………………

……………………………………………………………

……………………………………………………………

Signed

………………………

Print name................................
position/appointment held……………….
E-mail address…………….
Telephone number…………

2 Composition of Evaluation Team

2.1 To gain a Qualification Level, an FSTD is evaluated in accordance with a structured routine conducted by a technical team which is appointed by the Authority. The team normally consists of at least the following personnel:

a. A technical FSTD inspector of the Authority, or an accredited inspector from another JAA Authority, qualified in all aspects of flight simulation hardware, software and computer modelling or, exceptionally, a person designated by the Authority with equivalent qualifications; and

b. One of the following:

i. A flight inspector of the Authority, or an accredited inspector from another JAA Authority, who is qualified in flight crew training procedures and is holding a valid type rating on the aeroplane (or for BITD, class rated on the class of aeroplane) being simulated; or

ii. A flight inspector of the Authority who is qualified in flight crew training procedures assisted by a Type Rating Instructor, holding a valid type rating on the aeroplane (or for BITD, class rated on the class of aeroplane) being simulated; or, exceptionally,

iii. A person designated by the Authority who is qualified in flight crew training procedures and is holding a valid type rating on the aeroplane (or for BITD, class rated on the class of aeroplane) being simulated and sufficiently experienced to assist the technical team. This person should fly out at least part of the functions and subjective test profiles.

Where a designee is used as a substitute for one of the Authority's inspectors, the other person shall be a properly qualified inspector of the Authority or an accredited inspector from another JAA Authority.

For an FTD level 1 and FNPT Type I, one suitably qualified Inspector may combine the functions in a. and b. above.

For a BITD this team consists of an Inspector from a JAA National Aviation Authority and one from another JAA National Aviation Authority, including the manufacturer's Authority if applicable.

2.2 Additionally the following persons should be present:

a. For FFS, FTD and FNPT a type or class rated Training Captain from the FSTD operator or main FSTD users.

b. For all types, sufficient FSTD support staff to assist with the running of tests and operation of the instructor's station.

2.3 On a case-by-case basis, when an FFS is being evaluated, the Authority may reduce the evaluation team to an Authority flight inspector supported by a type rated training captain from a main flight simulator user for evaluation of a specific flight simulator of a specific FSTD operator, provided:

a. This composition is not being used prior to the second recurrent evaluation;

b. Such an evaluation will be followed by an evaluation with a full authority evaluation team;

c. The Authority flight inspector will perform some spot checks in the area of objective testing;

d. No major change or upgrading has been applied since the directly preceding evaluation;

e. No relocation of the FSTD has taken place since the last evaluation;

f. A system is established enabling the Authority to monitor and analyse the status of the FSTD on a continuous basis;

g. The FSTD hardware and software has been working reliably for the previous years. This should be reflected in the number and kind of (technical log) discrepancies and the results of the quality system audits.

ACJ No. 2 to JAR- FSTD A.015 (explanatory material)
FSTD Evaluations
See JAR–FSTD A.015

1 General

1.1 During initial and recurrent FSTD evaluations it will be necessary for the Authority to conduct the Objective and Subjective tests described in JAR–FSTD A.030 and JAR–FSTD A.035, and detailed in ACJ No 1 to JAR-FSTD A.030. There will be occasions when all tests cannot be completed – for example during recurrent evaluations on a convertible FSTD – but arrangements should be made for all tests to be completed within a reasonable time.

1.2 Following an evaluation, it is possible that a number of defects may be identified. Generally these defects should be rectified and the Authority notified of such action within 30 days. Serious defects, which affect flight crew training, testing and checking, could result in an immediate downgrading of the Qualification Level, or if any defect remains unattended without good reason for period greater than 30 days, subsequent downgrading may occur or the FSTD Qualification could be revoked.

2 Initial Evaluations

2.1 Objective Testing

2.1.1 Objective Testing is centred around the QTG. Before testing can begin on an initial evaluation the acceptability of the validation tests contained in the QTG should be agreed with the Authority well in advance of the evaluation date to ensure that the FSTD time especially devoted to the running of some of the tests by the Authority is not wasted. The acceptability of all tests depends upon their content, accuracy, completeness and recency of the results.

2.1.2 Much of the time allocated to Objective Tests depends upon the speed of the automatic and manual systems set up to run each test and whether or not special equipment is required. The Authority will not necessarily warn the FSTD operator of the sample validations tests which will be run on the day of the evaluation, unless special equipment is required. It should be remembered that the FSTD cannot be used for Subjective Tests whilst part of the QTG is being run. Therefore sufficient time (at least 8 consecutive hours) should be set aside for the examination and running of the QTG. A useful explanation of how the validation tests should be run is contained in the ‘RAeS Aeroplane Flight Simulator Evaluation Handbook’ (February 95 or as amended) produced in support of the ICAO Manual of Criteria for the Qualification of Flight Simulators and JAR–FSTD A.

2.2 Subjective Testing

2.2.1 The Subjective Tests for the evaluation can be found in ACJ No 1 to JAR-FSTD A.030, and a suggested Subjective Test Profile is described in sub-paragraph 4.6 below.

2.2.2 Essentially one working day is required for the Subjective Test routine, which effectively denies use of the FSTD for any other purpose.

2.3 Conclusion

2.3.1 To ensure adequate coverage of Subjective and Objective Tests and to allow for cost effective rectification and re-test before departure of the inspection team, adequate time (up to three consecutive days) should be dedicated to an initial evaluation of an FSTD.

3 Recurrent Evaluations

3.1 Objective Testing

3.1.1 During recurrent evaluations, the Authority will wish to see evidence of the successful running of the QTG between evaluations. The Authority will select a number of tests to be run during the evaluation, including those that may be cause for concern. Again adequate notification would be given when special equipment is required for the test.

3.1.2 Essentially the time taken to run the Objective Tests depends upon the need for special equipment, if any, and the test system, and the FSTD cannot be used for Subjective Tests or other functions whilst testing is in progress. For a modern FSTD incorporating an automatic test system, four (4) hours would normally be required. FSTDs that rely upon Manual Testing may require a longer period of time.

3.2 Subjective Testing

ACJ No. 2 to JAR-FSTD A.015 (continued)

3.2.1 Essentially the same subjective test routine should be flown as per the profile described in sub-paragraph 4.6 below with a selection of the subjective tests taken from ACJ No 1 to JAR- FSTD A.030.

3.2.2 Normally, the time taken for recurrent Subjective Testing is about four (4) hours, and the FSTD cannot perform other functions during this time.

3.3 Conclusion

3.3.1 To ensure adequate coverage of Subjective and Objective Tests during a recurrent evaluation, a total of 8 hours should be allocated, (4 hours for a BITD). However, it should be remembered that any FSTD deficiency that arises during the evaluation could necessitate the extension of the evaluation period.

3.3.2 In the case of a BITD, the recurrent evaluation may be conducted by one suitably qualified Flight Inspector only, in conjunction with the visit of any Registered Facility or inspection of any Flight Training Organisation, using the BITD.

4 Functions and Subjective Tests – Suggested Test Routine

4.1 During initial and recurrent evaluations of an FSTD, the competent Authority will conduct a series of Functions and Subjective Tests that together with the Objective Tests complete the comparison of the FSTD with the type or class of aeroplane.

4.2 Whereas functions tests verify the acceptability of the simulated aeroplane systems and their integration, Subjective Tests verify the fitness of the FSTD in relation to training, checking and testing tasks.

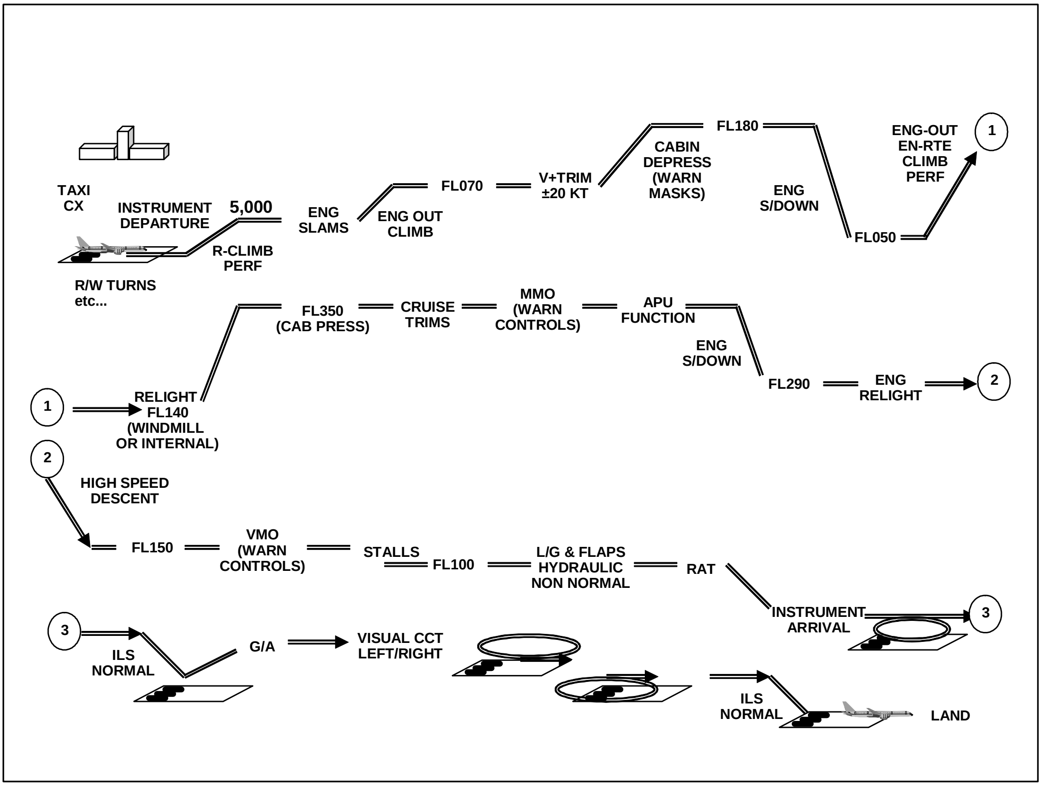
4.3 The FSTD should provide adequate flexibility to permit the accomplishment of the desired/required tasks while maintaining an adequate perception by the flight crew that they are operating in a real aeroplane environment. Additionally, the Instructor Operating Station (IOS) should not present an unnecessary distraction from observing the activities of the flight crew whilst providing adequate facilities for the tasks.

4.4 Section 1 of JAR– FSTD A sets out the requirements, and the ACJs in Section 2 the means of compliance for qualification. However, it is important that both the competent Authority and the FSTD operator understand what to expect from the routine of FSTD Functions and Subjective Tests. It should be remembered that part of the Subjective Tests routine for an FSTD should involve an uninterrupted fly-out (except for FTD level 1) comparable with the duration of typical training sessions in addition to assessment of flight freeze and repositioning. An example of such a profile is to be found in sub-paragraph 4.6 (4.7 for BITD) below. (A useful explanation of Functions and Subjective Tests and an example of Subjective Test routine check-list may be found in the RAeS Airplane Flight Simulator Evaluation Handbook Volume II (February 95 or as amended) produced in support of the ICAO Manual of Criteria for the Qualification of Flight Simulators and JAR–FSTD A.

4.5 JAA Regulatory Authorities and FSTD operators who are unfamiliar with the evaluation process are advised to contact a suitably experienced JAA Authority.

ACJ No 2 to JAR FSTD A.015 (continued)

4.6 Typical Test Profile for a FSTD A.



Note: (1) The Typical Test Profile (approximately 2 hours) should be flown at aeroplane masses at, or close to, the maximum allowable mass for the ambient atmospheric conditions. Those ambient conditions should be varied from Standard Atmosphere to test the validity of the limits of temperature and pressure likely to be required in the practical use of the FSTD. Visual exercises only apply to FSTDs fitted with a visual system.

(2) Flight with AFCS

(3) Manual handling qualities are purely generic and should not provide negative training

4.7 Typical Subjective Test Profile for BITDs (approximately 2 hours) - items and altitudes as applicable.

- Instrument departure, rate of climb, climb performance
- Level-off at 4 000 ft
- Fail engine (if applicable)
- Engine out climb to 6 000 ft (if applicable)
- Engine out cruise performance (if applicable), restart engine
- All engine cruise performance with different power settings
- Descent to 2000 ft
- All engine performance with different configurations, followed by ILS approach
- All engine go-around
- Non-precision approach

- Go-around with engine failure (if applicable)
- Engine out ILS approach (if applicable)
- Go-around engine out (if applicable)
- Non precision approach engine out (if applicable), followed by go-around
- Restart engine (if applicable)
- Climb to 4000 ft
- Manoeuvring:
- Normal turns left and right
- Steep turns left and right
- Acceleration and deceleration within operational range
- Approaching to stall in different configurations
- Recovery from spiral dive
- Auto flight performance (if applicable)
- System malfunctions
- Approach

ACJ to JAR-FSTD A.020 (acceptable means of compliance)
Validity of FSTD Qualification
See JAR-FSTD A.020

1. Prerequisites

1.1 On a case-by-case basis, the Authority may grant an extended validity of a FSTD qualification in excess of 12 months up to a maximum of 36 months, to a specific FSTD operator for a specific FSTD, provided:

a. an initial and at least one recurrent successful evaluation have been performed on this FSTD by the same Authority;

b. the FSTD operator has got a satisfactory record of successful regulatory FSTD evaluations over a period of at least 3 years;

c. the FSTD operator has established and successfully maintained a Quality System for at least 3 years;

d. the Authority performs a formal audit of the FSTD operator's Quality System every calendar year;

e. an accountable person of the FSTD operator with FSTD and training experience acceptable to the Authority (such as a type rated training captain), reviews the regular reruns of the QTG and conducts the relevant function and subjective tests every 12 months;

f. a report detailing the results of the QTG rerun tests and function and subjective evaluation will be signed and submitted by the accountable person described under subparagraph (e) above to the Authority.

2. Prerogative of the Authority

The Authority reserves the right to perform FSTD evaluations whenever it deems it necessary.

ACJ No.1 to JAR-FSTD A.025 (acceptable means of compliance)
Quality System
See JAR– FSTD A.025

1. Introduction

1.1 In order to show compliance with JAR– FSTD A.025, an FSTD operator should establish his Quality System in accordance with the instructions and information contained in the following paragraphs.

2 General

2.1 Terminology

a. The terms used in the context of the requirement for an FSTD operator's Quality System have the following meanings:

i. *Accountable Manager.* The person acceptable to the Authority who has corporate authority for ensuring that all necessary activities can be financed and carried out to the standard required by the Authority, and any additional requirements defined by the FSTD operator.

ii. *Quality Assurance.* All those planned and systematic actions necessary to provide adequate confidence that specified performance, functions and characteristics satisfy given requirements.

iii. *Quality Manager.* The manager, acceptable to the Authority, responsible for the management of the Quality System, monitoring function and requesting corrective actions.

2.2 Quality Policy

2.2.1 An FSTD operator should establish a formal written Quality Policy Statement that is a commitment by the Accountable Manager as to what the Quality System is intended to achieve. The Quality Policy should reflect the achievement and continued compliance with JAR– FSTD A together with any additional standards specified by the FSTD operator.

ACJ No. 1 to JAR-FSTD A.025 (continued)

2.2.2 The Accountable Manager is an essential part of the FSTD qualification holder's organisation. With regard to the above terminology, the term 'Accountable Manager' is intended to mean the Chief Executive/President/Managing Director/General Manager etc. of the FSTD operator's organisation, who by virtue of his position has overall responsibility (including financial) for managing the organisation.

2.2.3 The Accountable Manager will have overall responsibility for the FSTD qualification holder's Quality System including the frequency, format and structure of the internal management evaluation activities as prescribed in paragraph 4.9 below.

2.3 Purpose of the Quality System

2.3.1 The Quality System should enable the FSTD operator to monitor compliance with JAR– FSTD A, and any other standards specified by that FSTD operator, or the Authority, to ensure correct maintenance and performance of the device.

2.4 Quality Manager

2.4.1 The primary role of the Quality Manager is to verify, by monitoring activity in the fields of FSTD qualification, that the standards required by the Authority, and any additional requirements defined by the FSTD operator, are being carried out under the supervision of the relevant Manager.

2.4.2 The Quality Manager should be responsible for ensuring that the Quality Assurance Programme is properly established, implemented and maintained.

2.4.3 The Quality Manager should:

a. Have direct access to the Accountable Manager;

b. Have access to all parts of the FSTD operator's and, as necessary, any sub-contractor's organisation.

2.4.4 The posts of the Accountable Manager and the Quality Manager may be combined by FSTD operators whose structure and size may not justify the separation of those two posts. However, in this event, Quality Audits should be conducted by independent personnel.

3 Quality System

3.1 Introduction

3.1.1 The FSTD operator's Quality System should ensure compliance with FSTD qualification requirements, standards and procedures.

3.1.2 The FSTD operator should specify the structure of the Quality System.
3.1.3 The Quality System should be structured according to the size and complexity of the organisation to be monitored.

3.2 Scope

3.2.1 As a minimum, the Quality System should address the following:

a. The provision of JAR–FSTD A.

b. The FSTD operator's additional standards and procedures.

c. The FSTD operator's Quality Policy.

d. The FSTD operator's organisational structure.

e. Responsibility for the development, establishment and management of the Quality System.

f. Documentation, including manuals, reports and records.

g. Quality Procedures.

h. Quality Assurance Programme.

i. The provision of adequate financial, material and human resources.

j. Training requirements for the various functions in the organisation.

3.2.2 The Quality System should include a feedback system to the Accountable Manager to ensure that corrective actions are both identified and promptly addressed. The feedback system should also specify who is required to rectify discrepancies and non-compliance in each particular case, and the procedure to be followed if corrective action is not completed within an appropriate timescale.

3.3 Relevant Documentation

Relevant documentation should include the following:

a. Quality Policy.

b. Terminology.

c. Reference to specified STD technical standards.

d. A description of the organisation.

e. The allocation of duties and responsibilities.

f. Qualification procedures to ensure regulatory compliance.

g. The Quality Assurance Programme, reflecting:

- i. Schedule of the monitoring process.
- ii. Audit procedure
- iii. Reporting procedures.
- iv. Follow-up and corrective action procedures.
- v. Recording system.

h. Document control.

4. Quality Assurance Programme

4.1 Introduction

4.1.1 The Quality Assurance Programme should include all planned and systematic actions necessary to provide confidence that all maintenance is conducted and all performance maintained in accordance with all applicable requirements, standards and procedures.

4.1.2 When establishing a Quality Assurance Programme, consideration should, at least, be given to the paragraphs 4.2 to 4.9 below.

4.2 Quality Inspection

4.2.1 The primary purpose of a quality inspection is to observe a particular event/action/document etc., in order to verify whether established procedures and requirements are followed during the accomplishment of that event and whether the required standard is achieved.

4.2.2 Typical subject areas for quality inspections are:

Actual STD operation.

Maintenance.

Technical standards.

Flight simulator safety features.

4.3 Audit

4.3.1 An audit is a systematic and independent comparison of the way in which an activity is being conducted against the way in which the published procedures say it should be conducted.

4.3.2 Audits should include at least the following quality procedures and processes:

a. A statement explaining the scope of the audit.

b. Planning and preparation.

ACJ No. 1 to JAR-FSTD A.025 (continued)

c. Gathering and recording evidence

d. Analysis of the evidence.

4.3.3 Techniques which contribute to an effective audit are:

a. Interviews or discussions with personnel.

b. A review of published documents.

c. The examination of an adequate sample of records.

d. The witnessing of the activities which make up the operation

e. The preservation of documents and the recording of observations.

4.4 Auditors

4.4.1 An FSTD operator should decide, depending on the complexity and size of the organisation, whether to make use of a dedicated audit team or a single auditor. In any event, the auditor or audit team should have relevant FSTD experience.

4.4.2 The responsibilities of the auditors should be clearly defined in the relevant documentation.

4.5 Auditor's Independence

4.5.1 Auditors should not have any day to day involvement in the area of activity which is to be audited. An FSTD operator may, in addition to using the services of full-time dedicated personnel belonging to a separate quality department, undertake the monitoring of specific areas or activities by the use of part-time auditors. Due to the technological complexity of FSTDs, which requires auditors with very specialised knowledge and experience, an FSTD operator may undertake the audit function by the use of part-time personnel from within his own organisation or from an external source under the terms of an agreement acceptable to the Authority. In all cases the FSTD operator should develop suitable procedures to ensure that persons directly responsible for the activities to be audited are not selected as part of the auditing team. Where external auditors are used, it is essential that any external specialist is familiar with the type of device conducted by the FSTD operator.

4.5.2 The FSTD operator's Quality Assurance Programme should identify the persons within the company who have the experience, responsibility and authority to:

a. Perform quality inspections and audits as part of ongoing Quality Assurance.

b. Identify and record any concerns or findings, and the evidence necessary to substantiate such concerns or findings.

c. Initiate or recommend solutions to concerns or findings through designated reporting channels.

d. Verify the implementation of solutions within specific time scales.

e. Report directly to the Quality Manager.

4.6 Audit Scope

4.6.1 FSTD operators are required to monitor compliance with the procedures they have designed to ensure specified performance and functions. In doing so they should as a minimum, and where appropriate, monitor:

a. Organisation.

b. Plans and objectives.

c. Maintenance procedures.

d. FSTD Qualification Level.

e. Supervision.

f. FSTD technical status.

g. Manuals, logs, and records.

h. Defect deferral.

i. Personnel training.

j. Aeroplane modifications management.

4.7 Auditing scheduling

4.7.1 A Quality Assurance Programme should include a defined audit schedule and a periodic review. The schedule should be flexible, and allow unscheduled audits when trends are identified. Follow-up audits should be scheduled when necessary to verify that corrective action was carried out and that it was effective.

4.7.2 An FSTD operator should establish a schedule of audits to be completed during a specified calendar period. All aspects of the operation should be reviewed within every period of 12 months in accordance with the programme unless an extension to the audit period is accepted as explained below. An FSTD operator may increase the frequency of audits at his discretion but should not decrease the frequency without the agreement of the Authority.

4.7.3 When an FSTD operator defines the audit schedule, significant changes to the management, organisation, or technologies should be considered as well as changes to the regulatory requirements.

4.7.4 For FSTD operators whose structure and size may not justify the completion of a complex system of audits, it may be appropriate to develop a Quality Assurance Programme that employs a checklist. The checklist should have a supporting schedule that requires completion of all checklist items within a specified time scale, together with a statement acknowledging completion of a periodic review by top management.

4.7.5 Whatever arrangements are made, the FSTD operator retains the ultimate responsibility for the Quality System and especially the completion and follow up of corrective actions.

4.8 Monitoring and Corrective Action

4.8.1 The aim of monitoring within the Quality System is primarily to investigate and judge its effectiveness and thereby to ensure that defined policy, performance and function standards are continuously complied with. Monitoring activity is based upon quality inspections, audits, corrective action and follow-up. The FSTD operator should establish and publish a quality procedure to monitor regulatory compliance on a continuing basis. This monitoring activity should be aimed at eliminating the causes of unsatisfactory performance.

4.8.2 Any non-compliance identified as a result of monitoring should be communicated to the manager responsible for taking corrective action or, if appropriate, the Accountable Manager. Such non-compliance should be recorded, for the purpose of further investigation, in order to determine the cause and to enable the recommendation of appropriate corrective action.

4.8.3 The Quality Assurance Programme should include procedures to ensure that corrective actions are taken in response to findings. These quality procedures should monitor such actions to verify their effectiveness and that they have been completed. Organisational responsibility and accountability for the implementation of corrective actions resides with the department cited in the report identifying the finding. The Accountable Manager will have the ultimate responsibility for resourcing the corrective action and ensuring, through the Quality Manager, that the corrective action has re-established compliance with the standard required by the Authority, and any additional requirements defined by the FSTD operator.

4.8.4 Corrective action

a. Subsequent to the quality inspection/audit, the FSTD operator should establish:

i. The seriousness of any findings and any need for immediate corrective action.

ii. Cause of the finding.

iii. Corrective actions required to ensure that the non-compliance does not recur.

iv. A schedule for corrective action.

v. The identification of individuals or departments responsible for implementing corrective action.

vi. Allocation of resources by the Accountable Manager, where appropriate.

ACJ No. 1 to JAR-FSTD A.025 (continued)

4.8.5 The Quality Manager should:

a. Verify that corrective action is taken by the manager responsible in response to any finding of non-compliance.

b. Verify that corrective action includes the elements outlined in paragraph 4.8.4 above.

c. Monitor the implementation and completion of corrective action.

d. Provide management with an independent assessment of corrective action, implementation and completion.

e. Evaluate the effectiveness of corrective action through the follow-up process.

4.9 Management Evaluation

4.9.1 A management evaluation is a comprehensive, systematic, documented review of the Quality System and procedures by the management, and it should consider:

a. The results of quality inspections, audits and any other indicators.

b. The overall effectiveness of the management organisation in achieving stated objectives.

4.9.2 A management evaluation should identify and correct trends, and prevent, where possible, future non-conformities. Conclusions and recommendations made as a result of an evaluation should be submitted in writing to the responsible manager for action. The responsible manager should be an individual who has the authority to resolve issues and take action.

4.9.3 The Accountable Manager should decide upon the frequency, format, and structure of internal management evaluation activities.

4.10 Recording

4.10.1 Accurate, complete, and readily accessible records documenting the results of the Quality Assurance Programme should be maintained by the FSTD operator. Records are essential data to enable an FSTD operator to analyse and determine the root causes of non-conformity, so that areas of non-compliance can be identified and addressed.

4.10.2 The following records should be retained for a period of 5 years:

a. Audit schedules.

b. Quality inspection and audit reports.

c. Response to findings.

d. Corrective action reports.

e. Follow-up and closure reports; and

f. Management evaluation reports.

5 Quality Assurance responsibility for sub-contractors

5.1 Sub-contractors

5.1.1 FSTD operators may decide to sub-contract out certain activities to external agencies for the provision of services related to areas such as:

a. Maintenance.

b. Manual preparation.

5.1.2 The ultimate responsibility for the product or service provided by the sub-contractor always remains with the FSTD operator. A written agreement should exist between the FSTD operator and the sub-contractor clearly defining the services and quality to be provided. The sub-contractor's activities relevant to the agreement should be included in the FSTD operator's Quality Assurance Programme.

ACJ No. 1 to JAR-FSTD A.025 (continued)

5.1.3 The FSTD operator should ensure that the sub-contractor has the necessary authorisation/approval when required, and commands the resources and competence to undertake the task. If the FSTD operator requires the sub-contractor to conduct activity which exceeds the sub-contractor's authorisation/approval, the FSTD operator is responsible for ensuring that the sub-contractor's Quality Assurance takes account of such additional requirements.

6 Quality System Training

6.1 General

6.1.1 An FSTD operator should establish effective, well planned and resourced quality related briefing for all personnel.

6.1.2 Those responsible for managing the Quality System should receive training covering:

a. An introduction to the concept of the Quality System.

b. Quality management.

c. Concept of Quality Assurance.

d. Quality manuals.

e. Audit techniques.

f. Reporting and recording

g. The way in which the Quality System will function in the organisation.

6.1.3 Time should be provided to train every individual involved in quality management and for briefing the remainder of the employees. The allocation of time and resources should be sufficient for the scope of the training.

6.2 Sources of Training

6.2.1 Quality management courses are available from the various national or international Standards Institutions, and an FSTD operator should consider whether to offer such courses to those likely to be involved in the management of Quality Systems. FSTD operators with sufficient appropriately qualified staff should consider whether to carry out in-house training.

7. Standard Measurements for Flight Simulator Quality

7.1 General

7.1.1 It is recognised that a Quality System tied to measurement of FSTD performance will probably lead to improving and maintaining training quality. One acceptable means of measuring FSTD performance is as defined and agreed by industry in ARINC report 433 (May 15th, 2001 or as amended) entitled "Standard Measurements for Flight Simulator Quality".

ACJ No. 2 to JAR-FSTD A.025
BITD Operator's Quality System
See JAR-FSTD A.025

1 Introduction

1.1 In order to show compliance with JAR-FSTD A.025, a BITD operator should establish his Quality System in accordance with the instructions and information contained in the following paragraphs.

2 Quality Policy

2.1 A BITD operator should establish a formal written Quality Policy Statement that is a commitment by the Accountable Manager as to what the Quality System is intended to achieve.

2.2 The Accountable Manager is someone who by virtue of his position has overall authority and responsibility (including financial) for managing the organization.

2.3 The Quality Manager is responsible for the function of the Quality System and requesting corrective actions.

3 Quality System

3.1 The Quality System should enable the BITD operator to monitor compliance with JAR-FSTD A, and any other standards specified by that BITD operator to ensure correct maintenance and performance of the device.

3.2 A Quality Manager oversees the day-to-day control of quality.

3.3 For a small FSTD operator the position of the Accountable Manager and the Quality Manager may be combined. However, in this event, independent personnel should conduct Quality Audits.

4 Quality Assurance Programme

4.1 A Quality Assurance Programme together with a statement acknowledging completion of a periodic review by the Accountable Manager should include the following:

4.1.1 A maintenance facility which provides suitable BITD hardware and software test and maintenance capability.

4.1.2 A recording system in the form of a technical log in which defects, deferred defects and development work are listed, interpreted, actioned and reviewed within a specified time scale.

4.1.3 Planned routine maintenance of the BITD and periodic running of the QTG with adequate manning to cover BITD operating periods and routine maintenance work.

4.1.4 A planned audit schedule and a periodic review should be used to verify that corrective action was carried out and that it was effective. The auditor should have adequate knowledge of BITDs and should be acceptable to the Authority.

5 Quality System Training

5.1 The Quality Manager should receive appropriate Quality System training and brief other personnel on the procedures.

ACJ No. 3 to JAR-FSTD A.025
Installations
See JAR-FSTD A.025(c)

1 Introduction

1.1 This ACJ identifies those elements that are expected to be addressed, as a minimum, to ensure that the FSTD installation provides a safe environment for the users and operators of the FSTD under all circumstances.

2 Expected Elements

2.1 Adequate fire/smoke detection, warning and suppression arrangements should be provided to ensure safe passage of personnel from the FSTD.

2.2 Adequate protection should be provided against electrical, mechanical, hydraulic and pneumatic hazards – including those arising from the control loading and motion systems to ensure maximum safety of all personnel in the vicinity of the FSTD.

2.3 Other areas that should be addressed include:

a. A two way communication system that remains operational in the event of a total power failure.

b. Emergency lighting

c. Escape exits and escape routes

d. Occupant restraints (seats, seat belts etc.).

e. External warning of motion and access ramp or stairs activity.

f. Danger area markings.

g. Guard rails and gates

h. Motion and control loading emergency stop controls accessible from either pilot or instructor seats; and

i. A manual or automatic electrical power isolation switch.

ACJ No. 1 to JAR-FSTD A.030 (acceptable means of compliance)
FSTDs qualified on or after 1 August 2008
See JAR–FSTD A.030

NOTE: The structure and numbering of this ACJ departs from JAA layout due to the complexity of the technical content and the need to retain harmonisation with the ICAO Manual of Criteria for the Qualification of Flight Simulators (1995 or as amended).

1 Introduction

1.1 Purpose. This ACJ establishes the criteria that define the performance and documentation requirements for the evaluation of FSTDs used for training, testing and checking of flight crewmembers. These test criteria and methods of compliance were derived from extensive experience of 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 crewmembers. 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 ACJ are the result of the experience and expertise of Authorities, operators, and aeroplane and FSTD manufacturers. From 1989 to 1992 a specially convened international working group under the sponsorship of the Royal Aeronautical Society (RAeS) held several meetings with the stated purpose of establishing common test criteria that would be recognised internationally. The final RAeS document, entitled International Standards for the Qualification of Airplane Flight Simulators, dated January 1992 (ISBN 0–903409–98–4), was the core document used to establish these JAA criteria and also the ICAO Manual of Criteria for the Qualification of Flight Simulators (1995 or as amended). An international review under the co-chair of FAA and JAA during 2001 was the basis for a major modification of the ICAO Manual of Criteria for the Qualification of Flight Simulators (1995 or as amended) and for the JAR-FSTD A document.

1.2.3 In showing compliance with JAR–FSTD A.030, the Authority expects account to be taken of the IATA document entitled 'Design and Performance Data Requirements for Flight Simulators' – (1996 or as amended), as appropriate to the Qualification Level sought. In any case early contact with the Authority is advised at the initial stage of FSTD build to verify the acceptability of the data.

1.3 Levels of FSTD qualification.

Parts 2, and 3 of this ACJ describe the minimum requirements for qualifying Level A, B, C and D aeroplane FFS, Level 1 and 2 aeroplane FTDs, FNPT types I, II and IIMCC and BITDs.

See also Appendix 1 to JAR-FSTD A.030

1.4 Terminology.

Terminology and abbreviations of terms used in this ACJ are contained in ACJ to JAR-FSTD A.005.

1.5 Testing for FSTD qualification

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

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

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

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

1.5.4 For FNPTs and BITDs generic data packages can be used. In this case, for an initial evaluation only Correct Trend and Magnitude (CT&M) can be used. The tolerances listed in this ACJ are applicable for recurrent evaluations and should be applied to ensure the device remains at the standard initially qualified.

For initial qualification testing of FNPTs and BITDs, Validation Data will be used. They may be derived from a specific aeroplane within the class of aeroplane the FNPT or BITD is representing or they may be based on information from several aeroplanes within the class. With the concurrence of the Authority, it may be in the form of a manufacturer's previously approved set of Validation Data for the applicable FNPT or BITD. Once the set of data for a specific FNPT or BITD has been accepted and approved by the Authority, it will become the Validation Data that will 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 shall show that the proposed Validation Data are representative of the aeroplane or the class of aeroplane modelled. This report may include flight test data, manufacturer's design data, information from the Aeroplane Flight Manual (AFM) and Maintenance Manuals, results of approved or commonly accepted simulations or predictive models, recognized theoretical results, information from the public domain, or other sources as deemed necessary by the FSTD manufacturer to substantiate the proposed model.

1.5.5 In the case of new aircraft programmes, the aircraft manufacturer's data partially validated by flight test data, may be used in the interim qualification of the FSTD. However, the FSTD should be re-evaluated following the release of the manufacturer's approved data. The schedule should be as agreed by the Authority, FSTD operator, FSTD manufacturer, and aircraft manufacturer.

1.5.6 FSTD operators seeking initial or upgrade evaluation of a 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 ACJ. In this instance it may be necessary for an operator to acquire additional flight test data.

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

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

1.6 Qualification Test Guide (QTG)

1.6.1 The QTG is the primary reference document used for evaluating a 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 ACJ.

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

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

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

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

ii. Aeroplane model and series being simulated. For FNPTs and BITDs aeroplane model or class being simulated.

iii. References to aerodynamic data or sources for aerodynamic model.

ACJ No. 1 to JAR-FSTD A.030 (continued)

iv. References to engine data or sources for engine model.

v. References to flight control data or sources for flight controls model.

vi. Avionic equipment system identification where the revision level affects the training and checking capability of the FSTD.

vii. FSTD model and manufacturer.

viii. Date of FSTD manufacture.

ix. FSTD computer identification.

x. Visual system type and manufacturer (if fitted).

xi. Motion 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 Compliance (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. This should be short and definitive, based on the test title referred to in paragraph 2.3 of this ACJ;

ii. Test objective. This should be a brief summary of what the test is intended to demonstrate;

iii. Demonstration procedure. This is a brief description of how the objective is to be met;

iv. References. These are the aeroplane data source documents including both the document number and the page or condition number;

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

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

vii. Automatic test procedures (if applicable).

viii. Evaluation criteria. Specify the main parameter(s) under scrutiny during the test;

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

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

xi. Source data. Copy of the aeroplane source data, clearly marked with the document, page number, issuing authority, and the test number and title as specified in 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. An acceptable means of easily comparing FSTD test results with the validation data.

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

j. A copy of the version of the primary reference document as agreed with the Authority and used in the initial evaluation should be included.

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 – for a BITD the manufacturer - should further certify that all the QTG checks, for the requested Qualification Level, have been achieved and that the FSTD is representative of the respective aeroplane or, for FNPTs and BITDs representative of the respective class of aeroplane.

1.8.2 A copy of the FSTD operator's or BITD manufacturer's QTG, marked with test results, should accompany the request. Any QTG deficiencies raised by the 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. After review of these tests, the Authority will schedule an initial evaluation. The QTG should be clearly annotated to indicate when and where each test was accomplished. This may not be applicable for BITDs that would normally undergo initial qualification at the manufacturer's facility.

1.9 FSTD recurrent qualification basis

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

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

2 FSTD Validation Tests

2.1 General

2.1.1 FSTD performance and system operation should be objectively evaluated by comparing the results of tests conducted in the FSTD with aeroplane data unless specifically noted otherwise. To facilitate the

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validation of the FSTD, an appropriate recording device acceptable to the 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 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 ho90

w 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 an RAeS Working Group, the following text was inserted:

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

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

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

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

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

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

For FFS devices representing aeroplanes certificated after January 2002 the MQTG should be supported by a Validation Data Roadmap (VDR) as described in Appendix 2 to ACJ No. 1 to JAR-FSTD A.030. Data providers are encouraged to supply a VDR for older aeroplanes.
For FFS devices representing aeroplanes certificated prior to January 1992, an operator may, after reasonable attempts have failed to obtain suitable flight test data, indicate in the MQTG where flight test data are unavailable or unsuitable for a specific test. For such a test, alternative data should be submitted to the Authority for approval.

2.1.5 The table of FSTD Validation Tests in this ACJ indicates the required tests. Unless noted otherwise, FSTD tests should represent aeroplane performance and handling qualities at operating weights and centres of gravity (cg) positions typical of normal operation.

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

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

2.1.6 For the testing of Computer Controlled Aeroplane (CCA) FSTDs, flight test data are required for both the normal (N) and non-normal (NN) control states, as applicable to the aeroplane simulated and, as indicated in the validation requirements of this paragraph. Tests in the non-normal state should always include the least augmented state. Tests for other levels of control state degradation may be required as detailed by the Authority at the time of definition of a set of specific aeroplane tests for FSTD data. Where applicable, flight test data should record:

ACJ No. 1 to JAR-FSTD A.030 (continued)

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

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

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

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

2.1.9 Where normal, non-normal or other degraded control states are not applicable to the aeroplane being simulated, appropriate rationales should be included in the aeroplane manufacturer's validation data roadmap (VDR), which is described in Appendix 2 to ACJ No. 1 to JAR-FSTD A.030.

2.2 Test requirements

2.2.1 The ground and flight tests required for qualification are listed in the table of FSTD Validation Tests. 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. Time histories are required unless otherwise indicated in the table of validation tests.

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

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

Where tolerances are expressed as a percentage:

- for parameters that have units of percent, or parameters normally displayed in the cockpit in units of percent (e.g. N1, N2, engine torque or power), then a percentage tolerance will 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 labelled using the tolerances and units specified.

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

2.2.2.3 Where the tolerances have been replaced by 'Correct Trend and Magnitude' (CT&M), the FSTD should be tested and assessed as representative of the aeroplane or class of aeroplane to the satisfaction of the Authority. To facilitate future evaluations, sufficient parameters should be recorded to establish a reference. For the initial qualification of FNPTs and BITDs no tolerances are to be applied and the use of CT&M is to be assumed throughout.

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

a. Ground-on ground, independent of aeroplane configuration

b. Take-off - gear down with flaps in any certified takeoff position

c. Second segment climb – gear up with flaps in any certified take off position

d. Clean – flaps and gear up

e. Cruise – clean configuration at cruise altitude and airspeed

f. Approach – gear up or down with flaps at any normal approach positions as recommended by the aeroplane manufacturer

g. Landing – gear down with flaps in any certified landing position.

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2.3 Table of FSTD Validation Tests

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 Flight Test Data. 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.

TESTS	**TOLERANCE**	**FLIGHT CONDITIONS**	**FSTD LEVEL**												**COMMENTS**
			FS				**FTD**		**FNPT**			**BITD**			
			A	**B**	**C**	**D**	**Init.**	**Rec**	**I**	**II**	**MCC**	**Init.**	**Rec**		
															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. TAXY															
(1) Minimum Radius Turn.	± 0·9 m (3 ft) or ± 20% of aeroplane turn radius.	Ground	**CT&M**	✓	✓	✓									Plot both main and nose gear-turning loci. Data for no brakes and the minimum thrust required to maintain a steady turn except for aeroplanes requiring asymmetric thrust or braking to turn.
(2) Rate of Turn vs. Nosewheel Steering Angle (NWA).	± 10% or ± 2°/s turn rate.	Ground	**CT&M**	✓	✓	✓									Tests for a minimum of two speeds, greater than minimum turning radius speed, with a spread of at least 5 kts groundspeed.
b. TAKE-OFF															Note-All commonly used take-off flap settings should be demonstrated at least once either in minimum unstick speed (1b3), normal take-off (1b4), critical engine failure on take-off (1b5) or cross wind take-off (1b6).

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec	I	II	MCC	Init.	Rec	
(1) Ground Acceleration Time and Distance.	± 5% or ±1.5 s time and ± 5% or ± 61 m (200 ft) distance	Take-off	C T & M	✓	✓	✓	C T & M	✓						Acceleration time and distance should be recorded for a minimum of 80% of the total time from brake release to V_R. May be combined with normal takeoff (1b4) or rejected takeoff (1b7). Plotted data should be shown using appropriate scales for each portion of the manoeuvre. For FTD's test limited to time only
(2) Minimum Control Speed, ground (V_{MCG}) aerodynamic controls only per applicable airworthiness requirement or alternative engine inoperative test to demonstrate ground control characteristics.	± 25% of maximum aeroplane lateral deviation or ± 1·5 m (5 ft) For aeroplanes with reversible flight control systems: ± 10% or ± 2·2 daN (5 lb) rudder pedal force	Take-off	C T & M	✓	✓	✓								Engine failure speed should be within ± 1 kt of aeroplane engine failure speed. Engine thrust decay should be that resulting from the mathematical model for the engine variant applicable to the flight simulator under test. If the modelled engine variant is not the same as the aeroplane manufacturers' flight test engine, then a further test may be run with the same initial conditions using the thrust from the flight test data as the driving parameter. If a V_{MCG} test is not available an acceptable alternative is a flight test snap engine deceleration to idle at a speed between V1 and V1-10 kts, followed by control of heading using aerodynamic control only and recovery should be achieved with the main gear on the ground. To ensure only aerodynamic control, nosewheel steering should be disabled (i.e., castored) or the nosewheel held slightly off the ground.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec	I	II	MCC	Init.	Rec	
(3) Minimum Unstick Speed (V_{MU}) or equivalent test to demonstrate early rotation take off characteristics.	± 3 kts airspeed ± 1·5° pitch angle	Take-off	C T & M	✓	✓	✓								V_{MU} is defined as the minimum speed at which the last main landing gear leaves the ground. Main landing gear strut compression or equivalent air/ground signal should be recorded. If a V_{MU} test is not available, alternative acceptable flight tests are a constant high-attitude take-off run through main gear lift-off, or an early rotation take-off. Record time history data from 10 kts before start of rotation until at least 5 seconds after the occurrence of main gear lift-off.
(4) Normal Take-off.	± 3 kts airspeed ± 1·5° pitch angle ± 1·5° AOA ± 6 m (20 ft) height For aeroplanes with reversible flight control systems: ± 10% or ± 2·2 daN (5 lb) column force	Take-off	C T & M	✓	✓	✓								Data required for near maximum certificated take-off weight at mid centre of gravity and light take-off weight at an aft centre of gravity. If the aeroplane has more than one certificated take-off configuration, a different configuration should be used for each weight. Record take-off profile from brake release to at least 61 m (200 ft) AGL. May be used for ground acceleration time and distance (1b1). Plotted data should be shown using appropriate scales for each portion of the manoeuvre.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec	I	II	MCC	Init.	Rec	
(5) Critical Engine Failure on Take-off.	± 3 kts airspeed ± 1·5° pitch angle ± 1·5° AOA ± 6 m (20 ft) height ± 2° bank and sideslip angle ± 3° heading angle For aeroplanes with reversible flight control systems: ± 10% or ± 2·2 daN (5 lb) column force ± 10% or ± 1·3 daN (3 lb) wheel force ± 10% or ± 2·2 daN (5 lb) rudder pedal force.	Take-off	C T & M	✓	✓	✓								Record take-off profile to at least 61 m (200 ft) AGL. Engine failure speed should be within ± 3 kts of aeroplane data. Test at near maximum take-off weight.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL												COMMENTS
			FS				FTD		FNPT			BITD			
			A	B	C	D	Init.	Rec	I	II	MCC	Init.	Rec		
(6) Crosswind Take-off.	± 3 kts airspeed ± 1·5º pitch angle ± 1·5º AOA ± 6 m (20 ft) height ± 2º bank and sideslip angle ± 3° heading Correct trends at airspeeds below 40 kts for rudder/pedal and heading. For aeroplanes with reversible flight control systems: ± 10% or ± 2·2 daN (5 lb) column force ± 10% or ± 1·3 daN (3 lb) wheel force ± 10% or ± 2·2 daN (5 lb) rudder pedal force	Take-off	C T & M	✓	✓	✓									Record take-off profile from brake release to at least 61 m (200 ft) AGL. Requires test data, including wind profile, for a crosswind component of at least 60% of the AFM value measured at 10m (33 ft) above the runway.
(7) Rejected Take-off.	± 5% time or ± 1·5 s ± 7·5% distance or ± 76 m (250 ft)	Take-off	C T & M	✓	✓	✓									Record near maximum take-off weight. Speed for reject should be at least 80% of V_1. Autobrakes will be used where applicable. Maximum braking effort, auto or manual. Time and distance should be recorded from brake release to a full stop.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec	I	II	MCC	Init.	Rec	
(8) Dynamic Engine Failure after Take-off.	± 20% or ± 2º/s body angular rates	Take-off	C T & M	✓	✓	✓								Engine failure speed should be within ± 3 kts of aeroplane data. Engine failure may be a snap deceleration to idle. Record hands off from 5 secs before engine failure to + 5 secs or 30 deg bank, whichever occurs first. Note: for safety considerations, aeroplane flight test may be performed out of ground effect at a safe altitude, but with correct aeroplane configuration and airspeed. CCA: Test in normal AND Non-normal Control state.
c. CLIMB														
(1) Normal Climb All Engines Operating	± 3 kts airspeed ± 5% or ± 0·5 m/s (100 ft/min) R/C	Clean or specified climb configuration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Flight test data or aeroplane performance manual data may be used. Record at nominal climb speed and mid initial climb altitude. FSTD performance to be recorded over an interval of at least 300 m (1 000 ft). For FTD's may be a Snapshot test

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec	I	II	MCC	Init.	Rec	
(2) One Engine Inoperative Second Segment Climb.	± 3 kts airspeed ± 5% or ± 0·5 m/s (100 ft/min) R/C but not less than AFM values.	2nd Segment Climb for FNPTs and BITDs Gear up and Take-off Flaps		✓	✓	✓	C T & M	✓	✓	✓	✓	C T & M	✓	Flight test data or aeroplane performance manual data may be used. Record at nominal climb speed. Flight simulator performance to be recorded over an interval of at least 300m (1 000 ft). Test at WAT (Weight, Altitude, or Temperature) limiting condition. For FTD's may be a Snapshot test
(3) One Engine Inoperative En route Climb.	± 10% time ± 10% distance ± 10% fuel used	Clean	✓	✓	✓	✓	C T & M	✓						Flight test data or aeroplane performance manual data may be used. Test for at least a 1 550 m (5 000 ft) segment.
(4) One Engine Inoperative Approach Climb for aeroplanes with icing accountability if required by the flight manual for this phase of flight.	± 3 kts airspeed ± 5% or ± 0·5 m/s (100 ft/min) R/C but not less than AFM values	Approach			✓	✓								Flight test data or aeroplane performance manual data may be used. FSTD performance to be recorded over an interval of at least 300 m (1 000 ft). Test near maximum certificated landing weight as may be applicable to an approach in icing conditions. Aeroplane should be configured with all anti-ice and de-ice systems operating normally, gear up and go-around flap. All icing accountability considerations, in accordance with the flight manual for an approach in icing conditions, should be applied.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec	I	II	MCC	Init.	Rec	
d. CRUISE / DESCENT														
(1) Level Flight Acceleration	± 5% time	Cruise	C T & M	✓	✓	✓	✓	✓						Minimum of 50 kts increase using maximum continuous thrust rating or equivalent. For very small aeroplanes, speed change may be reduced to 80% of operational speed range.
(2) Level Flight Deceleration	± 5% time	Cruise	C T & M	✓	✓	✓	✓	✓						Minimum of 50 kts decrease using idle power. For very small aeroplanes, speed change may be reduced to 80% of operational speed range.
(3) Cruise Performance	± 0·05 EPR or ± 5% N1 or ± 5% torque ± 5% fuel flow	Cruise	✓	✓	✓	✓	✓	✓						May be a single snapshot showing instantaneous fuel flow, or a minimum of two consecutive snapshots with a spread of at least 3 minutes in steady flight.
(4) Idle Descent	± 3 kts airspeed ± 5% or ± 1·0 m/s (200 ft/min) R/D	Clean	✓	✓	✓	✓								Idle power stabilised descent at normal descent speed at mid altitude. Flight simulator performance to be recorded over an interval of at least 300 m (1 000 ft).
(5) Emergency Descent	± 5 kts airspeed ± 5% or ± 1·5 m/s (300 ft/min) R/D	As per AFM	✓	✓	✓	✓								Stabilised descent to be conducted with speedbrakes extended if applicable, at mid altitude and near VMO or according to emergency descent procedure. Flight simulator performance to be recorded over an interval of at least 900 m (3 000 ft).
e. STOPPING														

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec	I	II	MCC	Init.	Rec	
(1) Deceleration Time and Distance, Manual Wheel Brakes, Dry Runway, No Reverse Thrust.	± 5% or ±1.5 s time. For distances up to 1 220 m (4 000 ft) ± 61 m (200 ft) or ± 10%, whichever is the smaller. For distances greater than 1 220 m (4 000 ft) ± 5% distance.	Landing	C T & M	✓	✓	✓								Time and Distance should be recorded for at least 80% of the total time from touchdown to a full stop. Data required for medium and near maximum certificated landing weight. Engineering data may be used for the medium weight condition. Brake system pressure should be recorded.
(2) Deceleration Time and Distance, Reverse Thrust, No Wheel Brakes, Dry Runway.	± 5% or ±1.5 s time and the smaller of ± 10% or ± 61 m (200 ft) of distance.	Landing	C T & M	✓	✓	✓								Time and distance should be recorded for at least 80% of the total time from initiation of reverse thrust to full thrust reverser minimum operating speed. Data required for medium and near maximum certificated landing weights. Engineering data may be used for the medium weight condition.
(3) Stopping Distance, Wheel Brakes, Wet Runway.	± 10% or ± 61 m (200 ft) distance	Landing			✓	✓								Either flight test or manufacturers performance manual data should be used where available. Engineering data, based on dry runway flight test stopping distance and the effects of contaminated runway braking coefficients, are an acceptable alternative.
(4) Stopping Distance, Wheel Brakes, Icy Runway.	± 10% or ± 61 m (200 ft) distance	Landing			✓	✓								Either flight test or manufacturer's performance manual data should be used where available. Engineering data, based on dry runway flight test stopping distance and the effects of contaminated runway braking coefficients, are an acceptable alternative.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec	I	II	MCC	Init.	Rec	
f. ENGINES														
(1) Acceleration	± 10% T_i or ± 0·25s ± 10% T_t	Approach or Landing	CT&M	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	T_i = Total time from initial throttle movement until a 10% response of a critical engine parameter. T_t = Total time from initial throttle movement to 90% of go around power. Critical engine parameter should be a measure of power (N1, N2, EPR, etc). Plot from flight idle to go around power for a rapid throttle movement. FTD, FNPT and BITD only: CT&M acceptable.
(2) Deceleration	± 10% T_i or ± 0·25s ± 10% T_t	Ground	CT&M	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	T_i = Total time from initial throttle movement until a 10% response of a critical engine parameter. T_t = Total time from initial throttle movement to 90% decay of maximum take-off power. Plot from maximum take-off power to idle for a rapid throttle movement. FTD, FNPT and BITD only: CT&M acceptable.
2. HANDLING QUALITIES														

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec	I	II	MCC	Init.	Rec	
a. STATIC CONTROL CHECKS														NOTE: Pitch, roll and yaw controller position vs. force or time shall be measured at the control. An alternative method would be to instrument the FSTD in an equivalent manner to the flight test aeroplane. The force and position data from this instrumentation can be directly recorded and matched to the aeroplane data. Such a permanent installation could be used without any time for installation of external devices. CCA: Testing of position versus force is not applicable if forces are generated solely by use of aeroplane hardware in the FSTD.
(1) Pitch Controller Position vs. Force and Surface Position Calibration.	± 0·9 daN (2 lbs) breakout. ± 2·2 daN (5 lbs) or ± 10% force. ± 2° elevator angle	Ground	✓	✓	✓	✓	CT&M	✓						Uninterrupted control sweep to stops. Should be validated (where possible) with inflight data from tests such as longitudinal static stability, stalls, etc. Static and dynamic flight control tests should be accomplished at the same feel or impact pressures.
Column Position vs. Force only.	± 2.2 daN (5 lbs) or ± 10% Force.	Cruise or Approach							✓	✓	✓	CT&M	✓	FNPT 1 and BITD: Control forces and travel shall broadly correspond to that of the replicated class of aeroplane.
(2) Roll Controller Position vs. Force and Surface Position Calibration.	± 0·9 daN (2 lbs) breakout ± 1·3 daN (3 lbs) or ± 10% force ± 2° aileron angle ± 3° spoiler angle	Ground	✓	✓	✓	✓	CT&M	✓						Uninterrupted control sweep to stops. Should be validated with in-flight data from tests such as engine out trims, steady state sideslips, etc. Static and dynamic flight control tests should be accomplished at the same feel or impact pressures.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec	I	II	MCC	Init.	Rec	
Wheel Position vs. Force only.	± 1.3 daN (3 lbs) or ± 10% Force	Cruise or Approach							✓	✓	✓	C T & M	✓	FNPT 1 and BITD: Control forces and travel shall broadly correspond to that of the replicated class of aeroplane
(3) Rudder Pedal Position vs. Force and Surface Position Calibration.	± 2·2 daN (5 lbs) breakout ± 2·2 daN (5 lbs) or ± 10% force ± 2º rudder angle	Ground	✓	✓	✓	✓	C T & M	✓						Uninterrupted control sweep to stops. Should be validated with in flight data from tests such as engine out trims, steady state sideslips, etc. Static and dynamic flight control tests should be accomplished at the same feel or impact pressures.
Pedal Position vs. Force only.	± 2.2 daN (5 lbs) or ± 10% Force.	Cruise or Approach							✓	✓	✓	C T & M	✓	FNPT 1 and BITD: Control forces and travel shall broadly correspond to that of the replicated class of aeroplane
(4) Nosewheel Steering Controller Force and Position Calibration.	± 0·9 daN (2 lbs) breakout ± 1·3 daN (3 lbs) or ± 10% force ± 2º NWA	Ground	C T & M	✓	✓	✓								Uninterrupted control sweep to stops.
(5) Rudder Pedal Steering Calibration.	± 2º NWA	Ground	C T & M	✓	✓	✓								Uninterrupted control sweep to stops.
(6) Pitch Trim Indicator vs. Surface Position Calibration	± 0·5º trim angle.	Ground	✓	✓	✓	✓								Purpose of test is to compare flight simulator against design data or equivalent.
	±1° of trim angle	Ground					✓	✓	✓	✓	✓	C T & M	✓	BITD: Only applicable if appropriate trim settings are available, e.g. data from the AFM.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec	I	II	MCC	Init.	Rec	
(7) Pitch Trim Rate	± 10% or ± 0.5 deg/s trim rate (°/s)	Ground and approach	✓	✓	✓	✓	✓	✓						Trim rate to be checked at pilot primary induced trim rate (ground) and autopilot or pilot primary trim rate in flight at go-around flight conditions.
(8) Alignment of Cockpit Throttle Lever vs. Selected Engine Parameter.	± 5° of TLA or ± 3% N1 or ± 0·03 EPR or ± 3% torque For propeller-driven aeroplanes, where the propeller levers do not have angular travel, a tolerance of ± 2 cm (± 0.8 in) applies.	Ground	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Simultaneous recording for all engines. The tolerances apply against aeroplane data and between engines. For aeroplanes with throttle detents, all detents to be presented. In the case of propeller-driven aeroplanes, if an additional lever, usually referred to as the propeller lever, is present, it should also be checked. Where these levers do not have angular travel a tolerance of ± 2 cm (± 0·8 inches) applies. May be a series of Snapshot tests.
(9) Brake Pedal Position vs. Force and Brake System Pressure Calibration.	± 2·2 daN (5 lbs) or ± 10% force. ± 1·0 MPa (150 psi) or ± 10% brake system pressure.	Ground	**CT&M**	✓	✓	✓								Flight simulator computer output results may be used to show compliance. Relate the hydraulic system pressure to pedal position in a ground static test.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL												COMMENTS
			FS				FTD		FNPT			BITD			
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.		
b. DYNAMIC CONTROL CHECKS															Tests 2b1, 2b2, and 2b3 are not applicable if dynamic response is generated solely by use of aeroplane hardware in the flight simulator. Power setting may be that required for level flight unless otherwise specified.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL												COMMENTS
			FS				FTD		FNPT			BITD			
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.		
(1) Pitch Control.	For underdamped systems: ± 10% of time from 90% of initial displacement (A_d) to first zero crossing and ± 10(n+1)% of period thereafter ± 10% amplitude of first overshoot applied to all overshoots greater than 5% of initial displacement (A_d). ± 1 overshoot (first significant overshoot should be matched) For overdamped systems: ± 10% of time from 90% of initial displacement (Ad) to 10 % of initial displacement (0·1 Ad).	Take-off, Cruise, and Landing			✓	✓									Data should be for normal control displacements in both directions (approximately 25% to 50% full throw or approximately 25% to 50% of maximum allowable pitch controller deflection for flight conditions limited by the manoeuvring load envelope). Tolerances apply against the absolute values of each period (considered independently). n = The sequential period of a full oscillation. Refer to paragraph 2.4.1

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
(2) Roll Control.	<u>For underdamped systems:</u> ± 10% of time from 90% of initial displacement (A_d) to first zero crossing and ± 10(n+1)% of period thereafter. ± 10% amplitude of first overshoot applied to all overshoots greater than 5% of initial displacement (A_d). ± 1 overshoot (first significant overshoot should be matched) <u>For overdamped systems:</u> ± 10% of time from 90% of initial displacement (Ad) to 10 % of initial displacement (0·1 Ad).	Take-off, Cruise, and Landing			✓	✓								Data should be for normal control displacement (approximately 25% to 50% of full throw or approximately 25% to 50% of maximum allowable roll controller deflection for flight conditions limited by the manoeuvring load envelope). Refer to paragraph 2.4.1

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
(3) Yaw Control.	<u>For underdamped systems:</u> ± 10% of time from 90% of initial displacement (A_d) to first zero crossing and ± 10(n+1)% of period thereafter. ± 10% amplitude of first overshoot applied to all overshoots greater than 5% of initial displacement (A_d). ± 1 overshoot (first significant overshoot should be matched) <u>For overdamped systems:</u> ± 10% of time from 90% of initial displacement (Ad) to 10 % of initial displacement (0·1 Ad).	Take-off, Cruise, and Landing			✓	✓								Data should be for normal displacement (Approximately 25% to 50% of full throw). Refer to paragraph 2.4.1

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL												COMMENTS
			FS				FTD		FNPT			BITD			
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.		
(4) Small Control Inputs - pitch.	± 0·15 °/s body pitch rate or ± 20% of peak body pitch rate applied throughout the time history.	Approach or Landing			✓	✓									Control inputs should be typical of minor corrections made while established on an ILS approach (approximately 0·5 to 2 °/s pitch rate). Test in both directions. Show time history data from 5 seconds before until at least 5 seconds after initiation of control input. CCA: Test in normal AND non-normal control state.
(5) Small Control Inputs - roll	± 0·15 °/s body roll rate or ± 20% of peak body roll rate applied throughout the time history	Approach or Landing			✓	✓									Control inputs should be typical of minor corrections made while established on an ILS approach (approximately 0·5 to 2 °/s roll rate). Test in one direction. For aeroplanes that exhibit non-symmetrical behaviour, test in both directions. Show time history data from 5 seconds before until at least 5 seconds after initiation of control input. CCA: Test in normal AND non-normal control state.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
(6) Small Control Inputs – yaw	± 0·15 °/s body yaw rate or ± 20% of peak body yaw rate applied throughout the time history	Approach or Landing			✓	✓								Control inputs should be typical of minor corrections made while established on an ILS approach (approximately 0·5 to 2 °/s yaw rate). Test in one direction. For aeroplanes that exhibit non-symmetrical behaviour, test in both directions. Show time history data from 5 seconds before until at least 5 seconds after initiation of control input. CCA: Test in normal AND non-normal control state.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
c. LONGITUDINAL														Power setting may be that required for level flight unless otherwise specified.
(1) Power Change Dynamics.	± 3 kts airspeed ± 30 m (100 ft) altitude. ± 1.5º or ± 20% pitch angle	Approach	✓	✓	✓	✓	**CT&M**	✓		✓	✓			Power change from thrust for approach or level flight to maximum continuous or go-around power. Time history of uncontrolled free response for a time increment equal to at least 5 secs before initiation of the power change to completion of the power change + 15 secs. CCA: Test in Normal AND Non-normal Control state.
Power Change Force	± 2.2 daN (5 lbs) or ± 10% Force	Approach							✓	✓	✓	**CT&M**	✓	For an FNPT I and a BITD the power change force test only is acceptable.
(2) Flap Change Dynamics.	± 3 kts airspeed ± 30 m (100 ft) altitude. ± 1.5º or ± 20% pitch angle	Take-off through initial flap retraction and approach to landing	✓	✓	✓	✓	**CT&M**	✓		✓	✓			Time history of uncontrolled free response for a time increment equal to at least 5 secs before initiation of the reconfiguration change to completion of the reconfiguration change + 15 secs. CCA: Test in Normal AND Non-normal Control state.
Flap Change Force	± 2.2 daN (5 lbs) or ± 10% Force								✓	✓	✓	**CT&M**	✓	For an FNPT I and a BITD the flap change force test only is acceptable.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
(3) Spoiler / Speedbrake Change Dynamics.	± 3 kts airspeed ± 30 m (100 ft) altitude. ± 1.5 ° or ± 20% pitch angle	Cruise	✓	✓	✓	✓	**CT&M**	✓		✓	✓			Time history of uncontrolled free response for a time increment equal to at least 5 secs before initiation of the reconfiguration change to completion of the reconfiguration change + 15 secs. Results required for both extension and retraction. CCA: Test in Normal AND Non-normal Control state.
(4) Gear Change Dynamics.	± 3 kts airspeed ± 30 m (100 ft) altitude. ± 1.5º or ± 20% pitch angle For FNPTs and BITDs, ± 2º or ± 20% pitch angle	Takeoff (retraction) and Approach (extension)	✓	✓	✓	✓	**CT&M**	✓		✓	✓			Time history of uncontrolled free response for a time increment equal to at least 5 secs before initiation of the configuration change to completion of the reconfiguration change + 15 secs. CCA: Test in Normal AND Non-normal Control state.
Gear Change Force	± 2.2 daN (5 lbs) or ± 20% Force.	Take-off and Approach							✓	✓	✓	**CT&M**	✓	For an FNPT I and a BITD the gear change force test only is acceptable.
(5) Longitudinal Trim.	± 1º elevator ± 0·5º stabilizer ± 1º pitch angle ± 5% net thrust or equivalent	Cruise, Approach and Landing	✓	✓	✓	✓	**CT&M**	✓						Steady-state wings level trim with thrust for level flight. May be a series of snapshot tests. CCA: Test in Normal OR Non-normal Control state.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
	± 2 deg Pitch Control (Elevator & Stabilizer) ± 2 deg Pitch ± 5% Power or Equivalent	Cruise, Approach							✓	✓	✓	**C T & M**	✓	May be a series of Snapshot tests. FNPT I and BITD may use equivalent stick and trim controllers.
(6) Longitudinal Manoeuvring Stability (Stick Force/g).	± 2·2 daN (5 lbs) or ± 10% pitch controller force Alternative method: ± 1º or ± 10% change of elevator	Cruise, Approach and Landing	✓	✓	✓	✓				✓	✓	**C T & M**	✓	Continuous time history data or a series of snapshot tests may be used. Test up to approximately 30º of bank for approach and landing configurations. Test up to approximately 45º of bank for the cruise configuration. Force tolerance not applicable if forces are generated solely by the use of aeroplane hardware in the FSTD.. Alternative method applies to aeroplanes which do not exhibit stick-force-per-g characteristics. CCA: Test in Normal AND Non-normal Control state as applicable.
(7) Longitudinal Static Stability.	± 2·2 daN (5 lbs) or ± 10% pitch controller force. Alternative method: ± 1° or ± 10% change of elevator	Approach	✓	✓	✓	✓			**C T & M**	✓	✓	**C T & M**	✓	Data for at least two speeds above and two speeds below trim speed. May be a series of snapshot tests. Force tolerance not applicable if forces are generated solely by the use of aeroplane hardware in the FSTD. Alternative method applies to aeroplanes which do not exhibit speed stability characteristics. CCA: Test in Normal OR Non-normal Control state as applicable.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
(8) Stall Characteristics.	± 3 kts airspeed for initial buffet, stall warning, and stall speeds. For aeroplanes with reversible flight control systems (for FS only): ± 10% or ± 2·2 daN (5 lb) column force (prior to g-break only.)	2nd Segment Climb and Approach or Landing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Wings-level (1 g) stall entry with thrust at or near idle power. Time history data should be shown to include full stall and initiation of recovery. Stall warning signal should be recorded and should occur in the proper relation to stall. FSTDs for aeroplanes exhibiting a sudden pitch attitude change or ‘g break’ should demonstrate this characteristic. CCA: Test in Normal AND Non-normal Control state. FNPT and BITD: Test need only determine the actuation of the stall warning device only.
(9) Phugoid Dynamics.	± 10% period. ± 10% time to ½ or double amplitude or ± 0·02 of damping ratio.	Cruise	✓	✓	✓	✓				✓	✓			Test should include 3 full cycles or that necessary to determine time to ½ or double amplitude, whichever is less. CCA: Test in Non-normal Control state.
	± 10% Period with representative damping	Cruise							✓			**CT&M**	✓	Test should include at least 3 full cycles. Time history recommended.
(10) Short Period Dynamics.	± 1·5° pitch angle or ± 2°/s pitch rate. ± 0·1 g normal acceleration.	Cruise	✓	✓	✓	✓				✓	✓			CCA: Test in Normal AND Non-normal Control state.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
d. LATERAL DIRECTIONAL														Power setting may be that required for level flight unless otherwise specified.
(1) Minimum Control Speed, Air (V_{MCA} or V_{MCL}), per Applicable Airworthiness Standard – or – Low Speed Engine Inoperative Handling Characteristics in the Air.	± 3 kts airspeed	Take-off or Landing (whichever is most critical in the aeroplane)	**CT&M**	✓	✓	✓	**CT&M**	✓	**CT&M**	**CT&M**	**CT&M**	**CT&M**	**CT&M**	Minimum speed may be defined by a performance or control limit which prevents demonstration of V_{MC} or V_{MCL} in the conventional manner. Take-off thrust should be set on the operating engine(s). Time history or snapshot data may be used CCA: Test in Normal OR Non-normal Control state. FNPT and BITD: It is important that there exists a realistic speed relationship between V_{mca} and V_s for all configurations and in particular the most critical full-power engine-out take-off configurations.
(2) Roll Response (Rate).	± 10% or ± 2°/sec roll rate FS only: For aeroplanes with reversible flight control systems: ± 10% or ± 1·3 daN (3 lb) roll controller force.	Cruise and Approach or Landing	✓	✓	✓	✓	**CT&M**	✓	✓	✓	✓	**CT&M**	✓	Test with normal roll control displacement (about 30% of maximum control wheel). May be combined with step input of flight deck roll controller test (2d3).

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
(3) Step Input of Cockpit Roll Controller (or Roll Overshoot).	± 10% or ± 2º bank angle	Approach or Landing	✓	✓	✓	✓				✓	✓			With wings level, apply a step roll control input using approximately one-third of roll controller travel. At approximately 20° to 30° bank, abruptly return the roll controller to neutral and allow at least 10 seconds of aeroplane free response. May be combined with roll response (rate) test (2d2). CCA: Test in Normal AND Non-normal Control state.
(4) Spiral Stability.	Correct trend and ± 2º or ± 10% bank angle in 20 seconds If alternate test is used: correct trend and ± 2° aileron.	Cruise and Approach or Landing	✓	✓	✓	✓	**CT&M**	✓	**CT&M**	✓	✓	**CT&M**	✓	Aeroplane data averaged from multiple tests may be used. Test for both directions. As an alternative test, show lateral control required to maintain a steady turn with a bank angle of approximately 30°. CCA: Test in Non-normal Control state.
(5) Engine Inoperative Trim.	± 1º rudder angle or ± 1º tab angle or equivalent pedal. ± 2º sideslip angle.	2nd Segment Climb and Approach or Landing	✓	✓	✓	✓	**CT&M**	✓		✓	✓			Test should be performed in a manner similar to that for which a pilot is trained to trim an engine failure condition. 2nd segment climb test should be at take-off thrust. Approach or landing test should be at thrust for level flight. May be snapshot tests.
(6) Rudder Response.	± 2º/s or ± 10% yaw rate	Approach or Landing	✓	✓	✓	✓								Test with stability augmentation ON and OFF. Test with a step input at approximately 25% of full rudder pedal throw. CCA: Test in Normal AND Non-normal Control state.
	± 2 deg/sec or ± 10% yaw rate or heading change								**CT&M**	✓	✓	**CT&M**	✓	

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL												COMMENTS
			FS				FTD		FNPT			BITD			
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.		
(7) Dutch Roll (Yaw Damper OFF).	± 0·5 s or ± 10% of period. ± 10% of time to ½ or double amplitude or ± 0·02 of damping ratio. ± 20% or ± 1 s of time difference between peaks of bank and sideslip	Cruise and Approach or Landing	✓	✓	✓	✓			C T & M	C T & M	C T & M				Test for at least 6 cycles with stability augmentation OFF. CCA: Test in Non-normal Control state.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
(8) Steady State Sideslip.	For a given rudder position: ± 2° bank angle ± 1° sideslip angle ± 10% or ± 2° aileron ± 10% or ± 5° spoiler or equivalent roll controller position or force For FFSs representing aircraft with reversible flight control systems: ±10% or ±1·3 daN (3 lb) wheel force ±10% or ±2·2 daN (5 lb) rudder pedal force.	Approach or Landing	✓	✓	✓	✓			**CT&M**	✓	✓	**CT&M**	✓	May be a series of snapshot tests using at least two rudder positions (in each direction for propeller driven aeroplanes) one of which should be near maximum allowable rudder. For FNPT and BITD a roll controller position tolerance of ± 10% or ± 5° applies instead of the aileron tolerance. For a BITD the force tolerance shall be CT&M.
e. LANDINGS														

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
(1) Normal Landing	± 3 kts airspeed ± 1·5º pitch angle ± 1·5º AOA ± 3 m (10 ft) or ± 10% of height For aeroplanes with reversible flight control systems: ± 10% or ± 2·2 daN (5 lb) column force	Landing	**CT&M**	✓	✓	✓								Test from a minimum of 61 m (200 ft) AGL to nosewheel touch- down. Two tests should be shown, including two normal landing flaps (if applicable) one of which should be near maximum certificated landing weight, the other at light or medium weight CCA: Test in Normal AND Non-normal Control state if applicable.
(2) Minimum Flap Landing.	± 3 kts airspeed ± 1·5º pitch angle ± 1·5º AOA ± 3 m (10 ft) or ± 10% of height For aeroplanes with reversible flight control systems: ± 10% or ± 2·2 daN (5 lb) column force	Minimum Certified Landing Flap Configuration		✓	✓	✓								Test from a minimum of 61 m (200 ft) AGL to nosewheel touchdown. Test at near maximum landing weight.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
(3) Crosswind Landing.	± 3 kts airspeed ± 1·5º pitch angle ± 1·5º AOA ± 3 m (10 ft) or ± 10% height ± 2º bank angle ± 2º sideslip angle ± 3° heading angle For aeroplanes with reversible flight control systems: ± 10% or ± 2·2 daN (5 lb) column force ± 10% or ± 1·3 daN (3 lb) wheel force ± 10% or ± 2·2 daN (5 lb) rudder pedal force.	Landing		✓	✓	✓								Test from a minimum of 61 m (200 ft) AGL to a 50% decrease in main landing gear touchdown speed. Requires test data, including wind profile, for a crosswind component of at least 60% of AFM value measured at 10m (33 ft) above the runway.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
(4) One Engine Inoperative Landing.	± 3 kts airspeed ± 1·5º pitch angle ± 1·5º AOA ± 3 m (10 ft) or ± 10% height ± 2º bank angle ± 2º sideslip angle ± 3° heading angle	Landing		✓	✓	✓								Test from a minimum of 61 m (200 ft) AGL to a 50% decrease in main landing gear touchdown speed.
(5) Autopilot Landing (if applicable).	± 1·5 m (5 ft) flare height. ± 0·5 s or ± 10%T_f. ± 0·7 m/s (140 ft/min) R/D at touchdown. ± 3 m (10 ft) lateral deviation during rollout.	Landing		✓	✓	✓								If autopilot provides rollout guidance, record lateral deviation from touchdown to a 50% decrease in main landing gear touchdown speed. Time of autopilot flare mode engage and main gear touchdown should be noted. This test is not a substitute for the ground effects test requirement. T_f = Duration of Flare.
(6) All engine autopilot Go Around.	± 3 kts airspeed ± 1·5° pitch angle ± 1·5° AOA	As per AFM		✓	✓	✓								Normal all engine autopilot go around should be demonstrated (if applicable) at medium weight. CCA: Test in Normal AND Non-normal

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
(7) One-Engine-inoperative Go-around	± 3 kts airspeed ±1·5° pitch angle ±1·5° AOA ± 2° bank angle ± 2° sideslip angle	As per AFM		✓	✓	✓								Engine inoperative go-around required near maximum certificated landing weight with critical engine(s) inoperative. Provide one test with autopilot (if applicable) and one without autopilot. CCA: Non-autopilot test to be conducted in Non-normal mode.
(8) Directional Control (Rudder Effectiveness) with Reverse Thrust symmetric).	± 5 kts airspeed ± 2°/s yaw rate	Landing		✓	✓	✓								Apply rudder pedal input in both directions using full reverse thrust until reaching full thrust reverser minimum operating speed.
(9) Directional Control (Rudder Effectiveness) with Reverser Thrust (asymmetric)	± 5 kts airspeed ± 3° heading angle	Landing		✓	✓	✓								With full reverse thrust on the operating engine(s), maintain heading with rudder pedal input until maximum rudder pedal input or thrust reverser minimum operating speed is reached.
f. GROUND EFFECT														

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
(1) A Test to demonstrate Ground Effect.	± 1º elevator ± 0·5º stabilizer angle. ± 5% net thrust or equivalent. ± 1º AOA ± 1·5 m (5 ft) or ± 10% height ± 3 kts airspeed ± 1º pitch angle	Landing		✓	✓	✓								See Paragraph 2.4.2. A rationale should be provided with justification of results. CCA: Test in Normal OR Non-normal control state.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
g. WIND SHEAR														
(1) Four Tests, two take-off and two landing with one of each conducted in still air and the other with Wind Shear active to demonstrate Wind Shear models.	None	Take-off and Landing			✓	✓								Wind shear models are required which provide training in the specific skills required for recognition of wind shear phenomena and execution of recovery manoeuvres.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
														Wind shear models should be representative of measured or accident derived winds, but may be simplifications which ensure repeatable encounters. For example, models may consist of independent variable winds in multiple simultaneous components. Wind models should be available for the following critical phases of flight: (1) Prior to take-off rotation (2) At lift-off (3) During initial climb (4) Short final approach The United States Federal Aviation Administration (FAA) Wind shear Training Aid, wind models from the Royal Aerospace Establishment (RAE), the United States Joint Aerodrome Weather studies (JAWS) Project or other recognised sources may be implemented and should be supported and properly referenced in the QTG. Wind models from alternate sources may also be used if supported by aeroplane related data and such data are properly supported and referenced in the QTG. Use of alternate data should be co-ordinated with the Authority prior to submittal of the QTG for approval.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
h. FLIGHT AND MANOEUVRE ENVELOPE PROTECTION FUNCTIONS														This paragraph is only applicable to computer-controlled aeroplanes. Time history results of response to control inputs during entry into each envelope protection function (i.e., with normal and degraded control states if function is different) are required. Set thrust as required to reach the envelope protection function.
(1) Overspeed.	± 5 kts airspeed	Cruise	✓	✓	✓	✓	✓	✓						
(2) Minimum Speed.	± 3 kts airspeed	Take-off, Cruise and Approach or Landing	✓	✓	✓	✓	✓	✓						
(3) Load Factor.	± 0·1 g	Take-off, Cruise	✓	✓	✓	✓	✓	✓						
(4) Pitch Angle.	± 1·5° pitch angle	Cruise, Approach	✓	✓	✓	✓	✓	✓						
(5) Bank Angle.	± 2° or ± 10% bank angle	Approach	✓	✓	✓	✓	✓	✓						
(6) Angle of Attack.	± 1·5° AOA	Second Segment Climb and Approach or Landing	✓	✓	✓	✓	✓	✓						
3. MOTION SYSTEM														

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
a. Frequency response	As specified by the applicant for flight simulator qualification.	Not Applicable	✓	✓	✓	✓								Appropriate test to demonstrate frequency response required. See also ACJ No. 1 to JAR-FSTD A.030 para 2.4.3.2
b. Leg Balance	As specified by the applicant for flight simulator qualification.	Not Applicable	✓	✓	✓	✓								Appropriate test to demonstrate leg balance required See also ACJ No. 1 to JAR-FSTD A.030 para 2.4.3.2
c. Turn-around check	As specified by the applicant for flight simulator qualification.	Not Applicable	✓	✓	✓	✓								Appropriate test to demonstrate turn-around required. See also ACJ No. 1 to JAR-FSTD A.030 para 2.4.3.2
d. Motion effects														Refer to ACJ No 1 to JAR-FSTD A.030 3.3(n) subjective testing
e. Motion System repeatability	± 0·05g actual platform linear accelerations	None			✓	✓								Ensure that motion system hardware and software (in normal flight simulator operating mode) continue to perform as originally qualified. Performance changes from the original baseline can be readily identified with this information. See ACJ No. 1 to JAR-FSTD A.030 para 2.4.3.4

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
f. Motion cueing performance signature.	None	Ground and flight	✓	✓	✓	✓								For a given set of flight simulation critical manoeuvres record the relevant motion variables. These tests should be run with the motion buffet module disabled. See ACJ No. 1 to JAR-FSTD A.030 para 2.4.3.3
g. Characteristic motion vibrations	None	Ground and flight												The recorded test results for characteristic buffets should allow the comparison of relative amplitude versus frequency. For atmospheric disturbance testing, general purpose disturbance models that approximate demonstrable flight test data are acceptable. Principally, the flight simulator results should exhibit the overall appearance and trends of the aeroplane plots, with at least some of the frequency “spikes” being present within 1 or 2 Hz of the aeroplane data. See ACJ No. 1 to JAR-FSTD A.030 para 2.4.3.5

TESTS	**TOLERANCE**	**FLIGHT CONDITIONS**	**FSTD LEVEL**											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
The following tests with recorded results and an SOC are required for characteristic motion vibrations, which can be sensed at the flight deck where applicable by aeroplane type:														
(1) Thrust effects with brakes set	n/a	Ground				✓								Test should be conducted at maximum possible thrust with brakes set.
(2) Landing gear extended buffet	n/a	Flight				✓								Test condition should be for a normal operational speed and not at the gear limiting speed.
(3) Flaps extended buffet	n/a	Flight				✓								Test condition should be for a normal operational speed and not at the flap limiting speed.
(4) Speedbrake deployed buffet	n/a	Flight				✓								
(5) Approach-to-stall buffet	n/a	Flight				✓								Test condition should be approach-to-stall. Post-stall characteristics are not required.
(6) High speed or Mach buffet	n/a	Flight				✓								Test condition should be for high speed manoeuvre buffet/wind-up-turn or alternatively Mach buffet.
(7) In-flight vibrations	n/a	Flight (clean configuration)				✓								Test should be conducted to be representative of in-flight vibrations for propeller driven aeroplanes.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
4. VISUAL SYSTEM														
a. SYSTEM RESPONSE TIME														
(1) Transport Delay.	150 milliseconds or less after controller movement. 300 milliseconds or less after controller movement.	Pitch, roll and yaw	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	One separate test is required in each axis. See Appendix 5 to ACJ FSTD A.030 FNPT I and BITD only the instrument response time applies.
-- or --														
(2) Latency	- 150 milliseconds or less after controller movement. - 300 milliseconds or less after controller movement.	Take-off, Cruise, and Approach or Landing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	One test is required in each axis (pitch, roll, yaw) for each of the 3 conditions compared with aeroplane data for a similar input. The visual scene or test pattern used during the response testing shall be representative of the required system capacities to meet the daylight, twilight (dusk/dawn) and night visual capability as applicable. FS only: Response tests should be confirmed in daylight , twilight and night settings as applicable. FNPT I and BITD only the instrument response time applies.
b. DISPLAY SYSTEM TESTS														

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL												COMMENTS
			FS				FTD		FNPT			BITD			
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
(1) (a) Continuous collimated cross-cockpit visual field of view	Continuous, cross-cockpit, minimum collimated visual field of view providing each pilot with 180 degrees horizontal and 40 degrees vertical field of view. Horizontal FOV: Not less than a total of 176 measured degrees (including not less than ±88 measured degrees either side of the centre of the design eye point). Vertical FOV: Not less than a total of 36 measured degrees from the pilot's and co-pilot's eye point.	Not Applicable			✓	✓								Field of view should be measured using a visual test pattern filling the entire visual scene (all channels) consisting of a matrix of black and white 5° squares. Installed alignment should be confirmed in a Statement of Compliance.
(b) Continuous collimated visual field of view	Continuous, minimum collimated visual field of view providing each pilot with 45 degrees horizontal and 30 degrees vertical field of view	Not Applicable	✓	✓										30 degrees vertical field of view may be insufficient to meet the requirements of ACJ No. 1 to JAR-FSTD A.030 Table 2.3 paragraph 4.c (visual ground segment)

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
(2) System geometry	5° even angular spacing within ± 1° as measured from either pilot eye-point, and within 1·5° for adjacent squares.	Not Applicable	✓	✓	✓	✓								System geometry should be measured using a visual test pattern filling the entire visual scene (all channels) consisting of a matrix of black and white 5° squares with light points at the intersections. The operator should demonstrate that the angular spacing of any chosen 5° square and the relative spacing of adjacent squares are within the stated tolerances. The intent of this test is to demonstrate local linearity of the displayed image at either pilot eye-point.
(3) Surface Contrast Ratio	Not less than 5:1	Not Applicable			✓	✓								Surface contrast ratio should be measured using a raster drawn test pattern filling the entire visual scene (all channels). The test pattern should consist of black and white squares, 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 foot-lamberts). Measure any adjacent dark squares. The contrast ratio is the bright square value divided by the dark square value. Note. During contrast ratio testing, simulator aft-cab and flight deck ambient light levels should be zero.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL												COMMENTS
			FS				FTD		FNPT			BITD			
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.		
(4) Highlight Brightness	Not less than 20 cd/m^2 (6 ft-lamberts) on the display	Not Applicable			✓	✓									Highlight brightness should be measured by maintaining the full test pattern described in paragraph 4.b 3) above, superimposing a highlight on the centre white square of each channel and measuring the brightness using the 1° spot photometer. Lightpoints are not acceptable. Use of calligraphic capabilities to enhance raster brightness is acceptable.
(5) Vernier Resolution	Not greater than 2 arc minutes	Not Applicable			✓	✓									Vernier resolution should be demonstrated by a test of objects shown to occupy the required visual angle in each visual display used on a scene from the pilot's eye-point. The eye will subtend two arc minutes (arc tan (4/6 876)x60) when positioned on a 3 degree glideslope, 6 876 ft slant range from the centrally located threshold of a black runway surface painted with white threshold bars that are 16 ft wide with 4-ft gaps in-between. This should be confirmed by calculations in a statement of compliance.
(6) Lightpoint Size	Not greater than 5 arc minutes.	Not Applicable			✓	✓									Lightpoint size should be measured using a test pattern consisting of a centrally located single row of lightpoints reduced in length until modulation is just discernible in each visual channel. A row of 48 lights will form a 4° angle or less.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
(7) Lightpoint Contrast Ratio.	Not less than 10:1	Not Applicable	✓	✓										Lightpoint contrast ratio should be measured using a test pattern demonstrating a 1° area filled with lightpoints (i.e. lightpoint modulation just discernible) and should be compared to the adjacent background.
	Not less than 25:1				✓	✓								Note. During contrast ratio testing, simulator aft-cab and flight deck ambient light levels should be zero.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
c. VISUAL GROUND SEGMENT	Near end. The lights computed to be visible should be visible in the FSTD. Far end: ± 20% of the computed VGS	Trimmed in the landing configuration at 30 m (100 ft) wheel height above touchdown zone elevation on glide slope at a RVR setting of 300 m (1 000 ft) or 350m (1 200ft)	✓	✓	✓	✓				✓	✓			Visual Ground Segment. This test is designed to assess items impacting the accuracy of the visual scene presented to a pilot at DH on an ILS approach. Those items include RVR, glideslope (G/S) and localiser modelling accuracy (location and slope) for an ILS, for a given weight, configuration and speed representative of a point within the aeroplane's operational envelope for a normal approach and landing. If non-homogenous fog is used, the vertical variation in horizontal visibility should be described and be included in the slant range visibility calculation used in the VGS computation. FNPT: If a generic aeroplane is used as the basic model, a generic cut-off angle of 15 deg. is assumed as an ideal.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
5. SOUND SYSTEMS														*All tests in this section should be presented using an unweighted 1/3-octave band format from band 17 to 42 (50 Hz to 16 kHz). A minimum 20 second average should be taken at the location corresponding to the aeroplane data set. The aeroplane and flight simulator results should be produced using comparable data analysis techniques.* See ACJ FSTD A.030 para 2.4.5
a. TURBO-JET AEROPLANES														
(1) Ready for engine start	± 5 dB per 1/3 octave band	Ground				✓								Normal condition prior to engine start. The APU should be on if appropriate.
(2) All engines at idle	± 5 dB per 1/3 octave band	Ground				✓								Normal condition prior to take-off.
(3) All engines at maximum allowable thrust with brakes set	± 5 dB per 1/3 octave band	Ground				✓								Normal condition prior to take-off.
(4) Climb	± 5 dB per 1/3 octave band	En-route climb				✓								Medium altitude.
(5) Cruise	± 5 dB per 1/3 octave band	Cruise				✓								Normal cruise configuration.

ACJ No. 1 to JAR-FSTD A.030 (continued)

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
(6) Speedbrake / spoilers extended (as appropriate)	± 5 dB per 1/3 octave band	Cruise				✓								Normal and constant speedbrake deflection for descent at a constant airspeed and power setting.
(7) Initial approach	± 5 dB per 1/3 octave band	Approach				✓								Constant airspeed, gear up, flaps/slats as appropriate.
(8) Final approach	± 5 dB per 1/3 octave band	Landing				✓								Constant airspeed, gear down, full flaps.
b. PROPELLER AEROPLANES														
(1) Ready for engine start	± 5 dB per 1/3 octave band	Ground				✓								Normal condition prior to engine start. The APU should be on if appropriate.
(2) All propellers feathered	± 5 dB per 1/3 octave band	Ground				✓								Normal condition prior to take-off.
(3) Ground idle or equivalent	± 5 dB per 1/3 octave band	Ground				✓								Normal condition prior to take-off.
(4) Flight idle or equivalent	± 5 dB per 1/3 octave band	Ground				✓								Normal condition prior to take-off.
(5) All engines at maximum allowable power with brakes set	± 5 dB per 1/3 octave band	Ground				✓								Normal condition prior to take-off.
(6) Climb	± 5 dB per 1/3 octave band	En-route climb				✓								Medium altitude.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
(7) Cruise	± 5 dB per 1/3 octave band	Cruise				✓								Normal cruise configuration.
(8) Initial approach	± 5 dB per 1/3 octave band	Approach				✓								Constant airspeed, gear up, flaps extended as appropriate, RPM as per operating manual.
(9) Final approach	± 5 dB per 1/3 octave band	Landing				✓								Constant airspeed, gear down, full flaps, RPM as per operating manual.
c. SPECIAL CASES	± 5 dB per 1/3 octave band					✓								Special cases identified as particularly significant to the pilot, important in training, or unique to a specific aeroplane type or variant.
d. FLIGHT SIMULATOR BACKGROUND NOISE	Initial evaluation: not applicable. Recurrent evaluation: ± 3dB per 1/3 octave band compared to initial evaluation					✓								Results of the background noise at initial qualification should be included in the QTG document and approved by the qualifying authority. The simulated sound will be evaluated to ensure that the background noise does not interfere with training. Refer to ACJ FSTD A.030 para 2.4.5.6. The measurements are to be made with the simulation running, the sound muted and a dead cockpit.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FS				FTD		FNPT			BITD		
			A	B	C	D	Init.	Rec.	I	II	MCC	Init.	Rec.	
e. FREQUENCY RESPONSE	Initial evaluation: not applicable. Recurrent evaluation: cannot exceed ± 5 dB on three consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.				✓	✓								Only required if the results are to be used during recurrent evaluations according to ACJ FSTD A.030 para 2.4.5.7. The results shall be acknowledged by the authority at initial qualification.

ACJ No.1 to JAR-FSTD A.030 (continued)

2.4 Information for Validation Tests

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 FSTD to be representative, it too should present the pilot with the proper feel – that of the aircraft being simulated. Compliance with this requirement should be determined by comparing a recording of the control feel dynamics of the FSTD to actual aircraft measurements in the relevant configurations.

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

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

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

2.4.1.2 Control dynamics evaluation.

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

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

a. Underdamped Response.

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

2. The damping tolerance should be applied to overshoots on an individual basis. Care should be taken when applying the tolerance to small overshoots since the significance of such overshoots becomes

questionable. Only those overshoots larger than 5% of the total initial displacement should be considered. The residual band, labelled $T(A_d)$ 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 aeroplane data, the process should begin by overlaying or aligning the FSTD and aeroplane steady state values and then comparing amplitudes of oscillation peaks, the time of the first zero crossing, and individual periods of oscillation. The FSTD should show the same number of significant overshoots to within one when compared against the aeroplane data. This procedure for evaluating the response is illustrated in Figure 1 below.

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

c. Special considerations. Control systems, which 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	First overshoot and ± 1 subsequent overshoots

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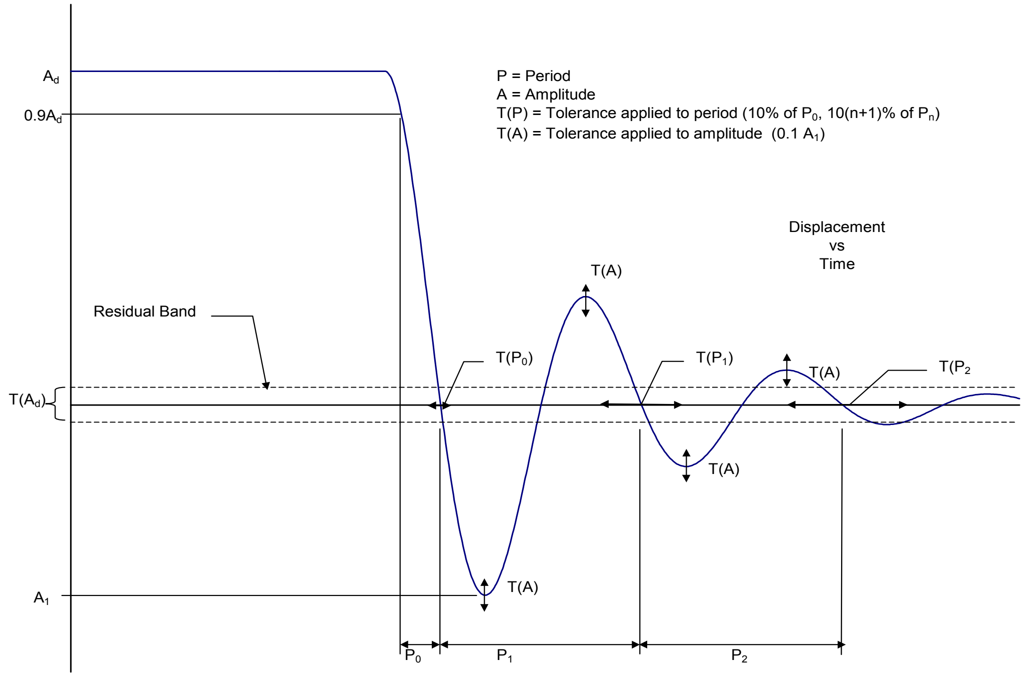

Figure 1 : Underdamped step response

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ACJ No.1 to JAR-FSTD A.030 (continued)

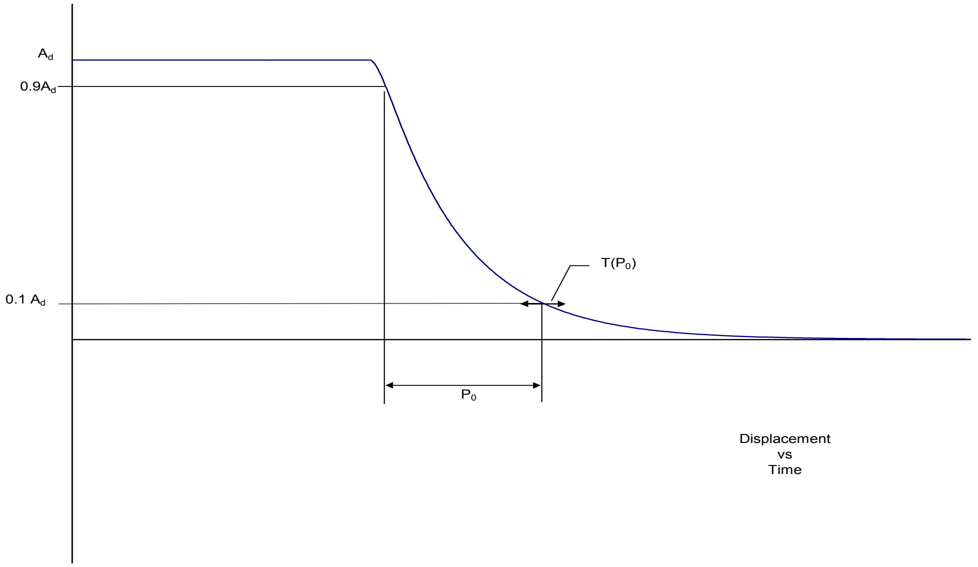

Figure 2 : Critically damped step response

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 – Slowly move the control such that approximately 100 seconds are required to achieve a full sweep. A full sweep is defined as movement of the controller from neutral to the stop, usually aft or right stop, then to the opposite stop, then to the neutral position.

b. Slow dynamic test – Achieve a full sweep in approximately 10 seconds.

c. Fast dynamic test – Achieve a full sweep in approximately 4 seconds.

Note: Dynamic sweeps may be limited to forces not exceeding 44·5 daN (100 lbs).

2.4.1.5 Tolerances

1. Static test , see paragraph 2.3 – 2.a(1), (2), and (3) of the table of FSTD validation tests.

2. Dynamic test – ± 0·9 daN (2 lbs) or ± 10% on dynamic increment above static test.

The 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 aeroplanes with reversible control systems. Hence, each case should be considered on its own merit on an ad hoc basis. Should the Authority find that alternative methods do not result in satisfactory performance, then more conventionally accepted methods should be used.

2.4.2 Ground Effect

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

A dedicated test should be provided which will 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:

a. Level fly-bys. 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 wingspan above the ground, one each at approximately 30% and 50% of the wingspan where height refers to main gear tyre above the ground. In addition, one level-flight trim condition should be conducted out of ground effect, e.g. at 150% of wingspan.

b. Shallow approach landing. The shallow approach landing 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 System

2.4.3.1 General

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

b. The objective validation tests presented 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 System Checks.

The intent of tests as described in the table of FSTD validation tests, paragraph 2.3 - 3.a, frequency response, 3.b leg balance, and 3.c, turn-around check, is to demonstrate the performance of the motion system hardware, and to check the integrity of the motion set-up with regard to calibration and wear. These tests are independent of the motion cueing software and should be considered as robotic tests.

2.4.3.3 Motion Cueing Performance Signature

a. Background. The intent of this test is to provide quantitative time history records of motion system response to a selected set of automated QTG manoeuvres during initial qualification. This is not intended to be a comparison of the motion platform accelerations against the flight test recorded accelerations (i.e. not to be compared against aeroplane cueing). This information describes a minimum set of manoeuvres and a guideline for determining the FSTD’s motion footprint. If over time there is a change to the initially certified motion software load or motion hardware then these baseline tests should be rerun.

b. List of tests. Table 1 delineates those tests that are important to pilot motion cueing and are general tests applicable to all types of aeroplanes and thus the motion cueing performance signature should be run for initial qualification. These tests can be run at any time deemed acceptable to the Authority prior to or during the initial qualification. The tests in table 2 are also significant to pilot motion cues but are provided for information only. These tests are <u>not</u> required to be run.

c. Priority. A priority (X) is given to each of these manoeuvres, with the intent of placing greater importance on those manoeuvres that directly influence pilot perception and control of the aeroplane motions. For the manoeuvres designated with a priority in the tables below, the FSTD motion cueing system should have a high tilt co-ordination gain, high rotational gain, and high correlation with respect to the aeroplane simulation model.

d. Data 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.

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. Conditions:

1. One test case on-ground: to be determined by the operator;

2. 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 aeroplane 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;

2. motion actuators position

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No.	Associated validation test	Manoeuvre	Priority	Comments
1	1b4	Take-off rotation (Vr to V2)	X	Pitch attitude due to initial climb should dominate over cab tilt due to longitudinal acceleration.
2	1b5	Engine failure between V1 and Vr	X	
3	2e6	Pitch change during go-around	X	
4	2c2 & 2c4	Configuration changes	X	
5	2c1	Power change dynamics	X	Resulting effects of power changes
6	2e1	Landing flare	X	
7	2e1	Touchdown bump		

Table 1 – Tests required for initial qualification

No.	Associated validation test	Manoeuvre	Priority	Comments
8	1a2	Taxi (including acceleration, turns, braking), with presence of ground rumble	X	
9	1b4	Brake release and initial acceleration	X	
10	1b1 & 3g	Ground rumble on runway, acceleration during take off, scuffing, runway lights and surface discontinuities	X	Scuffing and velocity cues are given priority
11	1b2 & 1b7	Engine failure prior to V1 (RTO)	X	Lateral and directional cues are given priority
12	1c1	Steady-state climb	X	
13	1d1& 1d2	Level flight acceleration and deceleration		
14	2c6	Turns	X	
15	1b8	Engine failures		
16	2c8	Stall characteristics	X	
17		System failures	X	Priority depending on the type of system failure and aeroplane type (e.g. flight controls failures, rapid decompression, inadvertent thrust reverser deployment)
18	2g1 & 2e3	Wind shear/crosswind landing	X	Influence on vibrations and on attitude control
19	1e1	Deceleration on runway		Including contamination effects

Table 2 – Tests that are significant but are not required to be run

2.4.3.5 Motion vibrations

a. Presentation of results. The characteristic motion vibrations are a means to verify that the FSTD can reproduce the frequency content of the aeroplane when flown in specific conditions. The test results should be presented as a Power Spectral Density (PSD) plot with frequencies on the horizontal axis and amplitude on the vertical axis. The aeroplane data and FSTD data should be presented in the same format with the same scaling. The algorithms used for generating the FSTD data should be the same as those used for the aeroplane data. If they are not the same then the algorithms used for the FSTD data should be proven to be sufficiently comparable. As a minimum the results along the dominant axes should be presented and a rationale for not presenting the other axes should be provided.

b. Interpretation of results. The overall trend of the PSD plot should be considered while focusing on the dominant frequencies. Less emphasis should be placed on the differences at the high frequency and low amplitude portions of the PSD plot. During the analysis it should be considered that certain structural components of the FSTD have resonant frequencies that are filtered and thus may not appear in the PSD plot. If such filtering is required the notch filter bandwidth should be limited to 1 Hz to ensure that the buffet feel is not adversely affected. In addition, a rationale should be provided to explain that the characteristic motion vibration is not being adversely affected by the filtering. The amplitude should match aeroplane data as per the description below; however, 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 System

2.4.4.1 Visual Display System

a. Contrast ratio (daylight systems). Should 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 2.3.4.b.(3) and paragraph 2.3.4.b.(7).

b. Highlight brightness test (daylight systems). Should 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 2.3.4.b.(4).

c. Resolution (daylight systems) should be demonstrated by a test of objects shown to occupy a visual angle of not greater than the specified value in arc minutes in the visual scene from the pilot's eyepoint. This should be confirmed by calculations in the statement of compliance. See paragraph 2.3.4.b.(5).

d. Lightpoint size (daylight systems) –should be measured in a test pattern consisting of a single row of lightpoints reduced in length until modulation is just discernible. See paragraph 2.3.4.b.(6).

e. Lightpoint size (twilight and night systems) – of sufficient resolution so as to enable achievement of visual feature recognition tests according to paragraph 2.3.4.b.(6).

2.4.4.2 Visual ground segment

(a) Altitude and RVR for the assessment have been selected in order to produce a visual scene that can be readily assessed for accuracy (RVR calibration) and where spatial accuracy (centreline and G/S) of the simulated aeroplane can be readily determined using approach/runway lighting and flight deck instruments.

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

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(c) Automatic positioning of the simulated aeroplane on the ILS is encouraged. If such positioning is accomplished, diligent care should be taken to ensure the correct spatial position and aeroplane attitude is achieved. Flying the approach manually or with an installed autopilot should also produce acceptable results.

2.4.5 Sound System

2.4.5.1 General. The total sound environment in the aeroplane is very complex, and changes with atmospheric conditions, aeroplane configuration, airspeed, altitude, power settings, etc. Thus, flight deck sounds are an important component of the flight deck operational environment and as such provide valuable information to the flight crew. These aural cues can either assist the crew, as an indication of an abnormal situation, or hinder the crew, as a distraction or nuisance. For effective training, the FSTD should provide flight deck sounds that are perceptible to the pilot during normal and abnormal operations, and that are comparable to those of the aeroplane. Accordingly, the FSTD operator should carefully evaluate background noises in the location being considered. To demonstrate compliance with the sound requirements, the objective or validation tests in this paragraph have been selected to provide a representative sample of normal static conditions typical of those experienced by a pilot.

2.4.5.2 Alternate engine fits. For FSTDs with multiple propulsion configurations any condition listed in paragraph 2.3, the table of FSTD validation tests, that is identified by the aeroplane manufacturer as significantly different, due to a change in engine model, should be presented for evaluation as part of the QTG.

2.4.5.3 Data and Data Collection System

(a) Information provided to the FSTD manufacturer should comply with "IATA Flight Simulator Design & Performance Data Requirements", 6th Edition, 2000. This information should contain calibration and frequency response data.

(b) The system used to perform the tests listed in para.2.3.5, within the table of FSTD validation tests, should comply with the following standards:

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

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

2.4.5.4 Headsets. If headsets are used during normal operation of the aeroplane they should also be used during the FSTD evaluation.

2.4.5.5 Playback equipment. Recordings of the QTG conditions according to paragraph 2.3, table of FSTD validation tests, should be provided during initial evaluations.

2.4.5.6 Background noise

(a) Background noise is the noise in the FSTD due to the FSTD's cooling and hydraulic systems that is not associated with the aeroplane, and the extraneous noise from other locations in the building. Background noise can seriously impact the correct simulation of aeroplane sounds, so the goal should be to keep the background noise below the aeroplane sounds. In some cases, the sound level of the simulation can be increased to compensate for the background noise. However, this approach is limited by the specified tolerances and by the subjective acceptability of the sound environment to the evaluation pilot.

(b) The acceptability of the background noise levels is dependent upon the normal sound levels in the aeroplane being represented. Background noise levels that fall below the lines defined by the following points, may be acceptable (refer to figure 3):

(1) 70 dB @ 50 Hz;

(2) 55 dB @ 1 000 Hz;

(3) 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. Aeroplane sounds, which fall below this limit require careful review and may require lower limits on the background noise.

(c) The background noise measurement may be rerun at the recurrent evaluation as stated in paragraph 2.4.5.8. The tolerances to be applied are that recurrent 1/3 octave band amplitudes cannot exceed ± 3 dB when compared to the initial results.

2.4.5.7 Frequency response - Frequency response plots for each channel should be provided at initial evaluation. These plots may be rerun at the recurrent evaluation as per paragraph 2.4.5.8. The tolerances to be applied are as follows:

(a) recurrent 1/3 octave band amplitudes cannot exceed ± 5 dB for three consecutive bands when compared to initial results.

(b) the average of the sum of the absolute differences between initial and recurrent results cannot exceed 2 dB (refer table 3).

2.4.5.8 Initial and recurrent evaluations. If recurrent frequency response and FSTD background noise results are within tolerance, respective to initial evaluation results, and the operator can prove that no software or hardware changes have occurred that will affect the aeroplane cases, then it is not required to rerun those cases during recurrent evaluations.

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

2.4.5.9 Validation testing. Deficiencies in aeroplane recordings should be considered when applying the specified tolerances to ensure that the simulation is representative of the aeroplane. Examples of typical deficiencies are:

(a) variation of data between tail numbers;

(b) frequency response of microphones;

(c) repeatability of the measurements;

(d) extraneous sounds during recordings.

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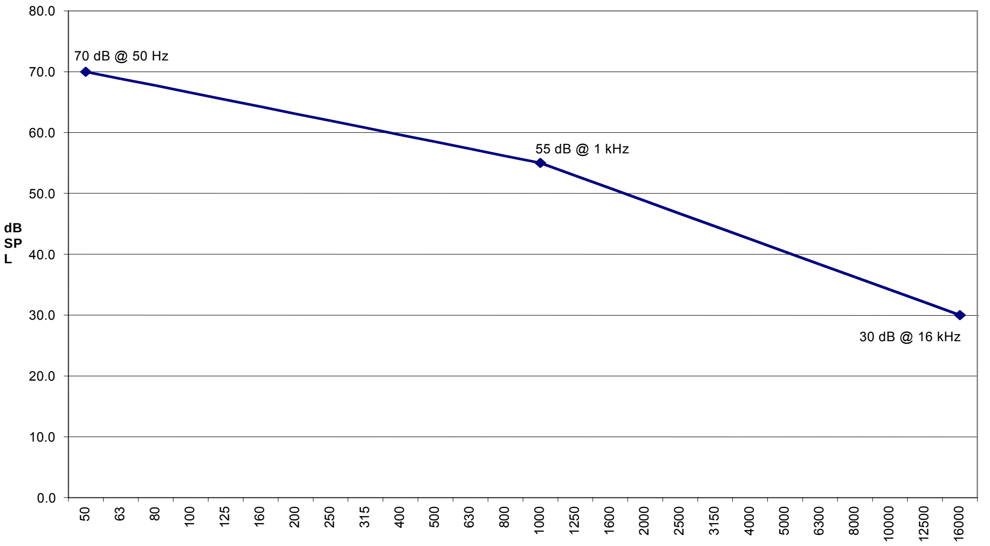

Figure 3. 1/3 Octave Band Frequency (Hz)

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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

Functions and Subjective Tests

3.1 Discussion

3.1.1 Accurate replication of aeroplane systems functions will be checked at each flight crewmember position. This includes procedures using the operator’s approved manuals, aeroplane manufacturers approved manuals and checklists. A useful source of guidance for conducting the tests required to establish that the criteria set out in this document are complied with by the flight simulator under evaluation are published in the RAeS Airplane Flight Simulator Evaluation Handbook. Handling qualities, performance, and FSTD systems operation will be subjectively assessed. In order to assure the functions tests are conducted in an efficient and timely manner, operators are encouraged to coordinate with the appropriate Authority responsible for the evaluation so that any skills, experience or expertise needed by the 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 aeroplane. Unlike the objective tests listed in paragraph 2 above, the subjective testing should cover those areas of the flight envelope which may reasonably be reached by a trainee, even though the FSTD has not been approved for training in that area. Thus it is prudent to examine, for example, the normal and abnormal FSTD performance to ensure that the simulation is representative even though it may not be a requirement for the level of qualification being sought. (Any such subjective assessment of the simulation should include reference to paragraph 2 and 3 above in which the minimum objective standards acceptable for that Qualification Level 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, 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 Line Oriented Flight Training (LOFT) scenario or special emphasis items in the operator’s training programme. Unless directly related to a requirement for the current Qualification Level, the results of such an evaluation would not affect the FSTD’s current status.

3.1.4 Functions tests will be run in a logical flight sequence at the same time as performance and handling assessments. This also permits real time FSTD running for 2 to 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 aeroplanes and innovative training programmes. For example, ‘high angle of attack manoeuvring’ is included to provide an alternative to ‘approach to stalls’. Such an alternative is necessary for aeroplanes employing flight envelope limiting technology.

3.2.3 All systems functions will be assessed for normal and, where appropriate, alternate operations. Normal, abnormal, and emergency procedures associated with a flight phase will be assessed during the evaluation of manoeuvres or events within that flight phase. Systems are listed separately under ‘any flight phase’ to assure appropriate attention to systems checks.

3.2.4 When evaluating functions and subjective tests, the fidelity of simulation required for the highest level of qualification should be very close to the aeroplane. However, for the lower levels of qualification the degree of fidelity may be reduced in accordance with the criteria contained in paragraph 2 above.

3.2.5 Evaluation of the lower orders of FSTD should be tailored only to the systems and flight conditions which have been simulated. Similarly, many tests will be applicable for automatic flight. Where automatic flight is not possible and pilot manual handling is required, the FSTD shall 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 Qualification Level should be assessed to ensure the absence of any negative impact on the intended training and testing manoeuvres.

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Functions and subjective tests

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
a PREPARATION FOR FLIGHT										
(1) Preflight. Accomplish a functions check of all switches, indicators, systems, and equipment at all crewmembers' and instructors' stations and determine that;										
(a) the flight deck design and functions are identical to that of the aeroplane or class of aeroplane simulated	✓	✓	✓	✓	✓	✓	✓	✓	✓	
(b) design and functions represent those of the simulated class of aeroplane										✓
b SURFACE OPERATIONS (PRE-TAKE-OFF)										
(1) Engine Start										
(a) Normal start	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(b) Alternate start procedures	✓	✓	✓	✓	✓	✓				
(c) Abnormal starts and shutdowns (hot start, hung start, tail pipe fire, etc.)	✓	✓	✓	✓	✓	✓				
(2) Pushback/Powerback	✓	✓	✓	✓						
(3) Taxi										
(a) Thrust response	✓	✓	✓	✓			✓	✓	✓	
(b) Power lever friction	✓	✓	✓	✓			✓	✓	✓	
(c) Ground handling	✓	✓	✓	✓			✓	✓	✓	
(d) Nose wheel scuffing	✓	✓	✓	✓						
(e) Brake operation (normal and alternate/emergency)							✓	✓	✓	
A Brake fade (if applicable)	✓	✓	✓	✓						
B. Other	✓	✓	✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
c TAKE-OFF										
(1) Normal										✓(1)
(a) Aeroplane/engine parameter relationships	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(b) Acceleration characteristics (motion)	✓	✓	✓	✓						
(c) Acceleration characteristics (not associated with motion)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(d) Nose wheel and rudder steering	✓	✓	✓	✓	✓	✓	✓	✓	✓	
(e) Crosswind (maximum demonstrated)	✓	✓	✓	✓				✓	✓	
(f) Special performance (e.g. reduced V1, max de-rate, short field operations)	✓	✓	✓	✓						
(g) Low visibility take-off	✓	✓	✓	✓				✓	✓	
(h) Landing gear, wing flap leading edge device operation	✓	✓	✓	✓			✓	✓	✓	✓
(i) Contaminated runway operation	✓	✓	✓	✓						
(j) Other	✓	✓	✓	✓						
(2) Abnormal/emergency										
(a) Rejected	✓	✓	✓	✓					✓	
(b) Rejected special performance (e.g. reduced V_1, max de-rate, short field operations)	✓	✓	✓	✓						
(c) With failure of most critical engine at most critical point, continued take-off	✓	✓	✓	✓						
(d) With wind shear	✓	✓	✓	✓						
(e) Flight control system failures, reconfiguration modes, manual reversion and associated handling	✓	✓	✓	✓						
(f) Rejected, brake fade	✓	✓	✓	✓						
(g) Rejected, contaminated runway	✓	✓	✓	✓						
(h) Other	✓	✓	✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
d CLIMB										
(1) Normal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(2) One or more engines inoperative	✓	✓	✓	✓	✓	✓	✓(2)	✓	✓	✓(2)
(3) Other	✓	✓	✓	✓	✓	✓				
e CRUISE										
(1) Performance characteristics (speed vs. power)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(2) High altitude handling	✓	✓	✓	✓	✓	✓		✓	✓	
(3) High Mach number handling (Mach tuck, Mach buffet) and recovery (trim change)	✓	✓	✓	✓	✓	✓		✓(3)	✓(3)	
(4) Overspeed warning (in excess of Vmo or Mmo)	✓	✓	✓	✓						
(5) High IAS handling	✓	✓	✓	✓	✓	✓		✓	✓	

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
f MANOEUVRES										
(1) High angle of attack, approach to stalls, stall warning, buffet, and g-break (take-off, cruise, approach, and landing configuration)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(2) Flight envelope protection (high angle of attack, bank limit, overspeed, etc)	✓	✓	✓	✓	✓	✓				
(3) Turns with/without speedbrake/spoilers deployed	✓	✓	✓	✓	✓	✓	✓	✓	✓	
(4) Normal and standard rate turns	✓	✓	✓	✓						✓
(5) Steep turns	✓	✓	✓	✓						✓
(6) Performance turn	✓	✓	✓	✓						
(7) In flight engine shutdown and restart (assisted and windmill)	✓	✓	✓	✓	✓	✓			✓	
(8) Manoeuvring with one or more engines inoperative, as appropriate	✓	✓	✓	✓	✓	✓	✓(2)	✓	✓	✓(2)
(9) Specific flight characteristics (e.g. direct lift control)	✓	✓	✓	✓	✓	✓				
(10) Flight control system failures, reconfiguration modes, manual reversion and associated handling	✓	✓	✓	✓	✓	✓			✓	
(11) Other	✓	✓	✓	✓	✓	✓				
g DESCENT										
(1) Normal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(2) Maximum rate (clean and with speedbrake, etc)	✓	✓	✓	✓	✓	✓	✓	✓	✓	
(3) With autopilot	✓	✓	✓	✓					✓	
(4) Flight control system failures, reconfiguration modes, manual reversion and associated handling	✓	✓	✓	✓	✓	✓			✓	
(5) Other	✓	✓	✓	✓	✓	✓				

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
h INSTRUMENT APPROACHES AND LANDING										
Only those instrument approach and landing tests relevant to the simulated aeroplane type or class should be selected from the following list, where tests should be made with limiting wind velocities, wind shear and with relevant system failures, including the use of Flight Director.										
(1) Precision										
(a) PAR	✓	✓	✓	✓			✓	✓	✓	✓
(b) CAT I/GBAS (ILS/MLS) published approaches										
A Manual approach with/without flight director including landing	✓	✓	✓	✓	✓	✓		✓	✓	
B Autopilot/autothrottle coupled approach and manual landing	✓	✓	✓	✓	✓	✓			✓	
C Manual approach to DH and G/A all engines	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
D Manual one engine out approach to DH and G/A	✓	✓	✓	✓	✓	✓	✓(2)	✓	✓	✓(2)
E Manual approach controlled with and without flight director to 30 m (100 ft) below CAT I minima										
(i) with cross-wind (maximum demonstrated)	✓	✓	✓	✓						
(ii) with wind shear	✓	✓	✓	✓						
F Autopilot/autothrottle coupled approach, one engine out to DH and G/A	✓	✓	✓	✓	✓	✓			✓	
G Approach and landing with minimum/standby electrical power	✓	✓	✓	✓	✓	✓			✓	
(c) CAT II/GBAS (ILS/MLS) published approaches										
A Autopilot/autothrottle coupled approach to DH and landing	✓	✓	✓	✓	✓	✓				
B Autopilot/autothrottle coupled approach to DH and G/A	✓	✓	✓	✓	✓	✓				
C Autocoupled approach to DH and manual G/A	✓	✓	✓	✓	✓	✓				
D Autocoupled/autothrottle Category II published approach	✓	✓	✓	✓						

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TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(d) CAT III/GBAS (ILS/MLS) published approaches										
A Autopilot/autothrottle coupled approach to land and rollout	✓	✓	✓	✓	✓	✓				
B Autopilot/autothrottle coupled approach to DH/Alert Height and G/A	✓	✓	✓	✓	✓	✓				
C Autopilot/autothrottle coupled approach to land and rollout with one engine out	✓	✓	✓	✓	✓	✓				
D Autopilot/autothrottle coupled approach to DH/Alert Height and G/A with one engine out	✓	✓	✓	✓	✓	✓				
E Autopilot/autothrottle coupled approach (to land or to go around)										
(i) with generator failure	✓	✓	✓	✓						
(ii) with 10 knot tail wind	✓	✓	✓	✓						
(iii) with 10 knot crosswind	✓	✓	✓	✓						
(2) Non-precision										
(a) NDB	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(b) VOR, VOR/DME, VOR/TAC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(c) RNAV (GNSS)	✓	✓	✓	✓	✓	✓			✓	
(d) ILS LLZ (LOC), LLZ(LOC)/BC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(e) ILS offset localizer	✓	✓	✓	✓						
(f) direction finding facility	✓	✓	✓	✓						
(g) surveillance radar	✓	✓	✓	✓						
NOTE: If Standard Operating Procedures are to use autopilot for non-precision approaches then these should be evaluated.										

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
i VISUAL APPROACHES (SEGMENT) AND LANDINGS										
(1) Manoeuvring, normal approach and landing all engines operating with and without visual approach aid guidance	✓	✓	✓	✓				✓	✓	
(2) Approach and landing with one or more engines inoperative	✓	✓	✓	✓				✓	✓	
(3) Operation of landing gear, flap/slats and speedbrakes (normal and abnormal)	✓	✓	✓	✓						
(4) Approach and landing with crosswind (max. demonstrated for Flight simulator)	✓	✓	✓	✓				✓	✓	
(5) Approach to land with wind shear on approach	✓	✓	✓	✓						
(6) Approach and landing with flight control system failures,(for Flight simulator - reconfiguration modes, manual reversion and associated handling (most significant degradation which is probable))	✓	✓	✓	✓					✓	
(7) Approach and landing with trim malfunctions										
(a) longitudinal trim malfunction	✓	✓	✓	✓						
(b) lateral-directional trim malfunction	✓	✓	✓	✓						
(8) Approach and landing with standby (minimum) electrical/hydraulic power	✓	✓	✓	✓						
(9) Approach and landing from circling conditions (circling approach)	✓	✓	✓	✓						
(10) Approach and landing from visual traffic pattern	✓	✓	✓	✓						
(11) Approach and landing from non-precision approach	✓	✓	✓	✓						
(12) Approach and landing from precision approach	✓	✓	✓	✓						
(13) Approach procedures with vertical guidance (APV), e.g., SBAS	✓	✓	✓	✓						
(14) Other	✓	✓	✓	✓						
NOTE: FSTD with visual systems, which permit completing a special approach procedure in accordance with applicable regulations, may be approved for that particular approach procedure.										

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
j MISSED APPROACH										
(1) All engines	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(2) One or more engine(s) out	✓	✓	✓	✓	✓	✓	✓(2)	✓	✓	✓(2)
(3) With flight control system failures, reconfiguration modes, manual reversion and for flight simulator - associated handling	✓	✓	✓	✓	✓	✓			✓	
k SURFACE OPERATIONS (POST LANDING)										
(1) Landing roll and taxi										
(a) Spoiler operation	✓	✓	✓	✓	✓	✓		✓	✓	
(b) Reverse thrust operation	✓	✓	✓	✓	✓	✓		✓	✓	
(c) Directional control and ground handling, both with and without reverse thrust	✓	✓	✓	✓	✓	✓				
(d) Reduction of rudder effectiveness with increased reverse thrust (rear pod-mounted engines)	✓	✓	✓	✓						
(e) Brake and anti-skid operation with dry, wet, and icy condition	✓	✓	✓	✓						
(f) Brake operation, to include auto-braking system where applicable	✓	✓	✓	✓	✓	✓	✓	✓	✓	
(g) Other	✓	✓	✓	✓	✓	✓				
l ANY FLIGHT PHASE										
(1) Aeroplane and powerplant systems operation										
(a) Air conditioning and pressurisation (ECS)	✓	✓	✓	✓	✓	✓			✓	
(b) De-icing/anti-icing	✓	✓	✓	✓	✓	✓		✓	✓	
(c) Auxiliary powerplant/auxiliary power unit (APU)	✓	✓	✓	✓	✓	✓				
(d) Communications	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(e) Electrical	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(f) Fire and smoke detection and suppression	✓	✓	✓	✓	✓	✓			✓	

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(g) Flight controls (primary and secondary)	✓	✓	✓	✓	✓	✓			✓	
(h) Fuel and oil, hydraulic and pneumatic	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(i) Landing gear	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(j) Oxygen	✓	✓	✓	✓	✓	✓			✓	
(k) Powerplant	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(l) Airborne radar	✓	✓	✓	✓	✓	✓				
(m) Autopilot and Flight Director	✓	✓	✓	✓	✓	✓			✓	
(n) Collision avoidance systems. (e.g. GPWS,TCAS)	✓	✓	✓	✓	✓	✓				
(o) Flight control computers including stability and control augmentation	✓	✓	✓	✓	✓	✓				
(p) Flight display systems	✓	✓	✓	✓	✓	✓				
(q) Flight management computers	✓	✓	✓	✓	✓	✓				
(r) Head-up guidance, head-up displays	✓	✓	✓	✓	✓	✓				
(s) Navigation systems	✓	✓	✓	✓			✓	✓	✓	✓
(t) Stall warning/avoidance	✓	✓	✓	✓			✓	✓	✓	
(u) Wind shear avoidance equipment	✓	✓	✓	✓						
(v) Automatic landing aids	✓	✓	✓	✓						
(2) Airborne procedures										
(a) Holding	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(b) Air hazard avoidance. (traffic, weather)			✓	✓	✓	✓				
(c) Wind shear			✓	✓	✓	✓				
(3) Engine shutdown and parking										
(a) Engine and systems operation	✓	✓	✓	✓	✓	✓	✓	✓	✓	
(b) Parking brake operation	✓	✓	✓	✓	✓	✓	✓	✓	✓	
(4) Other as appropriate including effects of wind	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
m VISUAL SYSTEM										
(1) Functional test content requirements (Levels C and D)										
Note—The following is the minimum airport model content requirement to satisfy visual capability tests, and provides suitable visual cues to allow completion of all functions and subjective tests described in this appendix. FSTD operators are encouraged to use the model content described below for the functions and subjective tests. If all of the elements cannot be found at a single real world airport, then additional real world airports may be used. The intent of this visual scene content requirement description is to identify that content required to aid the pilot in making appropriate, timely decisions.										
(a) two parallel runways and one crossing runway displayed simultaneously; at least two runways should be lit simultaneously			✓	✓						
(b) runway threshold elevations and locations shall be modelled to provide sufficient correlation with aeroplane systems (e.g., HGS, GPS, altimeter); slopes in runways, taxiways, and ramp areas should not cause distracting or unrealistic effects, including pilot eye-point height variation			✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(c) representative airport buildings, structures and lighting			✓	✓						
(d) one useable gate, set at the appropriate height, for those aeroplanes that typically operate from terminal gates			✓	✓						
(e) representative moving and static gate clutter (e.g., other aeroplanes, power carts, tugs, fuel trucks, additional gates)			✓	✓						
(f) representative gate/apron markings (e.g., hazard markings, lead-in lines, gate numbering) and lighting			✓	✓						
(g) representative runway markings, lighting, and signage, including a wind sock that gives appropriate wind cues			✓	✓						
(h) representative taxiway markings, lighting, and signage necessary for position identification, and to taxi from parking to a designated runway and return to parking; representative, visible taxi route signage shall be provided; a low visibility taxi route (e.g. Surface Movement Guidance Control System, follow-me truck, daylight taxi lights) should also be demonstrated			✓	✓						
(i) representative moving and static ground traffic (e.g., vehicular and aeroplane)			✓	✓						
(j) representative depiction of terrain and obstacles within 25 NM of the reference airport			✓	✓						
(k) representative depiction of significant and identifiable natural and cultural features within 25 NM of the reference airport **Note**—This refers to natural and cultural features that are typically used for pilot orientation in flight. Outlying airports not intended for landing need only provide a reasonable facsimile of runway orientation.			✓	✓						
(l) representative moving airborne traffic			✓	✓						
(m) appropriate approach lighting systems and airfield lighting for a VFR circuit and landing, non-precision approaches and landings, and Category I, II and III precision approaches and landings			✓	✓						
(n) representative gate docking aids or a marshaller			✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(2) Functional test content requirements (Levels A and B) **Note**—The following is the minimum airport model content requirement to satisfy visual capability tests, and provides suitable visual cues to allow completion of all functions and subjective tests described in this appendix. FSTD operators are encouraged to use the model content described below for the functions and subjective tests.										
(a) representative airport runways and taxiways	✓	✓					✓	✓	✓	
(b) runway definition	✓	✓					✓	✓	✓	
(c) runway surface and markings	✓	✓					✓	✓	✓	
(d) lighting for the runway in use including runway edge and centreline lighting, visual approach aids and approach lighting of appropriate colours	✓	✓					✓	✓	✓	
(e) representative taxiway lights	✓	✓								
(3) Visual scene management										
(a) Runway and approach lighting intensity for any approach should be set at an intensity representative of that used in training for the visibility set; all visual scene light points should fade into view appropriately	✓	✓	✓	✓						
(b) The directionality of strobe lights, approach lights, runway edge lights, visual landing aids, runway centre line lights, threshold lights, and touchdown zone lights on the runway of intended landing should be realistically replicated	✓	✓	✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(4) Visual feature recognition **Note—**Tests 4(a) through 4(g) below contain the minimum distances at which runway features should be visible. Distances are measured from runway threshold to an aeroplane aligned with the runway on an extended 3-degree glide slope in suitable simulated meteorological conditions. For circling approaches, all tests below apply both to the runway used for the initial approach and to the runway of intended landing										
(a) Runway definition, strobe lights, approach lights, and runway edge white lights from 8 km (5 sm) of the runway threshold	✓	✓	✓	✓				✓	✓	
(b) Visual Approach Aids lights from 8 km (5 sm) of the runway threshold			✓	✓						
(c) Visual Approach Aids lights from 5 km (3 sm) of the runway threshold	✓	✓						✓	✓	
(d) Runway centreline lights and taxiway definition from 5 km (3 sm)	✓	✓	✓	✓				✓	✓	
(e) Threshold lights and touchdown zone lights from 3 km (2 sm)	✓	✓	✓	✓				✓	✓	
(f) Runway markings within range of landing lights for night scenes as required by the surface resolution test on day scenes	✓	✓	✓	✓				✓	✓	
(g) For circling approaches, the runway of intended landing and associated lighting should fade into view in a non-distracting manner	✓	✓	✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(5) Airport model content										
Minimum of three specific airport scenes as defined below;										
(a) terminal approach area										
A accurate portrayal of airport features is to be consistent with published data used for aeroplane operations			✓	✓						
B all depicted lights should be checked for appropriate colours, directionality, behaviour and spacing (e.g., obstruction lights, edge lights, centre line, touchdown zone, VASI, PAPI, REIL and strobes)			✓	✓						
C depicted airport lighting should be selectable via controls at the instructor station as required for aeroplane operation			✓	✓						
D selectable airport visual scene capability at each model demonstrated for:			✓	✓						
(i) night										
(ii) twilight										
(iii) day										
E (i) ramps and terminal buildings which correspond to an operator's LOFT and LOS scenarios			✓	✓						
(ii) terrain- appropriate terrain, geographic and cultural features										
(iii) dynamic effects - the capability to present multiple ground and air hazards such as another aeroplane crossing the active runway or converging airborne traffic; hazards should be selectable via controls at the instructor station			✓ ✓	✓ ✓						
(iv) illusions - operational visual scenes which portray representative physical relationships known to cause landing illusions, for example short runways, landing approaches over water, uphill or downhill runways, rising terrain on the approach path and unique topographic features			✓	✓						
Note - Illusions may be demonstrated at a generic airport or specific aerodrome.										

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(6) Correlation with aeroplane and associated equipment										
(a) visual system compatibility with aerodynamic programming	✓	✓	✓	✓				✓	✓	
(b) visual cues to assess sink rate and depth perception during landings. Visual cueing sufficient to support changes in approach path by using runway perspective. Changes in visual cues during take-off and approach should not distract the pilot		✓	✓	✓				✓	✓	
(c) accurate portrayal of environment relating to flight simulator attitudes	✓	✓	✓	✓				✓	✓	
(d) the visual scene should correlate with integrated aeroplane systems, where fitted (e.g. terrain, traffic and weather avoidance systems and Head-up Guidance System (HGS))			✓	✓						
(e) representative visual effects for each visible, ownship, aeroplane external light		✓	✓	✓						
(f) the effect of rain removal devices should be provided			✓	✓						
(7) Scene quality										
(a) surfaces and textural cues should be free from apparent quantization (aliasing)			✓	✓						
(b) system capable of portraying full colour realistic textural cues			✓	✓						
(c) the system light points should be free from distracting jitter, smearing or streaking	✓	✓	✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(d) demonstration of occulting through each channel of the system in an operational scene	✓	✓								
(e) demonstration of a minimum of ten levels of occulting through each channel of the system in an operational scene			✓	✓						
(f) system capable of providing focus effects that simulate rain and light point perspective growth			✓	✓						
(g) system capable of six discrete light step controls (0-5)	✓	✓	✓	✓						
(8) Environmental effects										
(a) the displayed scene should correspond to the appropriate surface contaminants and include runway lighting reflections for wet, partially obscured lights for snow, or suitable alternative effects			✓	✓						
(b) Special weather representations which include the sound, motion and visual effects of light, medium and heavy precipitation near a thunderstorm on take-off, approach and landings at and below an altitude of 600 m (2 000 ft) above the aerodrome surface and within a radius of 16 km (10 sm) from the aerodrome			✓	✓						
(c) in - cloud effects such as variable cloud density, speed cues and ambient changes should be provided			✓	✓						
(d) the effect of multiple cloud layers representing few, scattered, broken and overcast conditions giving partial or complete obstruction of the ground scene			✓	✓						
(e) gradual break-out to ambient visibility/RVR, defined as up to 10% of the respective cloud base or top, 20 ft ≤ transition layer ≤200 ft; cloud effects should be checked at and below a height of 600 m (2 000 ft) above the aerodrome and within a radius of 16 km (10 sm) from the airport			✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(f) visibility and RVR measured in terms of distance. Visibility/RVR should be checked at and below a height of 600 m (2 000 ft) above the aerodrome and within a radius of 16 km (10 sm.) from the airport	✓	✓	✓	✓						
(g) patchy fog giving the effect of variable RVR Note – Patchy fog is sometimes referred to as patchy RVR.			✓	✓						
(h) effects of fog on aerodrome lighting such as halos and defocus			✓	✓						
(i) effect of ownship lighting in reduced visibility, such as reflected glare, to include landing lights, strobes, and beacons			✓	✓						
(j) wind cues to provide the effect of blowing snow or sand across a dry runway or taxiway should be selectable from the instructor station			✓	✓						
(9) Instructor controls of:										
(a) Environmental effects, e.g. cloud base, cloud effects, cloud density, visibility in kilometres/statute miles and RVR in metres/feet	✓	✓	✓	✓				✓	✓	
(b) Airport/aerodrome selection	✓	✓	✓	✓			✓	✓	✓	
(c) Airport/aerodrome lighting including variable intensity where appropriate	✓	✓	✓	✓				✓(4)	✓(4)	
(d) Dynamic effects including ground and flight traffic	✓	✓	✓	✓						
(10) Night visual scene capability	✓	✓	✓	✓						
(11) Twilight visual scene capability			✓	✓						
(12) Daylight visual scene capability			✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
n MOTION EFFECTS										
The following specific motion effects are required to indicate the threshold at which a flight crewmember should recognise an event or situation. Where applicable below, flight simulator pitch, side loading and directional control characteristics should be representative of the aeroplane as a function of aeroplane type: (1) Effects of runway rumble, oleo deflections, ground speed, uneven runway, runway centreline lights and taxiway characteristics (a) After the aeroplane has been pre-set to the takeoff position and then released, taxi at various speeds, first with a smooth runway, and note the general characteristics of the simulated runway rumble effects of oleo deflections. Next repeat the manoeuvre with a runway roughness of 50%, then finally with maximum roughness. The associated motion vibrations should be affected by ground speed and runway roughness. If time permits, different gross weights can also be selected as this may also affect the associated vibrations depending on aeroplane type. The associated motion effects for the above tests should also include an assessment of the effects of centreline lights, surface discontinuities of uneven runways, and various taxiway characteristics	*	✓	✓	✓						
(2) Buffets on the ground due to spoiler/speedbrake extension and thrust (a) Perform a normal landing and use ground spoilers and reverse thrust – either individually or in combination with each other – to decelerate the simulated aeroplane. Do not use wheel braking so that only the buffet due to the ground spoilers and thrust reversers is felt.	*	✓	✓	✓						
(3) Bumps associated with the landing gear (a) Perform a normal take-off paying special attention to the bumps that could be perceptible due to maximum oleo extension after lift-off. When the landing gear is extended or retracted, motion bumps could be felt when the gear locks into position	*	✓	✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(4) Buffet during extension and retraction of landing gear (a) Operate the landing gear. Check that the motion cues of the buffet experienced are reasonably representative of the actual aeroplane	*	✓	✓	✓						
(5) Buffet in the air due to flap and spoiler/speedbrake extension and approach to stall buffet (a) First perform an approach and extend the flaps and slats, especially with airspeeds deliberately in excess of the normal approach speeds. In cruise configuration verify the buffets associated with the spoiler/speedbrake extension. The above effects could also be verified with different combinations of speedbrake/flap/gear settings to assess the interaction effects	*	✓	✓	✓						
(6) Approach to stall buffet (a) Conduct an approach-to-stall with engines at idle and a deceleration of 1 knot/second. Check that the motion cues of the buffet, including the level of buffet increase with decreasing speed, are reasonably representative of the actual aeroplane	*	✓	✓	✓						
(7) Touchdown cues for main and nose gear (a) Fly several normal approaches with various rates of descent. Check that the motion cues of the touchdown bump for each descent rate are reasonably representative of the actual aeroplane	*	✓	✓	✓						
(8) Nose wheel scuffing (a) Taxi the simulated aeroplane at various ground speeds and manipulate the nose wheel steering to cause yaw rates to develop which cause the nose wheel to vibrate against the ground (“scuffing”). Evaluate the speed/nose wheel combination needed to produce scuffing and check that the resultant vibrations are reasonably representative of the actual aeroplane	*	✓	✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(9) Thrust effect with brakes set (a) With the simulated aeroplane set with the brakes on at the take-off point, increase the engine power until buffet is experienced and evaluate its characteristics. This effect is most discernible with wing mounted engines. Confirm that the buffet increases appropriately with increasing engine thrust	*	✓	✓	✓						
(10) Mach and manoeuvre buffet (a) With the simulated aeroplane trimmed in 1 g flight while at high altitude, increase the engine power such that the Mach number exceeds the documented value at which Mach buffet is experienced. Check that the buffet begins at the same Mach number as it does in the aeroplane (for the same configuration) and that buffet levels are a reasonable representation of the actual aeroplane. In the case of some aeroplanes, manoeuvre buffet could also be verified for the same effects. Manoeuvre buffet can occur during turning flight at conditions greater than 1 g, particularly at higher altitudes	*	✓	✓	✓						
(11) Tyre failure dynamics (a) Dependent on aeroplane type, a single tire failure may not necessarily be noticed by the pilot and therefore there should not be any special motion effect. There may possibly be some sound and/or vibration associated with the actual tire losing pressure. With a multiple tire failure selected on the same side the pilot may notice some yawing which should require the use of the rudder to maintain control of the aeroplane			✓	✓						
(12) Engine malfunction and engine damage (a) The characteristics of an engine malfunction as stipulated in the malfunction definition document for the particular FSTD should describe the special motion effects felt by the pilot. The associated engine instruments should also vary according to the nature of the malfunction	*	✓	✓	✓						

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
(13) Tail strikes and pod strikes	*	✓	✓	✓						
(a) Tail-strikes can be checked by over-rotation of the aeroplane at a speed below V_r whilst performing a takeoff. The effects can also be verified during a landing. The motion effect should be felt as a noticeable bump. If the tail strike affects the aeroplane's angular rates, the cueing provided by the motion system should have an associated effect.										
(b) Excessive banking of the aeroplane during its take-off/landing roll can cause a pod strike. The motion effect should be felt as a noticeable bump. If the pod strike affects the aeroplane's angular rates, the cueing provided by the motion system should have an associated effect	*	✓	✓	✓						
o SOUND SYSTEM										
(1) The following checks should be performed during a normal flight profile with motion										
(a) precipitation			✓	✓						
(b) rain removal equipment			✓	✓						
(c) significant aeroplane noises perceptible to the pilot during normal operations, such as engine, flaps, gear, spoiler extension/retraction, thrust reverser to a comparable level of that found in the aeroplane	✓	✓	✓	✓				✓	✓	
(d) abnormal operations for which there are associated sound cues including, but not limited to, engine malfunctions, landing gear/tire malfunctions, tail and engine pod strike and pressurization malfunction			✓	✓						
(e) sound of a crash when the flight simulator is landed in excess of limitations			✓	✓						
(f) significant engine/propeller noise perceptible to pilot during normal operations							✓	✓	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD		FNPT			BITD
	A	B	C	D	1	2	I	II	MCC	
p SPECIAL EFFECTS										
(1) Braking Dynamics (a) representative brake failure dynamics (including antiskid) and decreased brake efficiency due to high brake temperatures based on aeroplane related data. These representations should be realistic enough to cause pilot identification of the problem and implementation of appropriate procedures. FSTD pitch, side-loading and directional control characteristics should be representative of the aeroplane			✓	✓						
(2) Effects of Airframe and Engine Icing (a) See Appendix 1 to JAR FSTD A.030 par 2.1(t).			✓	✓						
NOTE- For Level ‘A’, an asterisk (*****) denotes that the appropriate effect is required to be present.										
NOTE -It is accepted that tests will only apply to FTD Level 1 if that system and flight condition is simulated. It is intended that the tests listed below should be conducted in automatic flight. Where automatic flight is not possible and pilot manual handling is required, the FTD shall be at least controllable to permit the conduct of the flight.										

Notes

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

(1) Takeoff characteristics sufficient to commence the airborne exercises

(2) For FNPT 1 and BITD only if multi-engine

(3) Only trim change required

(4) For FNPT, variable intensity airport lighting not required.

Appendix 1 to ACJ No. 1 to JAR-FSTD A.030 (interpretative material)
Validation Test Tolerances

1 Background

1.1 The tolerances listed in ACJ No. 1 of JAR-FSTD A.030 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) Flight-test is subject to many sources of potential error, e.g. instrumentation errors and atmospheric disturbance during data collection;

(b) Data that exhibit rapid variation or noise may also be difficult to match;

(c) Engineering 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; 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) Hardware (avionics units and flight controls);

(b) Iteration rates;

(c) Execution order;

(d) Integration methods;

(e) Processor architecture;

(f) Digital drift:

(1) Interpolation methods;

(2) Data handling differences;

(3) Auto-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) Flight test data could not reasonably be made available;

(b) Data from engineering simulations made up only a small portion of the overall validation data set;

(c) Key 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) Flight-test data are often not available due to sound technical reasons;

(b) Alternative technical solutions are being advanced;

(c) Cost is an ever-present issue.

1.10 Guidelines are therefore needed for the application of tolerances to engineering-simulator-generated validation data.

2 Non-Flight-Test Tolerances

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 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.

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Appendix 2 to ACJ No.1 to JAR-FSTD A.030
Validation Data Roadmap

1 General

1.1 Aeroplane manufacturers or other sources of data should supply a validation data roadmap (VDR) document as part of the data package. A VDR document contains guidance material from the aeroplane validation data supplier recommending the best possible sources of data to be used as validation data in the QTG. A VDR is of special value in the cases of requests for 'interim' qualification, requests for qualification of simulations of aeroplanes certificated prior to 1992, and for qualification of alternate engine or avionics fits (see Appendices 3 and 4 of this ACJ). A VDR should be submitted to the authority as early as possible in the planning stages for any FSTD planned for qualification to the standards contained herein. The respective State 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 Joint Aviation Authorities' FSTD Steering Group 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 aeroplane handling qualities and performance. The document should include rationale or explanation in cases where data or parameters are missing, engineering simulation data are to be used, flight test methods require explanation, etc., together with a brief narrative describing the cause/effect of any deviation from data requirements. Additionally, the document should make reference to other appropriate sources of validation data (e.g., sound and vibration data documents).

1.3 Table 1, below, depicts a generic roadmap matrix identifying sources of validation data for an abbreviated list of tests. A complete matrix should address all test conditions.

1.4 Additionally, two examples of 'rationale pages' are presented in Appendix F of the IATA Flight Simulator Design & Performance Data Requirements document. These illustrate the type of aeroplane and avionics configuration information and descriptive engineering rationale used to describe data anomalies, provide alternative data, or provide an acceptable basis to the authority for obtaining deviations from QTG validation requirements.

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Appendix 2 to ACJ No. 1 to JAR-FSTD A.030 (continued)

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 Roadmap

Appendix 3 to ACJ No.1 to JAR-FSTD 1A.030
Data Requirements for Alternate Engines - Approval Guidelines (Applicable to FFS only)

1 Background

1.1 For a new aeroplane type, the majority of flight validation data are collected on the first aeroplane configuration with a 'baseline' engine type. These data are then used to validate all FSTDs representing that aeroplane type.

1.2 In the case of FSTDs representing an aeroplane with engines of a different type than the baseline, or a different thrust rating than that of previously validated configurations, additional flight test validation data may be needed.

1.3 When a FSTD with additional and/or alternate engine fits is to be qualified, the QTG should contain tests against flight test validation data for selected cases where engine differences are expected to be significant.

2 Approval Guidelines for validating alternate Engine Fits

2.1 The following guidelines apply to FSTDs representing aeroplanes with an alternate engine fit; or, with more than one engine type or thrust rating.

2.2 Validation tests can be segmented into those that are dependent on engine type or thrust rating and those that are not.

2.3 For tests that are independent of engine type or thrust rating, the QTG can be based on validation data from any engine fit. Tests in this category should be clearly identified.

2.4 For tests which are affected by engine type, the QTG should contain selected engine-specific flight test data sufficient to validate that particular aeroplane-engine configuration. These effects may be due to engine dynamic characteristics, thrust levels and/or engine-related aeroplane configuration changes. This category is primarily characterised by differences between different engine manufacturers' products, but also includes differences due to significant engine design changes from a previously flight-validated configuration within a single engine type. See Table 1 below for a list of acceptable tests.

2.5 For those cases where the engine type is the same, but the thrust rating exceeds that of a previously flight-validated configuration by five percent (5%) or more, or is significantly less than the lowest previously validated rating (a decrease of fifteen percent (15%) or more), the QTG should contain selected engine-specific flight test data sufficient to validate the alternate thrust level. See Table 1 below for a list of acceptable tests. However, if an aeroplane manufacturer, qualified as a validation data supplier under the guidelines of ACJ nos1 and 2 to JAR-FSTD A.030(c)(1), shows that a thrust increase greater than 5% will not significantly change the aeroplane's flight characteristics, and then flight validation data are not needed.

2.6 No additional flight test data are required for thrust ratings which are not significantly different from that of the baseline or other applicable flight-validated engine-airframe configuration (i.e., less than 5% above or 15% below), except as noted in paragraphs 2.7 and 2.8, below. As an example, for a configuration validated with 50,000 pound-thrust-rated engines, no additional flight validation data are required for ratings between 42,500 and 52,500 lbs. If multiple engine ratings are tested concurrently, only test data for the highest rating are needed.

2.7 Throttle calibration data (i.e., commanded power setting parameter versus throttle position) should be provided to validate all alternate engine types, and engine thrust ratings which are higher or lower than a previously validated engine. Data from a test aeroplane or engineering test bench are acceptable, provided the correct engine controller (both hardware and software) is used.

2.8 The validation data described in paragraphs 2.4 through 2.7 above should be based on flight test data, except as noted in those paragraphs, or where other data are specifically allowed within ACJ No. 1 to JAR-FSTD 1A.030(c)(1). However, if certification of the flight characteristics of the aeroplane with a new thrust rating (regardless of percentage change) does require certification flight testing with a comprehensive stability and control flight instrumentation package, then the conditions in table 1 below should be obtained from flight testing and presented in the QTG. Conversely, flight test data other than throttle calibration as described above are not required if the new thrust rating is certified on the aeroplane without need for a comprehensive stability and control flight instrumentation package.

2.9 As a supplement to the engine-specific flight tests of table 1 below and baseline engine-independent tests, additional engine-specific engineering validation data should be provided in the QTG, as appropriate, to facilitate running the entire QTG with the alternate engine configuration. The specific validation tests to be supported by engineering simulation data should be agreed with the authority well in advance of FSTD evaluation.

2.10 A matrix or 'roadmap' should be provided with the QTG indicating the appropriate validation data source for each test (see Appendix 2 of this ACJ).

The following flight test conditions (one per test number) are appropriate and should be sufficient to validate implementation of alternate engine fits in a FSTD.

TEST NUMBER	TEST DESCRIPTION		ALTERNATE ENGINE TYPE	ALTERNATE THRUST RATING [2]
1.b.1, 4	Normal take-off/ground acceleration time & distance		X	X
1.b.2	$V_{mcg,}$ if performed for aeroplane certification		X	X
1.b.5	Engine-out take-off	Either test may be performed.	X	
1.b.8	Dynamic engine failure after take-off			
1.b.7	Rejected take-off if performed for aeroplane certification		X	
1.d.3	Cruise performance		X	
1.f.1, 2	Engine acceleration and deceleration		X	X
2.a.8	Throttle calibration [1]		X	X
2.c.1	Power change dynamics (acceleration)		X	X
2.d.1	V_{mca} if performed for aeroplane certification		X	X
2.d.5	Engine inoperative trim		X	X
2.e.1	Normal landing		X	

[1] Should be provided for all changes in engine type or thrust rating (see paragraph 2.7, above).
[2] See paragraphs 2.5 through 2.8 above for a definition of applicable thrust ratings.

Note: this table does not take in to consideration additional configuration settings and control laws.

Table 1: Alternate Engine Validation Flight Tests

Appendix 4 to ACJ No.1 to JAR-FSTD A.030
Data Requirements for Alternate Avionics (Flight-related Computers & Controllers) – Approval Guidelines

1. Background

1.1 For a new aeroplane type, the majority of flight validation data are collected on the first aeroplane configuration with a 'baseline' flight-related avionics ship-set (see paragraph 2.2, below). These data are then used to validate all FSTDs representing that aeroplane type.

1.2 In the case of FSTDs representing an aeroplane with avionics of a different hardware design than the baseline, or a different software revision than that of previously validated configurations, additional validation data may be required.

1.3 When a FSTD with additional and/or alternate avionics configurations is to be qualified, the QTG should contain tests against validation data for selected cases where avionics differences are expected to be significant.

2. Approval Guidelines for Validating Alternate Avionics

2.1 The following guidelines apply to FSTDs representing aeroplanes with a revised, or more than one, avionics configuration.

2.2 The aeroplane avionics can be segmented into those systems or components that can significantly affect the QTG results and those that cannot. The following avionics are examples of those for which hardware design changes or software revision updates may lead to significant differences relative to the baseline avionics configuration: Flight control computers and controllers for engines, autopilot, braking system, nose wheel steering system, high lift system, and landing gear system. Related avionics such as stall warning and augmentation systems should also be considered. The aeroplane manufacturer should identify for each validation test, which avionics systems, if changed, could affect test results.

2.3 The baseline validation data should be based on flight test data, except where other data are specifically allowed (see ACJ No.1 and 2 to JAR-FSTD A.030(c)(1)).

2.4 For changes to an avionics system or component that cannot affect MQTG validation test results, the QTG test can be based on validation data from the previously validated avionics configuration.

2.5 For changes to an avionics system or component that could affect an QTG validation test, but where that test is not affected by this particular change (e.g., the avionics change is a BITE update or a modification in a different flight phase), the QTG test can be based on validation data from the previously-validated avionics configuration. The aeroplane manufacturer should clearly state that this avionics change does not affect the test.

2.6 For an avionics change which affects some tests in the QTG, but where no new functionality is added and the impact of the avionics change on aeroplane response is a small, well-understood effect, the QTG may be based on validation data from the previously-validated avionics configuration. This should be supplemented with avionics-specific validation data from the aeroplane manufacturer's engineering simulation, generated with the revised avionics configuration. In such cases, the aeroplane manufacturer should provide a rationale explaining the nature of the change and its effect on the aeroplane response.

2.7 For an avionics change that significantly affects some tests in the QTG, especially where new functionality is added, the QTG should be based on validation data from the previously-validated avionics configuration and supplemental avionics-specific flight test data sufficient to validate the alternate avionics revision. However, additional flight validation data may not be needed if the avionics changes were certified without need for testing with a comprehensive flight instrumentation package. The aeroplane manufacturer should co-ordinate FSTD data requirements in this situation, in advance, with the authority.

2.8 A matrix or 'roadmap' should be provided with the QTG indicating the appropriate validation data source for each test (see Appendix 2 of ACJ No 1 to JAR-FSTD 1A.030).

Appendix 5 to ACJ No.1 to JAR-FSTD A.030
Transport Delay And Latency Testing Methods

1. General

1.1 The purpose of this appendix is to demonstrate how to determine the introduced transport delay through the FSTD system such that it does not exceed a specific time delay. That is, measure the transport delay from control inputs through the interface, through each of the host computer modules and back through the interface to motion, flight instrument and visual systems, and show that it is no more than the tolerances required in the validation test tables. (For Latency testing methods see para 2).

1.2 Four specific examples of transport delay are described as follows:

(a) simulation of classic non-computer controlled aircraft;

(b) simulation of computer controlled aircraft using real aircraft equipment;

(c) simulation of computer controlled aircraft using software emulation of aircraft equipment;

(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 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 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 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 (See figure 4A). The display manufacturer shall provide this delay time.

Appendix 5 to ACJ No. 1 to JAR-FSTD A.030 (continued)

1.12 Recorded signals. The signals recorded to conduct the transport delay calculations should be explained on a schematic block diagram. The FSTD manufacturer should also provide an explanation of why each signal was selected and how they relate to the above descriptions.

1.13 Interpretation of results. It is normal that FSTD results vary over time from test to test. This can easily be explained by a simple factor called 'sampling uncertainty.' All FSTDs run at a specific rate where all modules are executed sequentially in the host computer. The flight controls input can occur at any time in the iteration, but these data will not be processed before the start of the new iteration. For a FSTD running at 60 Hz a worst-case difference of 16·67 msec can be expected. Moreover, in some conditions, the host computer and the visual system do not run at the same iteration rate, therefore the output of the host computer to the visual will not always be synchronised.

1.14 The transport delay test should account for the worst case mode of operation of the visual system. The tolerance is as required in the validation test tables and motion response shall occur before the end of the first video scan containing new information.

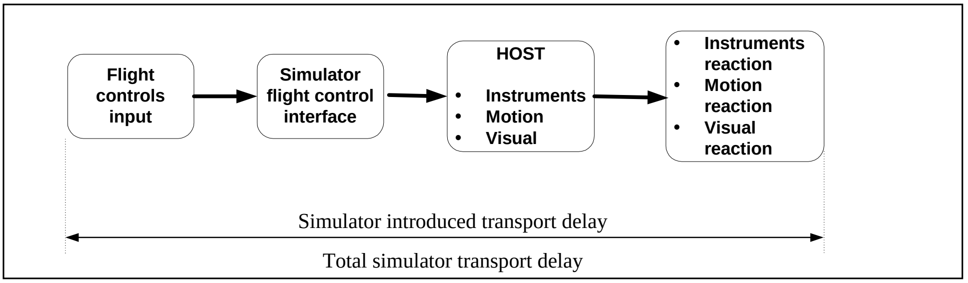

Figure 1: Transport Delay for simulation of classic non-computer controlled aircraft

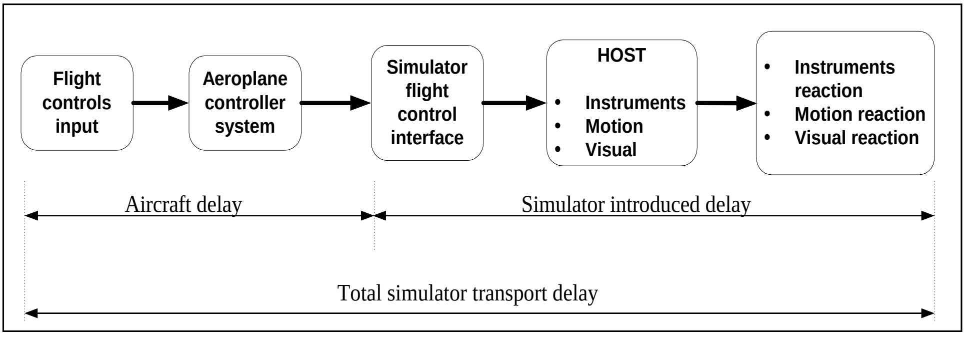

Figure 2: Transport Delay for simulation of computer controlled aircraft using real aircraft equipment

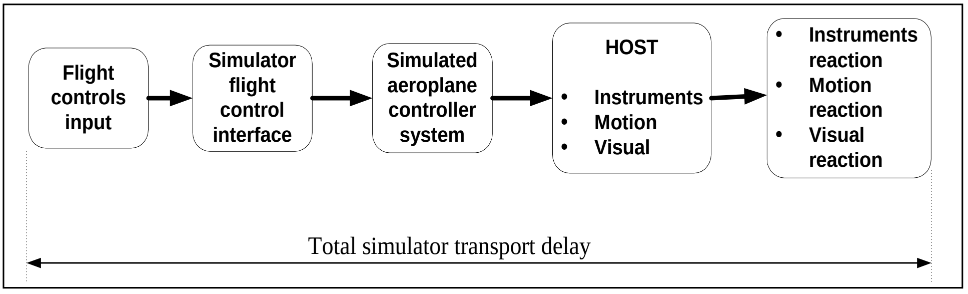

Figure 3: Transport Delay for simulation of computer controlled aircraft using software emulation of aircraft equipment

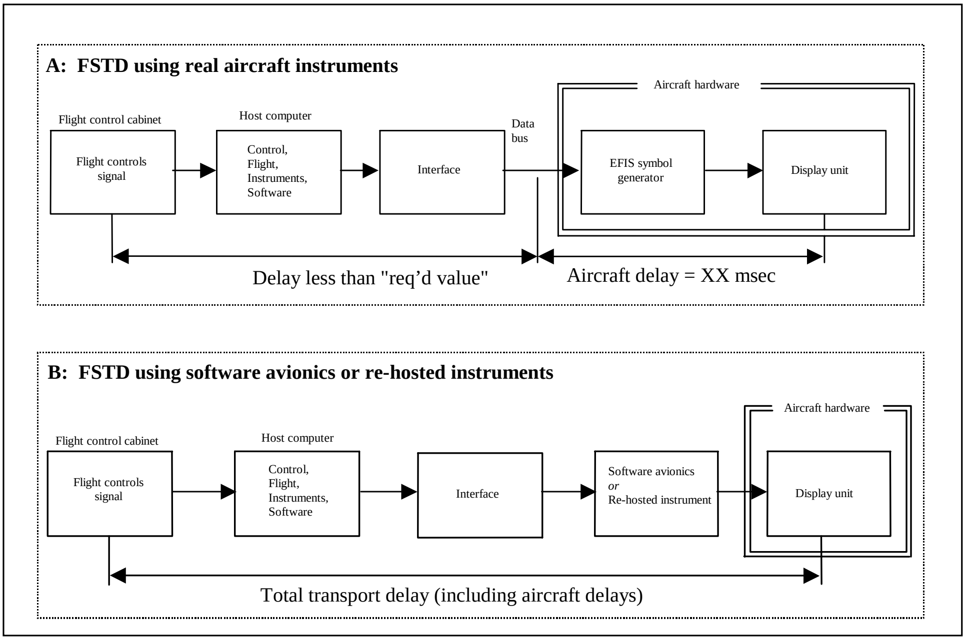

Figure 4A and 4B: Transport delay for simulation of aircraft using real or re-hosted instrument drivers

2. Latency Test Methods

2.1 The visual system, flight deck instruments and initial motion system response shall respond to abrupt pitch, roll and yaw inputs from the pilot's position within the specified time, but not before the time, when the aeroplane would respond under the same conditions. The objective of the test is to compare the recorded response of the FSTD to that of the actual aeroplane data in the take-off, cruise and landing configuration for rapid control inputs in all three rotational axes. The intent is to verify that the FSTD system response does not exceed the specified time (this does not include aeroplane response time as per the manufacturer's data) and that the motion and visual cues relate to actual aeroplane responses. For aeroplane response, acceleration in the appropriate corresponding rotational axis is preferred.

2.2 Interpretation of results. It is normal that FSTD results vary over time from test to test. This can easily be explained by a simple factor called 'sampling uncertainty.' All FSTDs run at a specific rate where all modules are executed sequentially in the host computer. The flight controls input can occur at any time in the iteration, but these data will not be processed before the start of the new iteration. For a FSTD running at 60 Hz a worst-case difference of 16·67 msec can be expected. Moreover, in some conditions, the host computer and the visual system do not run at the same iteration rate, therefore the output of the host computer to the visual will not always be synchronised.

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Appendix 6 to ACJ No.1 to JAR-FSTD A.030
Recurrent Evaluations - Validation Test Data Presentation

1. Background

1.1 During the initial evaluation of a 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 authority are looking for any change in the FSTD performance since initial qualification.

2. Recurrent Evaluation Test Results Presentation

2.1 To promote a more efficient recurrent evaluation, FSTD operators are encouraged to over-plot recurrent validation test results with MQTG FSTD results recorded during the initial evaluation and as amended. Any change in a validation test will be readily apparent. In addition to plotting recurrent validation test and MQTG results, operators may elect to plot reference data as well.

2.2 There 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 ACJ), which 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.

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Appendix 7 to ACJ No.1 to JAR-FSTD A.030
Applicability of JAR-STD Amendments to FSTD Data Packages for Existing Aeroplanes

Except where specifically indicated otherwise within ACJ No 1 to JAR-FSTD A.030 Para 2.3, validation data for QTG objective tests are expected to be derived from aeroplane flight-testing.

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

For types of aeroplanes first entering into service after the publication of a new amendment of JAR-FSTD A, the provision of acceptable data to support the FSTD qualification process is a matter of planning and regulatory agreement (see ACJ No. 1 to JAR-FSTD A.045 New Aeroplane FSTD Qualification).

For aeroplanes certificated prior to the release of the current amendment of JAR FSTD A, it may not always be possible to provide the required data for any new or revised objective test cases compared to the previous amendments. After certification, manufacturers do not normally keep flight test aeroplanes available with the required instrumentation to gather additional data. In the case of flight test data gathered by independent data providers, it is most unlikely that the test aeroplane will still be available.

Notwithstanding the above discussion, except where other types of data are already acceptable (see, for example, ACJ Nos 1 and 2 to JAR-FSTD A.030(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) as defined in Flight test at an alternate but near equivalent condition/configuration.

(b) Data from an audited engineering simulation ACJ JAR-FSTD A.005 Para 1.1.e from an acceptable source (for example meets the guidelines laid out in ACJ No 1 to JAR-FSTD A.030(c)(1) Para 2), or as used for aircraft certification.

(c) Aeroplane Performance Data as defined in ACJ JAR-FSTD A.005 Para 1.1.b or other approved published sources (e.g., Production flight test schedule) for the following tests:

i. 1c1 Normal climb, all engines

ii. 1c2 one engine inoperative 2nd segment climb

iii. 1c3 one engine inoperative en-route climb

iv. 1c4 one engine inoperative approach climb for aeroplanes with icing accountability

v. 1e3 stopping distance, wheel brakes, wet runway, and test

vi. 1e4 stopping distance, wheel brakes, icy runway

(d) Where 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 concerned taking into consideration the level of qualification sought for the FSTD

vii. Unpublished but acceptable sources e.g., calculations, simulations, video or other simple means of flight test analysis or recording

viii. Footprint test data from the actual training FSTD requiring qualification validated by NAA 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. An example might be a VMCG test, where the flight test engine and thrust profile do not match the simulated engine. The VMCG test could be run twice, once with the flight test thrust profile as an input and a second time with a fully integrated response to a fuel cut on the simulated engine.

For aeroplanes certified prior to the date of issue of an amendment, an operator may, after reasonable attempts have failed to obtain suitable flight test data, indicate in the MQTG where flight test data are unavailable or unsuitable for a specific test. For each case, where the preferred data are not available, a rationale should be provided laying out the reasons for the non-compliance and justifying the alternate data and or test(s).

Appendix 7 to ACJ No. 1 to JAR-FSTD A.030 (continued)

These rationales should be clearly recorded within the Validation Data Road map (VDR) in accordance with and as defined in Appendix 2 to ACJ No. 1 to JAR-FSTD A.030.

It should be recognised that there may come a time when there are so little compatible flight test data available that new flight test may be required to be gathered.

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Appendix 8 to ACJ No. 1 to JAR-FSTD A.030
General technical requirements for FSTD Qualification Levels

This Appendix summarises the general technical requirements for Flight Simulators levels A, B, C and D, FTD levels 1 and 2, FNPT levels I, II and IIMCC, and BITD.

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Appendix 8 to ACJ No. 1 to JAR-FSTD A.030 (continued)

Table 1 – General technical requirements for JAA Level A, B, C and D Full Flight Simulators

Qualification Level	General Technical Requirements
A	The lowest level of flight simulator technical complexity. An enclosed full-scale replica of the aeroplane cockpit/flight deck including simulation of all systems, instruments, navigational equipment, communications and caution and warning systems. An instructor's station with seat shall be provided. Seats for the flight crewmembers and two seats for inspectors/observers shall also be provided. Control forces and displacement characteristics shall correspond to that of the replicated aeroplane and they shall respond in the same manner as the aeroplane under the same flight conditions. The use of class specific data tailored to the specific aeroplane type with fidelity sufficient to meet the objective tests, functions and subjective tests is allowed. Generic ground effect and ground handling models are permitted. Motion, visual and sound systems sufficient to support the training, testing and checking credits sought are required. The visual system shall provide at least 45 degrees horizontal and 30 degrees vertical field of view per pilot. The response to control inputs shall not be greater than 300 milliseconds more than that experienced on the aircraft.
B	As for Level A plus: Validation flight test data shall 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 be derived from validation flight test data.
C	The second highest level of flight simulator fidelity. As for Level B plus: A daylight/twilight/night visual system is required with a continuous, cross-cockpit, minimum collimated visual field of view providing each pilot with 180 degrees horizontal and 40 degrees vertical field of view. A six degrees of freedom motion system shall be provided. The sound simulation shall include the sounds of precipitation and other significant aeroplane noises perceptible to the pilot and shall be able to reproduce the sounds of a crash landing. The response to control inputs shall not be greater than 150 milliseconds more than that experienced on the airplane. Windshear simulation shall be provided.
D	The highest level of flight simulator fidelity. As for Level C plus: There shall be complete fidelity of sounds and motion buffets.

Table 2 – General technical requirements for JAA Level 1 and 2 FTDs

Qualification Level	General Technical Requirements
1	Type specific with at least 1 system fully represented. Enclosed or open flight deck. Choice of systems simulated is the responsibility of the organisation seeking approval or re-approval for the course. The aeroplane system simulated shall comply with the relevant subjective and objective tests relevant to that system.
2	Type specific device with all applicable systems fully represented. An enclosed flight deck with an onboard instructor station. Type specific or generic flight dynamics (but shall be representative of aircraft performance). Primary flight controls which control the flight path and be broadly representative of airplane control characteristics. Significant sounds. Control of atmospheric conditions. Navigation Data Base sufficient to support simulated aeroplane systems.

Table 3A - General technical requirements for JAA Type I FNPTs

Qualification Level	General Technical Requirements
FNPT Type I	A cockpit/flight deck sufficiently enclosed to exclude distraction, which will replicate that of the aeroplane or class of aeroplane simulated and in which the navigation equipment, switches and the controls will operate as, and represent those in, that aeroplane or class of aeroplane. An instructor's station with seat shall be provided and shall provide an adequate view of the crewmembers panels and station. Effects of aerodynamic changes for various combinations of drag and thrust normally encountered in flight, including the effect of change in aeroplane attitude, sideslip, altitude, temperature, gross mass, centre of gravity location and configuration. Complete navigational data for at least 5 different European airports with corresponding precision and non-precision approach procedures including current updating within a period of 3 months. Stall recognition device corresponding to that of the replicated aeroplane or class of aeroplane.

Appendix 8 to ACJ No. 1 to JAR-FSTD A.030 (continued)

Table 3B - General technical requirements for JAA Type II FNPTs

Qualification Level	General Technical Requirements
FNPT Type II	As for Type I with the following additions or amendments: An enclosed flight deck, including the instructor's station. Crew members' seats shall be provided with sufficient adjustment to allow the occupant to achieve the design eye reference position appropriate to the aeroplane or class of aeroplane and for the visual system to be installed to align with that eye position. Control forces and control travels which respond in the same manner under the same flight conditions as in the aeroplane or class of aeroplane being simulated. Circuit breakers shall function accurately when involved in procedures or malfunctions requiring or involving flight crew response. Aerodynamic modelling shall reflect: (a) the effects of airframe icing; (b) the rolling moment due to yawing. A generic ground handling model shall be provided to enable representative flare and touch down effects to be produced by the sound and visual systems. Systems shall be operative to the extent that it shall be possible to perform all normal, abnormal and emergency operations as may be appropriate to the aeroplane or class of aeroplanes being simulated and as required for the training. Significant cockpit/flight deck sounds. A visual system (night/dusk or day) capable of providing a field-of-view of a minimum of 45 degrees horizontally and 30 degrees vertically, unless restricted by the type of aeroplane, simultaneously for each pilot. The visual system need not be collimated. The responses of the visual system and the flight deck instruments to control inputs shall be closely coupled to provide the integration of the necessary cues.

Table 3C - General technical requirements for JAA Type II MCC FNPTs

Qualification Level	General Technical Requirements
FNPT Type II MCC	For use in Multi-Crew Co-operation (MCC) training - as for Type II with additional instrumentation and indicators as required. for MCC training and operation. Reference ACJ no. 3 to JAR-FSTD A.030.

Table 4 - General technical requirements for JAA BITDs

Qualification Level	General Technical Requirements
BITD	A student pilot's station that represents a class of aeroplane sufficiently enclosed to exclude distraction. The switches and all the controls shall be of a representative size, shape, location and shall operate as and represent those as in the simulated class of aeroplane. In addition to the pilot's seat, suitable viewing arrangements for the instructor shall be provided allowing an adequate view of the pilot's panels. The Control forces, control travel and aeroplane performance shall be representative of the simulated class of aeroplane. Navigation equipment for flights under IFR with representative tolerances. This shall include communication equipment. Complete navigation database for at least 3 airports with corresponding precision and non-precision approach procedures including regular updates. Engine sound shall be available. Instructor controls of atmospheric conditions and to set and reset malfunctions relating to flight instruments, navigation aids, flight controls, engine out operations (for multi engine aeroplanes only). Stall recognition device corresponding to that of the simulated class of aeroplane.

ACJ No. 2 to JAR-FSTD A.030 (interpretative material)
Guidance on Design and Qualification of Level 'A' Aeroplane 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 aeroplanes used by the general aviation community.

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

(a) Type specific data package,

(b) QTG flight test data,

(c) Motion system,

(d) Visual system,

(e) Flight controls and

(f) Aircraft parts.

Note: To attempt to reduce the cost of ownership of a JAA Level A FFS, each element has been examined in turn and with a view to relaxing the requirements where possible whilst recognising the training, checking and testing credits allowed on such a device.

2 Data package

2.1 The cost of collecting specific flight test data sufficient to provide a complete model of the aerodynamics, engines and flight controls can be significant. The use of a class specific data package which could be tailored to represent a specific type of aeroplane (e.g. PA34 to PA31) is encouraged. This may enable a well-engineered light twin baseline data package to be carefully tuned to adequately represent any one of a range of similar aeroplanes. Such work including justification and the rationale for the changes would have to be carefully documented and made available for consideration by the JAA FSTD Steering Group as part of the qualification process. Note that for this lower level of FFS, the use of generic ground handling and generic ground effect models is allowed.

2.2 However specific flight test data to meet the needs of each relevant test within the QTG will be required. Recognising the cost of gathering such data, two 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 ‘Correct Trend and Magnitude’ (CT&M) thereby avoiding the need for specific flight test data.

(c) The use of CT&M is not to be taken as an indication that certain areas of simulation can be ignored. Indeed in the class of aeroplane envisaged, that might take advantage of Level A, it is imperative that the specific characteristics are present, and incorrect effects would be unacceptable (e.g. if the aeroplane has a weak positive spiral stability, it would not be acceptable for the FFS to exhibit neutral or negative spiral stability).

ACJ No. 2 to JAR-FSTD A.030 (continued)

(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 Level A FFS, the requirements for both the primary cueing and buffet simulation have been not specified in detail. Traditionally, for primary cueing, emphasis has been laid on the numbers of axes available on the motion system. For this level of FFS, it is felt appropriate that the FFS manufacturer should be allowed to decide on the complexity of the motion system. However, during the evaluation, the motion system will be assessed subjectively to ensure that it is supporting the piloting task, including engine failures, and is, under no circumstances, providing negative cueing.

3.2 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, under no circumstances, provide negative training.

4 Visual

4.1 Other than field of view (FOV), specific technical criteria for the visual systems are not specified. The emergence of lower cost ‘raster only’ daylight systems is recognised. The adequacy of the performance of the visual system will be determined by its ability to support the flying tasks. e.g. ‘visual cueing sufficient to support changes in approach path by using runway perspective’.

4.2 The need for collimated visual optics may not always be necessary. A single channel direct viewing system would be acceptable for a FFS of a single crew aeroplane. (The risk here is that, should the aeroplane be subsequently upgraded to multi-crew, the non-collimated visual system may be unacceptable.)

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

(a) At the CAT I all weather operations Decision Height, the appropriate visual ground segment may not be ‘seen’; and

(b) During an approach, where the aeroplane goes below the ideal approach path, during the subsequent pitch-up to recover, adequate visual reference to make a landing on the runway may be lost.

5 Flight Controls

The specific requirements for flight controls remain unchanged. Because the handling qualities of smaller aeroplanes are inextricably intertwined with their flight controls, there is little scope for relaxation of the tests and tolerances. It could be argued that with reversible control systems that the on the ground static sweep should in fact be replaced by more representative ‘in air’ testing. It is hoped that lower cost control loading systems would be adequate to fulfil the needs of this level of simulation (i.e. electric).

6 Aeroplane Parts

As with any level of FSTD, the components used within the flight deck area need not be aeroplane parts; however, any parts used should be robust enough to endure the training tasks. Moreover, the Level A FFS is type specific, thus all relevant switches, instruments, controls etc. within the simulated area will be required to look and feel ‘as aeroplane’.

ACJ No. 3 to JAR-FSTD A.030 (interpretative material)
Guidance on Design and Qualification of FNPTs
See also JAR-FSTD A.030

1 Background

1.1 Traditionally training devices used by the ab-initio professional pilot schools have been relatively simple instrument flight-only aids. These devices were loosely based on the particular school's aeroplane. The performance would be approximately correct in a small number of standard configurations, however the handling characteristics could range from rudimentary to loosely representative. The instrumentation and avionics fit varied between basic and very close to the target aeroplane. The approval to use such devices as part of a training course was based on a regular subjective evaluation of the equipment and its operator by an authority inspector.

1.2 JAR-FSTD A introduces two new devices: FNPT I & FNPT II. The FNPT I device is essentially a replacement for the traditional instrument flight ground training device taking advantage of recent technologies and having a more objective design basis. The FNPT II device is the more advanced of the two defined standards and fulfils the wider requirements of the various JAR-FCL professional pilot training modules up to and including (optionally with additional features) multi-crew co-operation (MCC) training.

1.3 The currently available technologies enable such new devices to have much greater fidelity and lower life-cycle costs than was previously possible. A more objective design basis encourages better understanding and therefore modelling of the aeroplane systems, handling and performance. These advances combined with the ever upwardly spiralling costs of flying and with the environmental pressures all point towards the need for revised standards.

1.4 The FNPT II device essentially bridges the gap in design complexity between the traditional subjectively created device and the objectively based Level A FFS.

1.5 These new standards are designed to replace the highly subjective design standards and qualification methods with new objective and subjective methods, which ensure that the devices fulfil their intended goals throughout their service lives.

2 Design Standards

There are two sets of design standards specified within JAR-FSTD A, FNPT I and FNPT II, the more demanding one of which is FNPT II.

2.1 Simulated Aeroplane Configuration

Unlike FFS devices, FNPT I and FNPT II devices are intended to be representative of a class of aeroplane (although they may in fact be type specific if desired).

The configuration chosen should sensibly represent the aeroplane or aeroplanes likely to be used as part of the overall training package. Areas such as general layout, seating, instruments and avionics, control type, control force and position, performance and handling and powerplant configuration should be representative of the class of aeroplane or the aeroplane itself.

It would be in the interest of all parties to engage in early discussions with the Authority to broadly agree a suitable configuration (known as the "designated aeroplane configuration"). Ideally any such discussion would take place in time to avoid any hold-ups in the design/build/acceptance process thereby ensuring a smooth entry into service.

2.2 The Cockpit/Flight Deck

The cockpit/flight deck should be representative of the designated aeroplane configuration. For good training ambiance the cockpit/flight deck should be sufficiently enclosed for FNPT I to exclude any distractions. For an FNPT II the cockpit/flight deck should be fully enclosed. The controls, instruments and avionics controllers should be representative: touch, feel, layout, colour and lighting to create a positive learning environment and good transfer of training to the aeroplane.

2.3 Cockpit/Flight Deck Components

As with any training device, the components used within the cockpit/flight deck area do not need to be aircraft parts: however, any parts used should be representative of typical training aeroplanes and should be robust enough to endure the training tasks. With the current state of technology the use of simple CRT monitor based representations and touch screen controls would not be acceptable. The training tasks envisaged for these devices are such that appropriate layout and feel is very important: i.e. the altimeter sub-scale knob needs to be physically located on the altimeter. The use of CRTs with physical overlays incorporating operational switches/knobs/buttons replicating an aeroplane instrument panel may be acceptable.

2.4 Data

The data used to model the aerodynamics flight controls and engines should be soundly based on the "designated aeroplane configuration". It is not acceptable and would not give good training if the models merely represented a few key configurations bearing in mind the extent of the credits available.

Validation data may be derived from a specific aeroplane within a set of aeroplanes that the FNPT is intended to represent, or it may be based on information from several aeroplanes within a set/group/range ("designated aeroplane configuration"). It is recommended that the intended validation data together with a substantiation report be submitted to the Authority for evaluation and approval prior to the commencement of the manufacturing process.

2.4.1 Data Collection and Model Development

Recognizing the cost of and complexity of flight simulation models, it should be possible to generate generic class "typical" models. Such models should be continuous and vary sensibly throughout the required training flight envelope. A basic requirement for any modelling is the integrity of the mathematical equations and models used to represent the flying qualities and performance of the class of aeroplane simulated. Data to tune the generic model to represent a more specific aeroplane can be obtained from many sources without recourse to expensive flight test:

(a) Aeroplane design data

(b) Flight and Maintenance Manuals

(c) Observations on ground and in air

Data obtained on the ground and in flight can be measured and recorded using a range of simple means such as:

(a) Video

(b) Pencil and paper

(c) Stopwatch

(d) New technologies (i.e. GPS)

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

2.5 Limitations

A further possible complication is the strong interaction between the flight control forces and the effects of both the engines and the aerodynamic configuration. For this reason a simple force cueing system in which forces vary not only with position but with configuration (speed, flaps, trim) will be necessary for the FNPT II device. For an FNPT I device a force cueing system may be spring-loaded, but it should be remembered that it is vitally important that negative characteristics would not be acceptable.

It should be remembered however that whilst a simple model may be sufficient for the task, it is vitally important that negative characteristics are not present.

3 Visual

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

3.1 Other than Field-of-View (FoV) specific technical criteria for the visual systems are not specified. The emergence of lower cost raster only daylight systems is recognised. The adequacy of the performance of the visual system will be determined by its ability to support the flying tasks. e.g. "visual cueing sufficient to support changes in approach path by using runway perspective".

3.2 The need for collimated visual optics is probably not necessary. A single channel direct viewing system (single projector or a monitor for each pilot) would probably be acceptable as no training credits for landing will be available. Distortions due to non-collimation would only become significant during on ground or near to the ground operations.

3.3 The minimum specified vertical FoV of 30 deg may not be sufficient for certain tasks.

Where the FNPT does not simulate a particular aeroplane type, then the design of the out-of-cockpit/flight deck view should be matched to the visual system such that the pilot has a FoV sufficient for the training tasks.

For example during an instrument approach the pilot should be able to see the appropriate visual segment at Decision Height. Additionally where the aeroplane deviates from the permitted approach path, undue loss of visual reference should not occur during the subsequent correction in pitch.

3.4 There are two methods of establishing latency, which is the relative response of the visual system, cockpit/flight deck instruments and initial motion system response. These should be coupled closely to provide integrated sensory cues.

For a generic FNPT, a Transport Delay test is the only suitable test that demonstrates that the FNPT system does not exceed the permissible delay. If the FNPT is based upon a particular aeroplane type, either Transport Delay or Latency tests are acceptable. Response time tests check response to abrupt pitch, roll, and yaw inputs at the pilot's position is within the permissible delay, but not before the time when the aeroplane would respond under the same conditions. Visual scene changes from steady state disturbance should occur within the system dynamic response limit but not before the resultant motion onset.

The test to determine compliance with these requirements should include simultaneously recording the analogue output from the pilot's control column, wheel, and pedals, the output from the accelerometer attached to the motion system platform located at an acceptable location near the pilots' seats, the output signal to the visual system display (including visual system analogue delays), and the output signal to the pilot's attitude indicator or an equivalent test approved by the Authority. The test results in a comparison of a recording of the simulator's response with actual aeroplane response data in the take-off, cruise, and landing configuration.

The intent is to verify that the FNPT system Transport Delays or time lags are less than the permissible delay and that the motion and visual cues relate to actual aeroplane responses. For aeroplane response, acceleration in the appropriate rotational axis is preferred.

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 and interfacing through all the simulation software modules in the correct order, using a handshaking protocol, finally through the normal output interfaces to the motion system, to the visual system and instrument displays. A recordable start time for the test should be provided by a pilot flight control input. The test mode should permit normal computation time to be consumed and should not alter the flow of information through the hardware/software system.

The Transport Delay of the system is then the time between control input and the individual hardware responses. It need only be measured once in each axis

3.5 Care should be taken when using the limited processing power of the lower cost visual systems to concentrate on the key areas which support the intended uses thereby avoiding compromising the visual model by including unnecessary features e.g. moving ground traffic, marshallers. The capacity of the visual model should be directed towards:

(a) Runway surface

(b) Runway lighting systems

(c) PAPI/ VASI approach guidance aids

(d) Approach lighting systems

(e) Simple taxiway

(f) Simple large-scale ground features e.g. large bodies of water, big hills

(g) Basic environmental lighting (night/dusk)

4 Motion

Although motion is not a requirement for either an FNPT I or II, should the operator choose to have one fitted, it will be evaluated to ensure that its contribution to the overall fidelity of the device is positive. Unless otherwise stated in this document, the motion requirements are as specified for a Level A FFS, see ACJ No 2 to JAR-FSTD A.030

5 Testing / Evaluation

To ensure that any device meets its design criteria initially and periodically throughout its life a system of objective and subjective testing will be used. The subjective testing may be similar to that in use in the recent past. The objective testing methodology is drawn from that used currently on FSTD.

The validation tests specified (ACJ No 1 to JAR-FSTD A.030 par. 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.

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 FSTDs, 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.

A number of tests within the QTG have had their tolerances reduced to "Correct Trend and Magnitude" (CT&M) thereby avoiding the need for specific validation data. The use of CT&M is not to be taken as an indication that certain areas of simulation can be ignored. For such tests, the performance of the device should be appropriate and representative of the simulated designated aeroplane and should under no circumstances exhibit negative characteristics. Where CT&M is used as a tolerance, it is strongly recommended that an automatic recording system be used to "footprint" the baseline results thereby avoiding the effects of possible divergent subjective opinions during recurrent evaluations.

The subjective tests listed under "Functions and Manoeuvres" (ACJ No 1 to JAR- FSTD A.030 para. 3) should be flown out by a suitably qualified and experienced pilot.

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

(a) Training environment

(b) Freezes and repositions

(c) Navaid environment

(d) Communications

(e) Weather 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 shall be in place. Such arrangements will cover routine maintenance, the provision of satisfactory spares holdings and personnel.

6 FNPT Type I

The design standards, testing and evaluation requirements for the FNPT Type I device are less demanding than those required for a FNPT Type II device. This difference in standard is in line with the reduced JAR-FCL credits available for this type of device.

7 Additional features

Any additional features in excess of the minimum design requirements added to an FNPT Type I & II will be subject to evaluation and should meet the appropriate standards in JAR-FSTD A.

ACJ No. 4 to JAR-FSTD A.030 (interpretative material)
Guidance on Design and Qualification of BITDs
See JAR–FSTD A.030

1 Background

1.1 Traditionally training devices used by the ab-initio pilot schools have been relatively simple instrument flight-only aids. These devices were loosely based on the particular school's aeroplane. The performance would be approximately correct in a small number of standard configurations, however the handling characteristics could range from rudimentary to loosely representative. The instrumentation and avionics fit varied between basic and very close to the target aeroplane. The approval to use such devices as part of a training course was based on a regular subjective evaluation of the equipment and its operator by an Authority inspector.

1.2 JAR-FSTD A introduces two new devices, FNPT type I and FNPT type II, where the FNPT I device is essentially a replacement for the traditional instrument flight ground training device taking advantage of recent technologies and having a more objective design basis.

1.3 JAR-FSTD A sets also the requirements and guidelines for the lowest level of FSTDs by introducing BITDs. It should be clearly understood that a BITD never can replace an FNPT I. The main purpose of a BITD is to replace an old instrument training device that cannot be longer approved either due to poor fidelity or system reliability.

2 Design Standards

2.1 Unlike FFS devices, a BITD is intended to be representative of a class of aeroplane. The configuration chosen should broadly represent the aeroplane likely to be used as part of the overall training package. It would be in the interest of all parties to engage in early discussions with the Authority to broadly agree a suitable configuration, known as the 'designated aeroplane configuration'.

2.2 The student pilot station should be broadly representative of the designated aeroplane configuration and should be sufficiently enclosed to exclude any distractions.

2.3 The main instrument panel in a BITD may be displayed on a CRT. Touch screen or mouse and keyboard operation by the student pilot would not be acceptable for any instrument or system.

2.4 The standards for BITDs were developed for low cost devices and therefore were kept as simple as possible. With advances in technology the higher standards defined for FFSs and FNPTs should be used where economically possible.

3 Validation Data

3.1 The data used to model the aerodynamics and engine(s) should be soundly based on the designated aeroplane configuration. It is not acceptable if the models merely represent a few key configurations.

3.2 Recognising the cost and complexity of flight simulation models, it should be possible to generate a generic class typical model. Such models should be continuous and vary sensibly throughout the required training flight envelope. A basic principal for any modelling is the integrity of the mathematical equations and models used to represent the flying qualities and performance of the class of aeroplane simulated. Data to tune the generic model to represent a more specific aeroplane can be obtained from many sources without recourse to expensive flight test:

(a) Aeroplane design date

(b) Flight and Maintenance Manuals

(c) Observations on ground and during flight

Data obtained on ground or in flight can be measured and recorded using a range of simple means such as:

(a) Video

(b) Pencil and paper

(c) Stopwatch

(d) New technologies like GPS etc.

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

4 Limitations

A force cueing system may be spring-loaded. But it should be remembered that it is vitally important that negative characteristics would not be acceptable.

5 Testing and Evaluation

To ensure that any device meets its design criteria initially and periodically throughout its 'life' a system of objective and subjective testing will be used. The subjective testing may be similar to that in use in the recent past. The objective testing methodology is drawn from that used currently on higher level training devices.

The validation tests specified in ACJ No 1 to JAR-FSTD A.030, para. 2.3 can be flown by a suitably skilled person and the results recorded manually. However a print out of the parameters of interest is highly recommended, thereby increasing the repeatability of the achieved results.

The tolerances specified are designated to ensure that the device meets its original target criteria year after year. It is therefore important that such target data is carefully derived and values are agreed with the inspecting Authority in advance of any formal qualification process. For initial qualification, it is highly desirable that the device meets its design criteria within the listed tolerances, however the tolerances contained in this document are specifically intended to be used to ensure repeatability during the 'life' of the device and in particular at each recurrent Authority evaluation.

Most of the tests within the QTG had their tolerances reduced to Correct Trend and Magnitude (CT&M). The use of CT&M is not to be taken as an indication that certain areas of simulation can be ignored. For such tests, the performance of the device should be approximate and representative of the simulated class of aeroplane and should under no circumstances exhibit negative characteristics. In all these cases it is strongly recommended to print out the baseline results during initial evaluation thereby avoiding the effects of possible divergent subjective opinions during recurrent evaluations.

The subjective tests listed under ACJ No 1 to JAR-FSTD A.030, para. 3, functions and manoeuvres, should be flown out by a suitably qualified and experienced pilot. Subjective testing will not only review the interaction of all the applicable systems but the integration of the BITD within a training syllabus, including:

(a) Training environment

(b) Freezes and repositions

(c) Navaid environment

In parallel with this objective and subjective testing process it is envisaged that suitable maintenance arrangements as part of a Quality System are in place. Such arrangements will cover routine maintenance, the provision of satisfactory spares supply and personnel.

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6 Guidelines for an Instrument Panel displayed on a Screen

<table>
<tr><td>a.</td><td>The basic flight instruments shall be displayed and arranged in the usual "T-layout". Instruments shall be displayed very nearly full-size as in the simulated class of aeroplane. The following instruments shall be displayed so as to be representative for the simulated class of aeroplane:
1. An attitude indicator with at least 5° and 10° pitch markings, and bank angle markings for 10°, 20°, 30° and 60°.
2. Adjustable altimeter(s) with 20 ft markings. Controls to adjust the QNH shall be located spatially correct at the respective instrument.
3. An airspeed indicator with at least 5 kts markings within a representative speed range and colour coding.
4. An HSI or heading indicator with incremental markings each of at least 5°, displayed on a 360° circle. The heading figures shall be radially aligned. Controls to adjust the course or heading bugs shall be located spatially correct at the respective instrument.
5. A vertical speed indicator with 100 fpm markings up to 1 000 fpm and 500 fpm thereafter within a representative range.
6. A turn and bank indicator with incremental markings for a rate of 3° per second turn for left and right turns. The 3° per second rate index shall be inside of the maximum deflection of the indicator.
7. A slip indicator representative of the simulated class of aeroplane, where a coordinated flight condition is indicated with the ball in centre position. A triangle slip indicator is acceptable if applicable for the simulated class of aeroplane
8. A magnetic compass with incremental markings each 10°.
9. Engine instruments as applicable to the simulated class of aeroplane, with markings for normal ranges, minimum and maximum limits.
10. A suction gauge or instrument pressure gauge, as applicable, with a display as applicable for the simulated class of aeroplane.
11. A flap position indicator, which displays the current flap setting. This indicator shall be representative of the simulated class of aeroplane.
12. A pitch trim indicator with a display that shows zero trim and appropriate indices of aeroplane nose down and nose up trim.
13. A stop watch or digital timer, which allows the readout of seconds and minutes.</td></tr>
<tr><td>b.</td><td>A communication and navigation panel shall be displayed in a manner that the frequency in use is shown. Controls to select the frequencies and other functions may be located on a central COM/NAV panel or on a separate ergonomically located panel. The NAV equipment shall include ADF, VOR, DME and ILS indicators with the following incremental markings:
1. One-half dot or less for course and glide slope indications on the VOR and ILS display.
2. 5° or less of bearing deviation for ADF and RMI, as applicable.
All NAV radios shall be equipped with an aural identification feature. A marker beacon receiver shall also be installed with an optical and aural identification.</td></tr>
</table>

ACJ No. 4 to JAR-FSTD A.030 (continued)

c.	All instrument displays shall be visible during all flight operation. The instrument system shall be designed to ensure jumping and stepping is not a distraction and to display all changes within the range of the replicated instruments that are equal or greater than the values stated below: 1. Attitude ½° pitch and 1° bank 2. Turn and bank of ¼ standard rate turn 3. IAS 1 kts 4. VSI 20 fpm 5. Altitude 3 ft 6. Heading on HSI ½° 7. Course and Heading on OBS and/or RMI 1° 8. ILS ¼° 9. RPM 25 10. MP ½ inch
d.	The update rate of all displays shall be proofed by a SOC. The resolution shall provide an image of the instruments that: 1. does not appear out of focus. 2. does not appear to "jump" or "step" to a distracting degree during operation. 3. does not appear with distracting jagged lines or edges.

7 Additional Information

Unlike with other FSTDs the manufacturer of a BITD has the responsibility for the initial evaluation of a new BITD model. Because all serial numbers of such a model are automatically qualified, the user approval at the operator's site becomes more important before the course approval is granted.

ACJ No. 1 to JAR-FSTD A.030(c)(1) (acceptable means of compliance)
Engineering Simulator Validation Data
See JAR-FSTD A.030(c)(1)

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

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

2. To be qualified to supply engineering simulator validation data, an aircraft 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

- has models 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 aircraft development and certification;

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

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

3. Aircraft manufacturers seeking to take advantage of this alternative arrangement shall contact the Authority at the earliest opportunity.

4. For the initial application, each applicant should demonstrate his ability to qualify to the satisfaction of the JAA FSTD Steering Group, in accordance with the criteria in this ACJ and the corresponding ACJ No. 2 to JAR-FSTD A.030(c)(1).

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ACJ No. 2 to JAR-FSTD A.030(c)(1) (interpretative material)
Engineering Simulator Validation Data – Approval Guidelines
See JAR-FSTD A.030(c)(1)

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 workstation based simulations.

2. Approval Guidelines – for using Engineering Simulator Validation Data

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, 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.

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 used as part of a QTG, an essential match is expected as described in Appendix 1 to JAR-FSTD A.030.

2.6 In cases where the use of engineering simulator data is envisaged, a complete proposal should be presented to the appropriate regulatory body(ies). Such a proposal would contain evidence of the aircraft manufacturer’s past achievements in high fidelity modelling.

2.7 The process will be applicable to “one step” away from a fully flight validated simulation.

2.8 A configuration management process should be maintained, including an audit trail which clearly defines the simulation model changes step by step away from a fully flight validated simulation, so that it would be possible to remove the changes and return to the baseline (flight validated) version.

2.9 The Authorities will conduct technical reviews of the proposed plan and the subsequent validation data to establish acceptability of the proposal.

2.10 The procedure will be considered complete when an approval statement is issued. This statement will identify acceptable validation data sources.

2.11 To be admissible as an alternative source of validation data an engineering simulator would:

(a) Have to exist as a physical entity, complete with a flight deck representative of the affected class of aircraft, with controls sufficient for manual flight.

(b) Have a visual system; and preferably also a motion system.

(c) Where appropriate, have actual avionics boxes interchangeable with the equivalent software simulations, to support validation of released software.

ACJ No. 2 to JAR-FSTD A.030(c)(1) (continued)

(d) Have a rigorous configuration control system covering hardware and software.

(e) Have been found to be a high fidelity representation of the aircraft by the pilots of the manufacturers, operators and the 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) The original (baseline) simulation models should have been fully flight-test validated.

(b) The 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.

(c) These engineering simulation/simulators will have been used as part of the aircraft design, development and certification process.

2.13 Training flight simulator(s) utilising these baseline simulation models should be currently qualified to at least internationally recognised standards such as contained in the ICAO Document 9625, the “Manual of Criteria for the Qualification of Flight Simulators”.

2.14 The type of modifications covered by this alternative procedure will be restricted to those with “well understood effects”:

(a) Software (e.g., flight control computer, autopilot, etc.).

(b) Simple (in aerodynamic terms) geometric revisions (e.g., body length).

(c) Engines – limited to non-propeller-driven aircraft.

(d) Control system gearing/rigging/deflection limits

(e) Brake, 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 proposed approach. Such analysis would show that the predicted effects of the change(s) were incremental in nature and both easily understood and well defined, confirming that additional flight test data were not required. In the event that the predicted effects were 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 be reviewed by an Authorities team established by the JAA FSTD Steering Group.

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ACJ to JAR-FSTD A.035
FFS Approved or Qualified before 1 April 1998
See JAR–FSTD A.035

1 Introduction

1.1 Under previous National Rules, FFS may have gained credits in accordance with primary reference documents, which state appropriate technical criteria.

1.2 Other FFS may not have been monitored to the same extent, but may have documents or statements from their Authority giving broad or specific permission for them to be used for certain training, testing and checking manoeuvres.

1.3 It is intended that FFS devices should continue to maintain their Qualification Level and or approval granted prior to the adoption of JAR–STD 1A and subsequently JAR-FSTD A.

2 Recategorisation

Some of these FFS may be of a standard that permits them to be recategorised as if they were FFS presented for initial qualification on or after 1 April 1998.

3 Equivalent categories AG, BG, CG, DG

3.1 FFS that are not recategorised and that do have an acceptable primary reference document used for their original national qualification or national approval, will gain a JAA qualification based upon their original technical Qualification Level. The equivalent qualification will relate to permitted manoeuvres in the original national qualification or approval document providing that these older FFS continue to meet the original national criteria when evaluated by the Authority.

3.2 The letter G will be added to each originally issued Qualification Level to show that the existing Qualification Level deserves its credit under the grandfather right provisions. To comply with the rule, the primary reference document should have meaningful validation, functions and subjective tests criteria, which reasonably cover the performance envelope of the FFS, and in particular the manoeuvres for which the equivalent JAA Qualification Level is given. The minimum acceptable standard is FAA AC 120-40A or equivalent.

4 Original national qualification

4.1 FFS that are not recategorised and that do not have an acceptable primary reference document may continue to enjoy credits for an agreed list of training, testing and checking manoeuvres, provided they maintain their performance in accordance with any validation, functions and subjective tests which have been previously established or a list of tests selected from ACJ No 1 to JAR-FSTD A.030 by agreement with the Authority. Again the tests should relate to the list of manoeuvres permitted under the original national qualification or approval document.

4.2 The award of credits to an FFS user should be at the discretion of the Authority. Current FFS users may retain the credits granted under their previous national criteria.

ACJ to JAR-FSTD A.035 (continued)

5 Grandfather rights summary

The following table summarises the arrangements for FFS approved or qualified before 1 April 1998 and which are not recategorised:

Primary Reference Document available	*JAA equivalent qualification level*	*Performance criteria*
Yes	AG Maximum training, BG testing and checking CG Credits similar DG to A, B, C, D	Perform to the original national validation functions and subjective tests from reference doc.
No	<u>Special Categories</u> Unique list of manoeuvres	Original validation, functions and subjective tests or a list of tests selected from ACJ No 1 to JAR-FSTD A.030 (by agreement)

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ACJ to JAR-FSTD A.036
Flight Training Devices Approved or Qualified before 1 July 2000
See JAR–FSTD A.036

1 Introduction

1.1 Under previous national rules, FTDs may have gained credits in accordance with primary reference documents which state appropriate technical criteria.

1.2 Other FTDs may not have been monitored to the same extent, but may have documents or statements from their National Authority giving broad or specific permission for them to be used for certain training, testing and checking manoeuvres.

1.3 In any case, it is intended that FTDs should continue to maintain their Qualification Level and or approval granted prior to the adoption of JAR–FSTD A in accordance with previous national criteria.

2 Recategorisation

Some of these FTDs may be of a standard which permits them to be recategorised as if they were FTDs presented for initial qualification on or after 1 July 2000.

3 Original national qualification

3.1 FTDs that are not recategorised and that do not have an acceptable primary reference document may continue to enjoy credits for an agreed list of training, testing and checking manoeuvres, provided they maintain their performance in accordance with any validation, functions and subjective tests which have been previously established or a list of tests selected from ACJ No 1 to JAR-FSTD A.030 by agreement with the Authority. Again these tests should relate to the list of manoeuvres permitted under the original national qualification or approval document.

3.2 The award of credits to an FTD user should be at the discretion of the Authority. Current FTD users may retain the credits granted under their previous national criteria.

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ACJ to JAR-FSTD A.037
FNPT Approved or Qualified before 1 July 1999
See JAR–FSTD A.037

1 The period of Grandfather Rights granted to FNPT’s had a period of validity of a maximum of six years from 1 July 1999 (which corresponds to the date of JAR-FCL 1 implementation). This period has now expired and Grandfather Rights under JAR-FSTD A.037 are no longer applicable to FNPT’s. All devices are now required to be qualified in accordance with JAR-STD 3A or JAR-FSTD A, as applicable

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ACJ to JAR-FSTD A.045 (explanatory material)
New Aircraft FFS/FTD Qualification – Additional Information
See JAR–FSTD A.045

1 It is usual that aircraft manufacturer's approved final data for performance, handling qualities, systems or avionics will not be available until well after a new or derivative aircraft has entered service. It is often necessary to begin flight crew training and certification several months prior to the entry of the first aircraft into service and consequently it may be necessary to use aircraft manufacturer-provided preliminary data for interim qualification of FSTDs.

2 In recognition of the sequence of events that should occur and the time required for final data to become available, the Authority may accept certain partially validated preliminary aircraft and systems data, and early release ('red label') avionics in order to permit the necessary programme schedule for training, certification and service introduction.

3 FSTD operators seeking qualification based on preliminary data should, however, consult the Authority as soon as it is known that special arrangements will be necessary or as soon as it is clear that the preliminary data will need to be used for FSTD qualification. Aircraft and FSTD manufacturers should also be made aware of the needs and be agreed party to the data plan and FSTD qualification plan. The plan should include periodic meetings to keep the interested parties informed of project status.

4 The precise procedure to be followed to gain Authority acceptance of preliminary data will vary from case to case and between aircraft manufacturers. Each aircraft manufacturer's new aircraft development and test programme is designed to suit the needs of the particular project and may not contain the same events or sequence of events as another manufacturer's programme or even the same manufacturer's programme for a different aircraft. Hence, there cannot be a prescribed invariable procedure for acceptance of preliminary data, but instead there should be a statement describing the final sequence of events, data sources, and validation procedures agreed by the FSTD operator, the aircraft manufacturer, the FSTD manufacturer, and the Authority.

NOTE: A description of aircraft manufacturer-provided data needed for flight simulator modelling and validation is to be found in the IATA Document 'Flight Simulator Design and Performance Data Requirements' – (Edition 6 2000 or as amended).

5 There should be assurance that the preliminary data are the manufacturer's best representation of the aircraft and reasonable certainty that final data will not deviate to a large degree from these preliminary, but refined, estimates. Data derived from these predictive or preliminary techniques should be validated by available sources including, at least, the following:

(a) Manufacturer's engineering report. Such report will explain the predictive method used and illustrating past success of the method on similar projects. For example, the manufacturer could show the application of the method to an earlier aircraft model or predict the characteristics of an earlier model and compare the results to final data for that model.

(b) Early flight tests results. Such data will often be derived from aircraft certification tests, and should be used to maximum advantage for early FSTD validation. Certain critical tests, which would normally be done early in the aircraft certification programme, should be included to validate essential pilot training and certification manoeuvres. These include cases in which a pilot is expected to cope with an aircraft failure mode including engine failures. The early data available will, however, depend on the aircraft manufacturer's flight test programme design and may not be the same in each case. However it is expected that the flight test programme of the aircraft manufacturer include provisions for generation of very early flight tests results for FSTD validation.

6 The use of preliminary data is not indefinite. The aircraft manufacturer's final data should be available within 6 months after aircraft first 'service entry' or as agreed by the Authority, the FSTD operator and the aircraft manufacturer, but usually not later than 1 year. In applying for an interim qualification, using preliminary data, the FSTD operator and the Authority should agree upon the update programme. This will normally specify that the final data update will be installed in the FSTD within a period of 6 months following the final data release unless special conditions exist and a different schedule agreed. The FSTD performance and handling validation would then be based on data derived from flight test. Initial aircraft systems data should be updated after engineering tests. Final aircraft systems data should also be used for FSTD programming and validation.

ACJ to JAR-FSTD A.045 (continued)

7 FSTD avionics should stay essentially in step with aircraft avionics (hardware & software) updates. The permitted time lapse between aircraft and FSTD updates is not a fixed time but should be minimal. It may depend on the magnitude of the update and whether the QTG and pilot training and certification is affected. Permitted differences in aircraft and FSTD avionics versions and the resulting effects on FSTD qualification should be agreed between the FSTD operator and the Authority. Consultation with the FSTD manufacturer is desirable throughout the agreement of the qualification process.

8 The following describes an example of the design data and sources which might be used in the development of an interim qualification plan.

(a) The plan should consist of the development of a QTG based upon a mix of flight test and engineering simulation data. For data collected from specific aircraft flight tests or other flights the required designed model and data changes necessary to support an acceptable Proof of Match (POM) should be generated by the aircraft manufacturer.

(b) In order that the two sets of data are properly validated, the aircraft manufacturer should compare their simulation model responses against the flight test data, when driven by the same control inputs and subjected to the same atmospheric conditions as were recorded in the flight test. The model responses should result from a simulation where the following systems are run in an integrated fashion and are consistent with the design data released to the FSTD manufacturer:

(1) Propulsion

(2) Aerodynamics

(3) Mass properties

(4) Flight controls

(5) Stability augmentation

(6) Brakes and landing gear.

9 For the qualification of FSTD of new aircraft types, it may be beneficial that the services of a suitably qualified test pilot are used for the purpose of assessing handling qualities and performance evaluation.

NOTE: The Proof of Match should meet the relevant ACJ No. 1 to JAR-FSTD A.030 tolerances.

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JAR-FSTD H

Utbildningshjälpmedel för flygsimulering (helikopter)

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HELICOPTER FLIGHT SIMULATION TRAINING DEVICES

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FOREWORD

1 The Civil Aviation Authorities of certain European countries have agreed common comprehensive and detailed aviation requirements, referred to as Joint Aviation Requirements (JARs), with a view to minimising Type Certification problems on joint ventures, to facilitate the export and import of aviation products, to make it easier for maintenance carried out in one European country to be accepted by the Civil Aviation Authority in another European country and to regulate commercial air transport operations.

2 JARs are recognised by the Civil Aviation Authorities of participating countries as an acceptable basis for showing compliance with their national codes.

3 The content has been prepared using the expertise available in this field and added to where necessary by making use of existing European regulations and the Federal Aviation Requirements of the United States of America where acceptable.

4 JAR–FSTD H is issued with no National Variants. It may be felt that the document does not contain all of the detailed compliance and interpretative information which some Civil Aviation Authorities and Industry organisations would like to see. However, it is accepted that JAR–FSTD H should be applied in practice and the lessons learned embodied in future amendments. The Civil Aviation Authorities of the JAA are therefore committed to early amendment in the light of experience.

5 Future development of the requirements of JAR–FSTD H, including the commitment in Paragraph 4, will be in accordance with the JAA's Notice of Proposed Amendment (NPA) procedures. These procedures allow for the amendment of JAR–FSTD H to be proposed by any organisation or person.

6 The Civil Aviation Authorities have agreed they should not unilaterally initiate amendment of their national codes without having made a proposal for amendment of JAR–FSTD H in accordance with the agreed procedure.

7 Definitions and abbreviations of terms used in JAR–FSTD H that are considered generally applicable are contained in JAR–1, Definitions and Abbreviations. However, definitions and abbreviations of terms used in JAR–FSTD H that are specific to a Subpart of JAR–FSTD H are normally given in the Subpart concerned or, exceptionally, in the associated compliance or interpretative material.

8 Amendments to the text in JAR–FSTD H are issued as Replacement Pages. These show an effective date and have the same status and applicability as JAR–FSTD H from that date.

9 New, amended and corrected text will be enclosed within heavy brackets until a subsequent Amendment' is issued.

10 Comment/Response documents developed following Notices of Proposed Amendment (NPA) consultation have been produced by the JAA and are published on the JAA Internet Site: www.jaa.nl. Readers can also apply to Central JAA for copies of specific Comment/Response Documents as required.

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SECTION 1 – REQUIREMENTS

1 GENERAL

1.1 This Section contains the requirements for helicopter Flight Simulation Training Devices.

2 PRESENTATION

2.1 The requirements of JAR–FSTD H are presented in two columns on loose pages, each page being identified by the date of issue and the Amendment number under which it is amended or reissued.

2.2 Sub-headings are in italic typeface.

2.3 Explanatory Notes not forming part of the requirements appear in smaller typeface.

2.4 New, amended and corrected text will be enclosed within heavy brackets until a subsequent ‘Amendment’ is issued.

2.5 After each paragraph, the various changes and amendments, if any since the initial issue, are indicated together with their date of issue.

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SUBPART A - APPLICABILITY

JAR–FSTD H.001 Applicability

JAR–FSTD H as amended applies to those persons, organisations or enterprises (Flight Simulation Training Devices (FSTD) operators) seeking initial qualification of FSTDs.

The version of JAR-FSTD H agreed by the Authority and used for issue of the initial qualification shall be applicable for future recurrent qualifications of the FSTD unless recategorised.

FSTD users shall also gain approval to use the FSTD as part of their approved training programmes despite the fact that the FSTD has been previously qualified.

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SUBPART B – GENERAL

JAR–FSTD H.005 Terminology
(See ACJ to FSTD H.005)

Because of the technical complexity of FSTD qualification, it is essential that standard terminology is used throughout. The following principal terms and abbreviations shall be used in order to comply with JAR–FSTD (H). Further terms and abbreviations are contained in ACJ to FSTD H.005.

(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).

(b) *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).* 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)*. 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 Training Device (OTD)*. A training aid other than FFS, FTD or FNPT which provides for training where a complete flight deck 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 Authority. It takes

account of helicopter to FSTD differences and the operating and training ability of the organization.

(g) *Flight Simulation Training Device Operator (FSTD operator)*. That person, organisation or enterprise directly responsible to the Authority for requesting and maintaining the qualification of a particular FSTD.

(h) *Flight Simulation Training Device User (FSTD User)*. The person, organization or enterprise requesting training, checking and testing credits through the use of an FSTD.

(i) *Flight Simulation Training Device Qualification (FSTD Qualification)*. The level of technical ability of an FSTD as defined in the compliance document.

(j) *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.

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SUBPART C – HELICOPTER FLIGHT SIMULATION TRAINING DEVICES

JAR–FSTD H.015 Application for FSTD Qualification

(See ACJ No. 1 to JAR-FSTD H.015)
(See ACJ No. 2 to JAR-FSTD H.015)

(a) The FSTD operator requiring evaluation of a FFS, FTD, or FNPT shall apply to the Authority giving 3 months notice. In exceptional cases this period may be reduced to one month at the discretion of the Authority.

(b) An FSTD Qualification Certificate will be issued following satisfactory completion of an evaluation of the FFS, FTD or FNPT by the Authority.

JAR–FSTD H.020 Validity of FSTD Qualification

(See ACJ to JAR-FSTD H.020)

(a) A FSTD qualification is valid for 12 months unless otherwise specified by the Authority.

(b) A FSTD qualification revalidation can take place at any time within the 60 days prior to the expiry of the validity of the qualification document. The new period of validity shall continue from the expiry date of the previous qualification document.

(c) The Authority shall refuse, revoke, suspend or vary a FSTD qualification, if the provisions of JAR–FSTD H are not satisfied.

JAR–FSTD H.025 Rules Governing FSTD Operators

(See ACJ No. 1 to JAR-FSTD H.025)
(See ACJ No. 2 to JAR-FSTD H.025)

The FSTD operator shall demonstrate his capability to maintain the performance, functions and other characteristics specified for the FSTD Qualification Level as follows:

(a) Quality System

(1) A Quality System shall be established and a Quality Manager designated to monitor compliance with, and the adequacy of, procedures required to ensure the maintenance of the Qualification Level of

JAR-FSTD H.015 (continued)

FSTDs. Compliance monitoring shall include a feedback system to the Accountable Manager to ensure corrective action as necessary.

(2) The Quality System shall include a Quality Assurance Programme that contains procedures designed to verify that the specified performance, functions and characteristics are being conducted in accordance with all applicable requirements, standards and procedures.

(3) The Quality System and the Quality Manager shall be acceptable to the Authority.

(4) The Quality System shall be described in relevant documentation.

(b) Updating. A link shall be maintained between the operator's organization, the Authority and the relevant manufacturers to incorporate important modifications, especially:

(1) Helicopter modifications which are essential for training and checking shall be introduced into all affected FSTDs whether or not enforced by an airworthiness directive.

(2) Modification of FSTDs, including motion and visual systems (where applicable):

(i) When essential for training and checking, FSTD operators shall update their FSTDs (for example in the light of data revisions). Modifications of the FSTD hardware and software which affect handling, performance and systems operation or any major modifications of the motion or visual system shall be evaluated to determine the impact on the original qualification criteria. FSTD operators shall prepare amendments for any affected validation tests. The FSTD operator shall test the FSTD to the new criteria.

(ii) The Authority shall be advised in advance of any major changes to determine if the tests carried out by the FSTD operator are satisfactory. A special evaluation of the FSTD may be necessary prior to returning it to training following the modification.

(c) Installations. Ensure that the FSTD is housed in a suitable environment which supports safe and reliable operation.

JAR-FSTD H.015 (continued)

(1) The FSTD operator shall ensure that the FSTD and its installation comply with the local regulations for health and safety. However, as a minimum all FSTD occupants and maintenance personnel shall be briefed on FSTD safety to ensure that they are aware of all safety equipment and procedures in the FSTD in case of emergency.

(2) The FSTD safety features such as emergency stops and emergency lighting shall be checked at least annually and recorded by the FSTD operator.

(d) Additional Equipment. Where additional equipment has been added to the FSTD even though not required for qualification, it will be assessed to ensure that it does not adversely affect the quality of training. Therefore any subsequent modification, removal or unserviceability of such equipment could affect the qualification of the device.

JAR–FSTD H.030 Requirements for FSTD qualified on or after 1 August 2008

(See Appendix 1 to JAR–FSTD H.030)
(See ACJ No. 1 to JAR-FSTD H.030)
(See ACJ No. 2 to JAR-FSTD H.030)
(See ACJ No. 3 to JAR-FSTD H.030)
(See ACJ No. 4 to JAR-FSTD H.030)
(See ACJ No. 5 to JAR-FSTD H.030)

(a) Any FSTD submitted for initial evaluation on or after 1 August 2008 will be evaluated against applicable JAR-FSTD H criteria for the Qualifications levels for which qualification has been applied. Recurrent evaluations of a FSTD will be based on the same version of JAR-FSTD H that was applicable for its initial evaluation. An upgrade will be based upon the currently applicable version of JAR-FSTD H.

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

(c) The FSTD shall be subjected to:

(1) Validation tests and

JAR-FSTD H.030 (continued)

(2) Functions & subjective tests

(d) Data shall be of a standard that satisfies the Authority before the FSTD can gain a Qualification Level.

(e) The FSTD operator shall submit a QTG in a form and manner which is acceptable to the Authority.

(f) The QTG will only be approved after completion of an initial or upgrade evaluation, and when all the discrepancies in the QTG have been addressed to the satisfaction of the Authority. After inclusion of the results of the tests witnessed by the Authority, the approved QTG becomes the Master QTG (MQTG), which is the basis for the FSTD qualification and subsequent recurrent FSTD evaluations

(g) The FSTD operator shall:

(1) Run the complete set of tests contained within the MQTG progressively between each annual evaluation by the Authority. Results shall be dated and retained in order to satisfy both the FSTD operator and the Authority that FSTD standards are being maintained; and

(2) Establish a Configuration Control System to ensure the continued integrity of the hardware and software of the qualified FSTD.

JAR-FSTD H.031 Requirements for FFS qualified on or after 1 April 2001 and before 1 August 2008

Any FFS submitted for initial evaluation on or after 1 April 2001 and before 1 August 2008, shall automatically be granted an equivalent qualification under JAR-FSTD H with effect from the re-evaluation conducted at the end of the current validity period. This re-evaluation, and all future re-evaluations, will be conducted in accordance with the requirements of the same version of JAR-STD 1H, which was applicable for its last evaluation prior to implementation of JAR-FSTD H. Any upgrade will be based on the currently applicable version of JAR-FSTD H.

JAR-FSTD H.032 Requirements for Flight Training Devices (FTD) qualified on or after 1 January 2004 and before 1 August 2008

Any FTD submitted for initial evaluation on or after 1 January 2004 and before 1 August 2008, shall automatically be granted an equivalent qualification under JAR-FSTD H with effect from the re-evaluation conducted at the end of the current validity period. This re-evaluation, and all future re-evaluations, will be conducted in accordance with the requirements of the same version of JAR-STD 2H, which was applicable for its last evaluation prior to implementation of JAR-FSTD H. Any upgrade will be based on the currently applicable version of JAR-FSTD H.

JAR-FSTD H.033 Requirements for Flight & Navigation Procedures Trainers (FNPT) qualified on or after 1 January 2003 and before 1 August 2008

Any FNPT submitted for initial evaluation on or after 1 January 2003 and before 1 August 2008, shall automatically be granted an equivalent qualification under JAR-FSTD H with effect from the re-evaluation conducted at the end of the current validity period. This re-evaluation, and all future re-evaluations, will be conducted in accordance with the requirements of the same version of JAR-STD 3H, which was applicable for its last evaluation prior to implementation of JAR-FSTD H. Any upgrade will be based on the currently applicable version of JAR-FSTD H.

JAR–FSTD H.035 Requirements for Full Flight Simulators approved or qualified before 1 April 2001
(See ACJ to JAR-FSTD H.035)

(a) FFS approved or qualified in accordance with national regulations of JAA Member States before 1 April 2001 will either be recategorised or will continue to maintain their approval under the Grandfather Rights provision, in accordance with sub-paragraphs (c) and (d) below. For FFS which are not re-categorized, maximum credit shall under no

circumstances exceed originally issued National credits.

(b) FFS's neither recategorised nor with an approval maintained under the Grandfather Rights provision, will be qualified in accordance with JAR–FSTD H.030.

(c) FFS that are not recategorised but that have a primary reference document used for their testing may be qualified by the Authority to an equivalent JAR–FSTD H Qualification Level, either AG, BG, CG or DG. An upgrade requires the recategorisation of the FFS.

(1) To gain and maintain an equivalent Qualification Level, these FFS shall be assessed in those areas which are essential to completing the flight crew member training and checking process, as applicable.

(2) The FFS shall be subjected to:

(i) Validation tests; and

(ii) Functions and subjective tests.

(d) FFS that are not recategorised and that do not have a primary reference document used for their testing, shall be qualified by special arrangement. Such FFS will be issued with a Special Category and shall be subjected to functions and subjective tests corresponding to those detailed within this document. In addition any previously recognised validation test shall be used.

JAR–FSTD H.036 Requirements for Flight Training Devices approved or qualified before 1 January 2004

No longer applicable.

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JAR–FSTD H.037 Requirements for Flight Navigation Procedures Trainers approved or qualified before 1 January 2003
(See ACJ to JAR-FSTD H.037)

(a) FNPTs or devices approved or qualified in accordance with national regulations of JAA Members States before 1 January 2003 will either be recategorised or will continue to maintain their approval under the Grandfather Rights provision, in accordance with sub-paragraphs (c) and (d) below. Grandfather Rights shall cease to exist on the 1st January 2009. For FNPT which are not recategorised maximum credits shall under no circumstances exceed originally issued National credits.

(b) Recategorised FNPTs will be qualified in accordance with JAR-FSTD H.030.

(c) FNPTs that are not recategorised, but that have a primary reference document used for their testing, may continue under previous authorisation, provided that they continue to comply with the primary reference document.

(1) To gain and maintain their equivalent qualification level, these FNPTs shall be assessed in those areas which are essential to completing the flight crew member training process, as applicable.

(2) The devices shall be subjected to:

(i) Validation tests and

(ii) Functions and subjective tests.

(d) FNPTs that are not recategorised and that do not have a primary reference document used for their testing shall be qualified by special arrangement. Such FNPTs will be issued with a Special Category and shall be subjected to Functions and Subjective Tests corresponding to those detailed within this document. In addition any previously recognized Validation tests shall be used.

JAR–FSTD H.040 Changes to qualified FSTD

(a) Requirement to notify major changes to a FSTD. The operator of a qualified FSTD shall inform the Authority of proposed major changes such as:

JAR-FSTD H.040 (continued)

(1) Helicopter modifications which could affect FSTD qualification.

(2) FSTD hardware and or software modifications which could affect the handling qualities, performance or system representations.

(3) Relocation of the FSTD; and

(4) Any deactivation of the FSTD.

The Authority may complete a special evaluation following major changes or when a FSTD appears not to be performing at its initial Qualification Level.

(b) Upgrade of a FSTD. A FSTD may be upgraded to a higher Qualification Level. Special evaluation is required before the award of a higher Level of Qualification.

(1) If an upgrade is proposed the FSTD operator shall seek the advice of the Authority and give full details of the modifications. If the upgrade evaluation does not fall upon the anniversary of the original qualification date, a special evaluation is required to permit the FSTD to continue to qualify even at the previous Qualification Level.

(2) In the case of a FSTD upgrade, an FSTD operator shall run all validation tests for the requested Qualification Level. Results from previous evaluations shall not be used to validate FSTD performance for the current upgrade.

(c) Relocation of a FSTD

(1) In instances where a FSTD is moved to a new location, the Authority shall be advised before the planned activity along with a schedule of related events.

(2) Prior to returning the FSTD to service at the new location the FSTD operator shall perform at least one third of the validation tests and all functions and subjective tests to ensure that the FSTD performance meets its original qualification standard. A copy of the test documentation shall be retained together with the FSTD records for review by the Authority.

(3) An evaluation of the FSTD in accordance with its original JAA qualification criteria shall be at the discretion of the Authority.

(d) Deactivation of a currently qualified FSTD

JAR-FSTD H.040(d) (continued)

(1) If a FSTD operator plans to remove a FSTD from active status for prolonged periods, the Authority shall be notified and suitable controls established for the period during which the FSTD is inactive.

(2) The FSTD operator shall agree a procedure with the Authority to ensure that the FSTD can be restored to active status at its original Qualification Level.

JAR–FSTD H.045 Interim FSTD Qualification
(See ACJ to JAR-FSTD H.045)

(a) In the case of new helicopter programmes, special arrangements shall be made to enable an interim Qualification Level to be achieved.

(b) For Full Flight Simulators, an interim Qualification Level will only be granted at levels A, B or C

(c) Requirements, details relating to the issue, and the period of validity of an interim Qualification Level will be decided by the Authority.

JAR–FSTD H.050 Transferability of FSTD Qualification

When there is a change of FSTD operator:

(a) The new FSTD operator shall advise the Authority in advance in order to agree upon a plan of transfer of the FSTD.

(b) At the discretion of the Authority, the FSTD shall be subject to an evaluation in accordance with its original JAA qualification criteria.

(c) Provided that the FSTD performs to its original standard, its original Qualification Level shall be restored. Revised user approval(s) may also be required.

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Appendix 1 to JAR-FSTD H.030
Flight Simulation Training Device Standards General

This appendix describes the minimum Full Flight Simulator (FFS), Flight Training Device (FTD) and Flight Navigation Procedures Trainer (FNPT) requirements for qualifying devices to the required Qualification Levels. Certain requirements included in this section shall be supported with a statement of compliance (SOC) and, in some designated cases, an objective test. The SOC will describe how the requirement was met. The test results shall 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 Multi-Crew Co-operation (MCC) training the general technical requirement are expressed in the MCC column with additional systems, instrumentation and indicators as required for MCC training and operation.

For MCC (Multi Crew Co-operation) minimum technical requirements are as for Level 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 CAT. 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 STANDARDS		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
1.1 General		**A**	**B**	**C**	**D**	**1**	**2**	**3**	**I**	**II**	**III**	**MCC**	
a.1	A flight deck that is a full-scale replica of the helicopter simulated. Additional required crewmember 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 that replicates the helicopter.					✓			✓	✓	✓	✓	
a.2	The flight deck, including the instructor's station is fully enclosed.	✓	✓	✓	✓								
	A flight deck, 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 Level 1 as appropriate for the replicated system 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.
	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.								✓	✓	✓	✓	The use of electronically displayed images with physical overlay incorporating operable switches, knobs and buttons is acceptable.

FSTD STANDARDS		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
1.1 General		A	B	C	D	1	2	3	I	II	III	MCC	
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 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 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 Level I.
	Aerodynamic and environment modelling shall be sufficient to permit accurate systems operation and indication.					✓							

	FSTD STANDARDS 1.1 General	FFS LEVEL A	B	C	D	FTD LEVEL 1	2	3	FNPT LEVEL I	II	III	MCC	COMPLIANCE
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 stabilization systems, and representations of nonlinearities due to 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 instrument indications automatically respond to control movement by a crewmember, helicopter performance, or external simulated environmental effects upon the helicopter	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

FSTD STANDARDS 1.1 General		FFS LEVEL A	FFS LEVEL B	FFS LEVEL C	FFS LEVEL D	FTD LEVEL 1	FTD LEVEL 2	FTD LEVEL 3	FNPT LEVEL I	FNPT LEVEL II	FNPT LEVEL III	FNPT LEVEL MCC	COMPLIANCE
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 different European airports with corresponding precision and non-precision approach procedures including current updating within a period of 3 months.
i.1	In addition to the flight crewmember stations, at least two suitable seats for the instructor and an additional observer shall be provided permitting adequate vision to the crewmembers' panel and forward windows. Observer seats need not represent those found in the helicopter but shall be adequately secured to the floor of the flight simulator, 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 will consider options to this standard based on unique cockpit configurations. Any additional seats installed shall be equipped with similar safety provisions.

FSTD STANDARDS 1.1 General		FFS LEVEL A	B	C	D	FTD LEVEL 1	2	3	FNPT LEVEL I	II	III	MCC	COMPLIANCE
i.2	Crewmember seats shall afford the capability for the occupants to be able to achieve the design eye reference position. In addition to the flight crewmember stations, at least two suitable seats for the instructor and an additional observer shall be provided permitting adequate vision to the crewmembers' panel and forward windows.					✓	✓	✓	✓	✓	✓	✓	The instructor's and observer's seats need not represent those found in the helicopter.

FSTD STANDARDS 1.1 General		FFS LEVEL A	FFS LEVEL B	FFS LEVEL C	FFS LEVEL D	FTD LEVEL 1	FTD LEVEL 2	FTD LEVEL 3	FNPT LEVEL I	FNPT LEVEL II	FNPT LEVEL III	FNPT LEVEL MCC	COMPLIANCE
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, and emergency operations appropriate to a helicopter as required for training. Once activated, proper systems operations should result from the system management by the crewmember 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 I: Ability to set the FNPT to minimum IMC speed or above

FSTD STANDARDS		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
1.1 General		A	B	C	D	1	2	3	I	II	III	MCC	
I.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 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.
I.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 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 operator'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 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 harmonized 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 harmonized with the sound and visual system.									✓	✓	✓	

FSTD STANDARDS		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
1.1 General		A	B	C	D	1	2	3	I	II	III	MCC	
n.1	Instructor controls for												
	(i) Wind speed and direction	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	
	(ii) Turbulence	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	
	(iii) Other atmospheric models to support the required training.				✓			✓			✓	✓	Examples: Generic atmospheric models of local wind patterns around mountains and structures..
	(iv) Adjustment of cloud base and visibility.	✓	✓	✓	✓		✓	✓		✓	✓	✓	
	(v) Temperature 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) Dry (ii) Wet (soft surface and hard surface) (iii) Icy (iv) Patchy Wet (v) Patchy Icy			✓	✓								
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

FSTD STANDARDS 1.1 General		FFS LEVEL A	FFS LEVEL B	FFS LEVEL C	FFS LEVEL D	FTD LEVEL 1	FTD LEVEL 2	FTD LEVEL 3	FNPT LEVEL I	FNPT LEVEL II	FNPT LEVEL III	FNPT LEVEL MCC	COMPLIANCE
													then satisfy this test requirement. FTD Level 2 aerodynamic data can be representative/generic and need not necessarily be based on flight test data.
r.1	(1) Transport delay. Transport delay is the time between control input and the individual hardware (systems) responses. As an alternative, a Latency test may be used to demonstrate that the flight simulator system does not exceed the permissible delay.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	For FTD Level 1, only instrument response is required within a maximum permissible delay of 200 milliseconds For Level 'A' & 'B' FFS and Level 2 FTD the maximum permissible delay is 150 milliseconds For Level 'C' & 'D' FFS and Level 3 FTD the maximum permissible delay is 100 milliseconds
	(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 Level 1 and FNPT Level I, only instrument response is required within a maximum permissible delay of 200 milliseconds For Level 'A' & 'B' FFS, Level 2 FTD and FNPT Level II and III the maximum permissible delay is 150 milliseconds For Level 'C' & 'D' FFS and Level 3 FTD the maximum permissible delay is 100 milliseconds

	FSTD STANDARDS 1.1 General	FFS LEVEL A	B	C	D	FTD LEVEL 1	2	3	FNPT LEVEL I	II	III	MCC	COMPLIANCE
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 Level 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			✓	✓			✓					
t.1	A system allowing for timely continuous updating of FSTD hardware and programming consistent with helicopter modifications.	✓	✓	✓	✓	✓	✓	✓					
u.1	The FSTD operator shall submit a Qualification Test Guide in a form and manner acceptable to the Authority. A recording system shall be provided that will enable the FSTD performance to be compared with QTG criteria.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
v.1	FSTD computer capacity, accuracy, resolution and dynamic response sufficient for the Qualification Level sought.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
w.1	Daily preflight documentation either in the daily log or in a location easily accessible for review.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

FSTD STANDARDS 1.2 Motion System		FFS LEVEL A	FFS LEVEL B	FFS LEVEL C	FFS LEVEL D	FTD LEVEL 1	FTD LEVEL 2	FTD LEVEL 3	FNPT LEVEL I	FNPT LEVEL II	FNPT LEVEL III	FNPT LEVEL MCC	COMPLIANCE
a.1	Motion cues as perceived by the pilot shall be representative of the helicopter, e.g. touchdown 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:												The instructor's and observer's seats need not represent those found in the helicopter.
	Having a minimum of 3 degrees of freedom (pitch, roll, heave) to accomplish the required task.	✓											
	6 degrees of freedom synergistic platform motion system		✓	✓	✓								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.

FSTD STANDARDS		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
1.2 Motion System		A	B	C	D	1	2	3	I	II	III	MCC	
d.1	Special effects programming to include the following:	✓	✓	✓	✓								For level A it may be of a generic nature sufficient to accomplish the required tasks.
	(1) Runway rumble, oleo deflections, effects of groundspeed and uneven surface characteristics.												
	(2) Buffet due to translational lift.												
	(3) Buffet during extension and retraction of landing gear.												See Appendix 4 to ACJ No. 1 to JAR-FSTD H.030 para 2.2 on Vibration Platforms for Helicopter FSTDs.
	(4) Buffet due to high speed and retreating blade stall.												
	(5) Buffet due to vortex ring.												
	(6) Representative cues resulting from; (i) touchdown (ii) translational lift.												
	(7) Antitorque device ineffectiveness.												
	(8) Buffet due to turbulence.												

Appendix 1 to JAR-FSTD H.030 (continued)

FSTD STANDARDS		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
1.2 Motion System		A	B	C	D	1	2	3	I	II	III	MCC	
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 Compliance 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 ACJ No. 1 to JAR-FSTD H.030 para 2.2 on Vibration Platforms for Helicopter FSTDs.

FSTD STANDARDS 1.3 Visual System		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
		A	B	C	D	1	2	3	I	II	III	MCC	
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 Level of Qualification 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 and 60 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. 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 with180 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.

FSTD STANDARDS 1.3 Visual System		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
		A	B	C	D	1	2	3	I	II	III	MCC	
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 takeoff and landing.	✓	✓										For Level 'A', Visual cueing sufficient to support changes in approach path by using FATO perspective
	Visual cues to assess rate of change of height, height AGL, translational displacements and rates, during takeoff, 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 minutes		✓				✓	✓		✓	✓	✓	This is equivalent to a light point resolution of 4 arc minutes.

FSTD STANDARDS		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
1.3 Visual System		A	B	C	D	1	2	3	I	II	III	MCC	
i.1	Daylight, dusk, and night visual scenes with sufficient scene content to recognise aerodromes, heliports, 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 touchdown.			✓	✓		✓	✓		✓	✓	✓	
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 heliport. Including elevated helipad, 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), harmonized visual/radar representations of installations. (iv) (For training in the use of Night Vision Goggles (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.

FSTD STANDARDS 1.3 Visual System		FFS LEVEL A	FFS LEVEL B	FFS LEVEL C	FFS LEVEL D	FTD LEVEL 1	FTD LEVEL 2	FTD LEVEL 3	FNPT LEVEL I	FNPT LEVEL II	FNPT LEVEL III	FNPT LEVEL MCC	COMPLIANCE
	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.			✓	✓		✓	✓		✓	✓	✓	
k.3	The visual system should be capable of producing, as a minimum:												Statement of Compliance required. Test required. Freedom of apparent quantization and other distracting visual effects are also applicable for Levels A and B.
	(1) A scene content comparable in detail with that produced by 6,000 polygons for daylight and 1000 visible light points for night and dusk scenes for the entire visual system.						✓	✓		✓	✓	✓	
	(2) A scene content comparable in detail with that produced by 4,000 polygons for daylight and 5000 visible light points for night and dusk scenes for the entire visual system			✓									
	(3) A scene content comparable in detail with that produced by 6,000 polygons for daylight and 7000 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						✓	✓		✓	✓	✓	

FSTD STANDARDS		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
1.3 Visual Systems		A	B	C	D	1	2	3	I	II	III	MCC	
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)				✓								

FSTD STANDARDS 1.4 Sound Systems		FFS LEVEL				FTD LEVEL			FNPT LEVEL				COMPLIANCE
		A	B	C	D	1	2	3	I	II	III	MCC	
a.1	Significant flight deck 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 Compliance required for FFS.
a.2	Sounds due to engines, transmission and rotors should be available								✓				
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 Compliance or Demonstration 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.	✓	✓	✓	✓								

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/TLOF.

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SECTION 2 – ADVISORY CIRCULARS JOINT (ACJ)

1 GENERAL

1.1 This Section contains Advisory Circulars Joint (ACJ) providing acceptable means of compliance and/or interpretative/explanatory material that have been agreed for inclusion in JAR–FSTD H.

1.2 Where a particular JAR paragraph does not have an ACJ, it is considered that no supplementary material is required.

2 PRESENTATION

2.1 The ACJs are presented in full page width on loose pages, each page being identified by the date of issue and the Amendment number under which it is amended or reissued.

2.2 A numbering system has been used in which the ACJ uses the same number as the JAR paragraph to which it refers. The number is introduced by the letters ACJ to distinguish the material from the JAR itself.

2.3 The acronym ACJ also indicates the nature of the material and for this purpose the type of material is defined as follows:

ACJ illustrate a means, or several alternative means, but not necessarily the only possible means by which a requirement can be met. It should however be noted that where a new ACJ is developed, any such ACJ (which may be additional to an existing ACJ) will be amended into the document following consultation under the NPA procedure. Such ACJ will be designated by (acceptable means of compliance).

An ACJ as interpretative/explanatory material may contain material that helps to illustrate the meaning of a requirement. Such ACJ will be designated by (interpretative/explanatory material).

2.4 New ACJ material may, in the first place, be made available rapidly by being published as a Temporary Guidance Leaflet (TGL). FSTD TGLs (JAR–FSTD) can be found in the Joint Aviation Authorities Administrative & Guidance Material, Section 6 – Flight Simulation Training Devices (FSTD), Part Three: Temporary Guidance Leaflet (JAR–FSTD). The procedures associated with Temporary Guidance Leaflets are included in the FSTD Joint Implementation Procedures, Section 6 – Flight Simulation Training Devices (FSTD), Part Two: Procedures (JAR–FSTD) Chapter 9.

Note: Any person who considers that there may be alternative ACJ to those published should submit details to the Operations Director, with a copy to the Regulation Director, for alternatives to be properly considered by the JAA. Possible alternative ACJ may not be used until published by the JAA as ACJ or TGLs.

2.5 Explanatory Notes not forming part of the ACJ text appear in a smaller typeface.

2.6 New, amended or corrected text is enclosed within heavy brackets.

2.7 After each ACJ, the various changes and amendments, when any since the initial issue, are indicated together with their date of issue.

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ACJ B – GENERAL

ACJ to JAR-FSTD H.005
Terminology, Abbreviations
See JAR–FSTD H.005

1 Terminology

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

- a Acceptable Change. A change to configuration, software etc., which qualifies as a potential candidate for alternative approach to validation.
- b Aircraft Performance Data. Performance data published by the aircraft manufacturer in documents such as the Aeroplane or Rotorcraft Flight Manual, Operations Manual, Performance Engineering Manual, or equivalent.
- c Airspeed. Calibrated airspeed when relevant or other airspeed which is clearly annotated.
- d Altitude. Pressure altitude when relevant or other altitude which is clearly annotated.
- e Audited Engineering Simulation. An aircraft manufacturer's engineering simulation which has undergone a review by the appropriate regulatory Authorities and been found to be an acceptable source of supplemental validation data.
- f Automatic Testing. Flight Synthetic Training Device (FSTD) testing wherein all stimuli are under computer control.
- g Bank. Bank/Roll angle (degrees)
- h Baseline. A fully flight-test validated production aircraft simulation. May represent a new aircraft type or a major derivative.
- i Breakout. The force required at the pilot's primary controls to achieve initial movement of the control position.
- j Closed Loop Testing. 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 Controlled Aircraft. An aircraft where the pilot inputs to the control surfaces are transferred and augmented via computers.
- l Control Sweep. A movement of the appropriate pilot's control from neutral to an extreme limit in one direction (Forward, Aft, Right, or Left), a continuous movement back through neutral to the opposite extreme position, and then a return to the neutral position.
- m Convertible FSTD. An 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 Engine Parameter. The engine parameter which is the most appropriate measure of the engine power delivered.
- o Damping (critical). 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 Damping ratio of 1:0
- p Damping (over-damped). An OVER-DAMPED response is that Damping of a second order system such that it has more Damping than is required for Critical Damping, as described above. This corresponds to a relative Damping ratio of more than 1:0.
- q Damping (under-damped). An UNDER-DAMPED response is that Damping 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 Damping ratio of less than 1:0.

r Daylight Visual. 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. The 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 in Nautical Miles unless specified otherwise.

u Driven. 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 Engineering Simulation. An 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 to generate data for checkout, proof-of-match/validation and other training FSTD data documents.

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

x Engineering Simulator Data. Data generated by an engineering simulation or engineering simulator, depending on the aircraft manufacturer's processes.

y Engineering Simulator Validation Data. Validation data generated by an engineering simulation or engineering simulator.

z Entry into Service. Refers 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 Essential Match. 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 Flight Test Data. Actual aircraft data obtained by the aircraft manufacturer (or other supplier of acceptable data) during an aircraft flight test programme.

cc Free Response. The response of the aircraft after completion of a control input or disturbance.

dd Frozen/Locked. 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 Authority. It takes account of differences between aircraft and FSTDs and the operating and training ability of the organisation.

ff FSTD Data. The various types of data used by the FSTD manufacturer and the applicant to design, manufacture, test and maintain the FSTD.

gg FSTD Evaluation. A detailed appraisal of an FSTD by the Authority to ascertain whether or not the standard required for a specified Qualification Level is met.

hh FSTD Operator. That person, organisation or enterprise directly responsible to the authority for requesting and maintaining the qualification of a particular FSTD.

ii FSTD Qualification Level. The level of technical capability of a FSTD.

ACJ to JAR-FSTD H.005 (continued)

jj Fuel used. Mass of fuel used (kilos or pounds)

kk Full Sweep. Movement 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 Functional Performance. An operation or performance that can be verified by objective data or other suitable reference material that may not necessarily be flight test data.

mm Functions Test. 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 Flight Test Data.

nn Grandfather Rights. The right of an FSTD operator to retain the Qualification Level granted under a previous regulation of a JAA 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 JAA member state.

oo Ground Effect. The change in aerodynamic characteristics due to modification of the air flow past the aircraft caused by the presence of the ground.

pp Hands-off Manoeuvre. A test manoeuvre conducted or completed without pilot control inputs.

qq Hands-on Manoeuvre. A test manoeuvre conducted or completed with pilot control inputs as required.

rr Heavy. Operational mass at or near maximum for the specified flight condition.

ss Height. Height above ground = AGL (meters or feet)

tt Highlight Brightness. The maximum displayed brightness~~,~~ which satisfies the appropriate brightness test.

uu Icing Accountability. 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 takeoff, climb (enroute, 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 Integrated Testing. Testing 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 Irreversible Control System. A control system in which movement of the control surface will not backdrive the pilot's control on the flight deck.

xx Latency. The additional time, beyond that of the basic perceivable response time of the aircraft due to the response time of the FSTD.

yy Light. Operational mass at or near minimum for the specified flight condition.

zz Line Oriented Flight Training (LOFT). Refers to aircrew 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 Manual Testing. FSTD testing wherein the pilot conducts the test without computer inputs except for initial setup. All modules of the simulation should be active.

bbb Master Qualification Test Guide (MQTG). The Authority approved QTG which incorporates the results of tests witnessed by the Authority. The MQTG serves as the reference for future evaluations.

ccc Medium. Normal operational weight for flight segment.

ddd Night Visual. 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 Nominal. Normal operational weight, configuration, speed etc. for the flight segment specified.

fff Non-normal Control. A term used in reference to Computer Controlled Aircraft. Non-normal Control is the state where one or more of the intended control, augmentation or protection functions are not fully available. (NOTE: Specific terms such as ALTERNATE, DIRECT, SECONDARY, BACKUP, etc, may be used to define an actual level of degradation).

ggg Normal Control. A term used in reference to Computer Controlled Aircraft. Normal Control is the state where the intended control, augmentation and Protection Functions are fully available.

hhh Objective Test (Objective Testing). A quantitative assessment based on comparison with data.

iii One Step. Refers 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. A person, organisation or enterprise engaging in or offering to engage in an aircraft operation.

kkk Power Lever Angle. The angle of the pilot's primary engine control lever(s) on the flight deck. This may also be referred to as PLA, THROTTLE, or POWER LEVER.

lll Predicted Data. Data derived from sources other than type specific aircraft flight tests.

mmm Primary Reference Document. Any regulatory document which has been used by an Authority to support the initial evaluation of a FSTD.

nnn Proof-of-Match (POM). A document which shows agreement within defined tolerances between model responses and flight test cases at identical test and atmospheric conditions.

ooo Protection Functions. Systems functions designed to protect an aircraft from exceeding its flight and manoeuvre limitations.

ppp Pulse Input. An 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 Reversible Control System. A partially powered or unpowered control system in which movement of the control surface will backdrive the pilot's control on the flight deck and/or affect its feel characteristics.

sss Robotic Test. A basic performance check of a system's hardware and software components. Exact test conditions are defined to allow for repeatability. The components are tested in their normal operational configuration and may be tested independently of other system components.

ttt Sideslip. Sideslip Angle (degrees)

uuu Snapshot. A presentation of one or more variables at a given instant of time.

vvv Statement of Compliance (SOC). A declaration that specific requirements have been met.

www Step Input. An abrupt input held at a constant value.

xxx Subjective Test (Subjective Testing). A qualitative assessment based on established standards as interpreted by a suitably qualified person.

yyy Throttle Lever Angle (TLA). The angle of the pilot's primary engine control lever(s) on the flight deck.

zzz Time History. A presentation of the change of a variable with respect to time.

aaaa Transport Delay. The 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 Twilight (Dusk/Dawn) Visual. 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 Update. The improvement or enhancement of an FSTD.

dddd Upgrade. The improvement or enhancement of an FSTD for the purpose of achieving a higher qualification.

eeee Validation Data. Data used to prove that the FSTD performance corresponds to that of the aircraft.

ffff Validation Flight Test Data. Performance, 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 Validation Test. A test by which FSTD parameters can be compared with the relevant validation data.

hhhh Vibration. 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 Visual Ground Segment Test. 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 Visual System Response Time. The 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 Well-Understood Effect. An 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	=	Aeroplane
AC	=	Advisory Circular
ACJ	=	Advisory Circular Joint
A/C	=	Aircraft
A_d	=	Total initial displacement of pilot controller (initial displacement to final resting amplitude)
AFM	=	Aeroplane Flight Manual
AFCS	=	Automatic Flight Control System
AGL	=	Above Ground Level (metres or feet)
A_n	=	Sequential amplitude of overshoot after initial X axis crossing, e.g. A1 = 1st overshoot.
AEO	=	All Engines Operating
AOA	=	Angle of Attack (degrees)
ARA	=	Airborne Radar Approach
BC	=	ILS localizer back course
CAT I/II/III	=	Landing category operations
CCA	=	Computer Controlled Aeroplane
CCH	=	Computer Controlled Helicopter
cd/m^2	=	Candela/metre^2, 3.4263 candela/m^2 = 1 ft-Lambert
CG	=	Centre of gravity
cm(s)	=	Centimetre, centimetres
CT&M	=	Correct Trend and Magnitude
daN	=	DecaNewtons
dB	=	Decibel
deg(s)	=	Degree, degrees
DGPS	=	Differential Global Positioning System
DH	=	Decision Height
DME	=	Distance Measuring Equipment
DPATO	=	Defined Point After Take-off
DPBL	=	Define Point Before Landing
EPR	=	Engine Pressure Ratio
EW	=	Empty Weight
FAA	=	United States Federal Aviation Administration (U.S.)
FATO	=	Final Approach and Takeoff
FD	=	Flight Director
FOV	=	Field Of View
FPM	=	Feet Per Minute
FTO	=	Flying Training Organisation
ft	=	Feet, 1 foot = 0.304801 metres
ft-Lambert	=	Foot-Lambert, 1 ft-Lambert = 3.4263 candela/m^2
g	=	Acceleration due to gravity (metres or feet/sec^2), 1g = 9.81 m/sec^2 or 32.2 feet/sec^2
G/S	=	Glideslope
GPS	=	Global Positioning System
GPWS	=	Ground Proximity Warning System
H	=	Helicopter
HGS	=	Head-up Guidance System
IATA	=	International Air Transport Association
ICAO	=	International Civil Aviation Organisation

ACJ to JAR-FSTD H.005 (continued)

IGE	=	In Ground Effect
ILS	=	Instrument Landing System
IMC	=	Instrument Meteorological Conditions
in	=	Inches 1 in = 2.54 cm
IOS	=	Instructor Operating Station
IPOM	=	Integrated proof of match
IQTG	=	International Qualification Test Guide (RAeS Document)
JAA	=	Joint Aviation Authorities
JAR	=	Joint Aviation Requirement
JAWS	=	Joint Airport Weather Studies
km	=	Kilometres 1 km = 0.62137 Statute Miles
kPa	=	KiloPascal (Kilo Newton/Metres2). 1 psi = 6.89476 kPa
kts	=	Knots calibrated airspeed unless otherwise specified, 1 Knot = 0.5148 m/sec or 1.689 ft/sec
lb	=	Pounds
LOC	=	Localizer
LOFT	=	Line oriented flight training
LOS	=	Line oriented simulation
LDP	=	Landing Decision Point
m	=	Metres, 1 Metre = 3.28083 feet
MCC	=	Multi-Crew Co-operation
MCTM	=	Maximum certificated take-off mass (kilos/pounds)
MEH	=	Multi-engine Helicopter
min	=	Minutes
MLG	=	Main landing gear
mm	=	Millimetres
MPa	=	MegaPascals [1 psi = 6894.76 pascals]
MQTG	=	Master Qualification Test Guide
ms	=	Millisecond(s)
MTOW	=	Maximum Take-off Weight
n	=	Sequential period of a full cycle of oscillation
N	=	NORMAL CONTROL Used in reference to Computer Controlled Aircraft
N/A	=	Not Applicable
N1	=	Engine Low Pressure Rotor revolutions per minute expressed in percent of maximum
N1/Ng	=	Gas Generator Speed
N2	=	Engine High Pressure Rotor revolutions per minute expressed in percent of maximum
N2/Nf	=	Free Turbine Speed
NAA	=	National Aviation Authority
NDB	=	Non-directional beacon
NM	=	Nautical Mile, 1 Nautical Mile = 6 080 feet = 1 852m
NN	=	Non-normal control a state referring to computer controlled aircraft
NR	=	Main Rotor Speed
NWA	=	Nosewheel Angle (degrees)
OEI	=	One Engine Inoperative
OGE	=	Out of Ground Effect
OM-B	=	Operations Manual – Part B (AFM)
OTD	=	Other Training Device
P0	=	Time from pilot controller release until initial X axis crossing (X axis defined by the resting amplitude)

P1	=	First full cycle of oscillation after the initial X axis crossing
P2	=	Second full cycle of oscillation after the initial X axis crossing
PANS	=	Procedure for air navigation services
PAPI	=	Precision Approach Path Indicator System
PAR	=	Precision approach radar
Pf	=	Impact or Feel Pressure
PLA	=	Power Lever Angle
PLF	=	Power for Level Flight
Pn	=	Sequential period of oscillation
POM	=	Proof-of-Match
PSD	=	Power Spectral Density
psi	=	pounds per square inch. (1 psi = 6·89476 kPa)
PTT	=	Part-Task Trainer
QTG	=	Qualification Test Guide
R/C	=	Rate of Climb (metres/sec or feet/min)
R/D	=	Rate of Descent (metres/sec or feet/min)
RAE	=	Royal Aerospace Establishment
RAeS	=	Royal Aeronautical Society
REIL	=	Runway End Identifier Lights
RNAV	=	Radio navigation
RVR	=	Runway Visual Range (metres or feet)
s	=	second(s)
sec(s)	=	second, seconds
sm	=	Statute Mile 1 Statute Mile = 5280 feet = 1609m
SOC	=	Statement of Compliance
SUPPS	=	Supplementary procedures referring to regional supplementary procedures
TCAS	=	Traffic alert and Collision Avoidance System
TGL	=	Temporary Guidance Leaflet
T(A)	=	Tolerance applied to Amplitude
T(p)	=	Tolerance applied to period
T/O	=	Take-off
Tf	=	Total time of the flare manoeuvre duration
Ti	=	Total time from initial throttle movement until a 10% response of a critical engine parameter
TLA	=	Throttle lever angle
TLOF	=	Touchdown and Lift Off
TDP	=	Take-off Decision Point
Tt	=	Total time from Ti to a 90% increase or decrease in the power level specified
VASI	=	Visual Approach Slope Indicator System
VDR	=	Validation Data Roadmap
VFR	=	Visual Flight Rules
VGS	=	Visual Ground Segment
Vmca	=	Minimum Control Speed (Air)
Vmcg	=	Minimum Control Speed (Ground)
Vmcl	=	Minimum Control Speed (Landing)
VOR	=	VHF omni-directional range
Vr	=	Rotate Speed
Vs	=	Stall Speed or minimum speed in the stall
V1	=	Critical Decision Speed
VTOSS	=	Take-off Safety Speed
Vy	=	Optimum Climbing Speed
Vw	=	Wind Velocity
WAT	=	Weight, Altitude, Temperature

ACJ C – HELICOPTER FLIGHT SIMULATION TRAINING DEVICES

ACJ No. 1 to JAR-FSTD H.015 (acceptable means of compliance)
FSTD Qualification – Application and Inspection
See JAR–FSTD H.015

1 Letter of Application

A sample of letter of application is provided overleaf.

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LETTER OF APPLICATION FOR INITIAL JAA EVALUATION OF A FLIGHT SIMULATION TRAINING DEVICE.

Part A

To be submitted not less than 3 months prior to requested qualification date

(Date)…………………

PRINCIPAL INSPECTOR
(JAA NAA OFFICE)

(Address)…………………………………………….

…………………………………………………………

(City)…………………………………………………….

(Country)…………………………………………….

Type of FSTD		Aircraft Type/class	Qualification Level Sought				
Full Flight Simulator	FFS		A	B	C	D	
Flight Training Device	FTD		1	2	3		
Flight and Navigation Procedures trainer	FNPT		I	II	III	II MCC	III MCC

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ACJ No. 1 to JAR-FSTD H.015 (continued)

Dear…………………………….,

.............…….…..... (Name of Applicant)................…....... requests the evaluation of its Flight Simulation Training Device for JAR-FSTD A qualification. The ……..(FSTD Manufacturer Name) FSTD with its ...………..... (Visual System Manufacturer Name, if applicable) Visual System is fully defined on page ......….... of the accompanying Qualification Test Guide (QTG) which was run on.....….... (date).….….... at ....(place).......

Evaluation is requested for the following configurations and engine fits as applicable:

e.g. Turbomeca Makila 1A1 / 1A2

1……………..

2…………….

3…………….

Dates requested are:………………………….. and the FSTD will be located at ……

The QTG will be submitted by……(Date)………… and in any event not less than 30 days before the requested evaluation date unless otherwise agreed with the Authority.

Comments:

………
………
………

Signed

…………………………………………………………………………

Print name…………………………………………………………….

position/appointment held……………………………………….

e mail address……………………………………………………….

telephone number…………………………………………………..

Part B

To be completed with attached QTG results

(Date)……………………………..

We have completed tests of the FSTD and declare that it meets all applicable requirements of the JAR–FSTD H (Helicopter) except as noted below. Appropriate hardware and software configuration control procedures have been established and these are appended for your inspection and approval.

The following MQTG tests are outstanding:

Tests	Comments

(Add boxes as required)

It is expected that they will be completed and submitted 3 weeks prior to the evaluation date.

Signed

…………………………………………………………………..

Print name…..

position/appointment held……………………………..

E-mail address……………………………………………..

Telephone number………………………………………..

ACJ No. 1 to JAR-FSTD H.015 (continued)

Part C

To be completed not less than 7 days prior to initial evaluation

(Date)…………………………..

The FSTD has been assessed by the following evaluation team:

(name)…………………… Qualification………………………..

(name)……………………. Qualification………………………..

(name)……………………. Qualification………………………..

(name)…………………… Pilot's Licence Nr…………………

(name)……………………. Flight Engineer's Licence Nr (if applicable)……………..

This team attest(s) that it conforms to the helicopter flight deck configuration of ....(Name of FSTD operator)..........(type of helicopter) helicopter and that the simulated systems and subsystems function equivalently to those in that helicopter. This pilot has also assessed the performance and the flying qualities of the FSTD and finds that it represents the designated helicopter.

(Additional comments as required)

…………………………………………………………….

…………………………………………………………….

…………………………………………………………….

Signed

………………………

Print name…..

position/appointment held……………………………

E-mail address…………………………………………

Telephone number……………………………………

2 Composition of Evaluation Team

2.1 To gain a Qualification Level, an FSTD is evaluated in accordance with a structured routine conducted by a technical team which is appointed by the Authority and consists of at least:

a. A technical FSTD inspector of the Authority, or an accredited inspector from another JAA Authority, qualified in all aspects of flight simulation hardware, software and computer modelling or, exceptionally, a person designated by the Authority with equivalent qualifications; and

b. One of the following:

(i) A flight inspector of the Authority, or an accredited inspector from another JAA Authority, who is qualified in flight crew training procedures and is holding a valid type rating on the helicopter being simulated; or

(ii). A flight inspector of the Authority who is qualified in flight crew training procedures assisted by a type rating instructor, holding a valid type rating on the helicopter being simulated ; or, exceptionally,

c. A person designated by the Authority who is qualified in flight crew training procedures and is holding a valid type rating on the helicopter being simulated and sufficiently experienced to assist the technical team. This person should fly out at least part of the functions and subjective test profiles.

d. Where a designated person is used as a substitute for one of the Authority's inspectors, the other person shall be a properly qualified inspector of the Authority or an accredited inspector from another JAA Authority.

e. For generic FNPT helicopters evaluations the valid type rating should be appropriate for the generic type of helicopter being represented. For FTD level 1 and FNPT level I, one suitably qualified Inspector may combine the functions in a. and b. above.

2.2 Additionally the following persons should be present:

a. (For FFS, FTD and FNPT) A type rated Training Captain typically from the FSTD operator or main FSTD users.

b. (For all types) Sufficient FSTD support staff to assist with the running of tests and operation of the instructor's station.

2.3 On a case-by-case basis, when an FSTD is being evaluated, the Authority may reduce the evaluation team to an Authority flight inspector supported by a type rated training captain from the main flight simulator user for evaluation of a specific flight simulator of a specific FSTD operator, provided:

a. This composition is not being used prior to the second recurrent evaluation;

b. Such an evaluation will be followed by an evaluation with a full authority evaluation team;

c. The Authority flight inspector will perform some spot checks in the area of objective testing;

d. No major change or upgrading has been applied since the directly preceding evaluation;

e. No relocation of the FSTD has taken place since the last evaluation;

f. A system is established enabling the Authority to monitor and analyse the status of the FSTD on a continuous basis;

g. The FSTD's hardware and software has been working reliably for the previous years. This should be reflected in the number and kind of (technical log) discrepancies and the results of the quality system audits.

ACJ No. 2 to JAR- FSTD H.015 (explanatory material)
FSTD Evaluations
See JAR–FSTD H.015

1 General

1.1 During initial and recurrent FSTD evaluations it will be necessary for the Authority to conduct the objective and subjective tests described in JAR-FSTD H.030 and JAR-FSTD H.035 and detailed in ACJ No. 1 to JAR-FSTD H.030. There will be occasions when all tests cannot be completed - for example during recurrent evaluations on a convertible FSTD - but arrangements should be made for all tests to be completed within a reasonable time.

1.2 Following an evaluation, it is possible that a number of defects may be identified; generally these defects should be rectified and the Authority notified of such action within 30 days. Serious defects which affect crew training, testing and checking when applicable, could result in an immediate downgrading of the Qualification Level, or if any defects remain unattended without good reason for period greater than 30 days, subsequent downgrading may occur or qualification could be revoked.

2 Initial Evaluations

2.1 Objective Testing

2.1.1 Objective Testing is centered around the QTG. Before testing can begin on an initial evaluation the acceptability of the validation tests contained in the QTG should be agreed with the Authority well in advance of the evaluation date to ensure that the FSTD time especially devoted to the running of some of the tests by the Authority is not wasted. The acceptability of all tests depends upon their content, accuracy, completeness and recency of the results.

2.1.2 Much of the time allocated to objective tests depends upon the speed of the automatic and manual systems set up to run each test and whether or not special equipment is required. The Authority will not necessarily warn the FSTD operator of the sample validations tests which will be run on the day of the evaluation, unless special equipment is required. It should be remembered that the FSTD cannot be used for subjective tests whilst part of the QTG is being run. Therefore sufficient time should be set aside for the examination and running of the QTG.

2.2 Subjective Testing

2.2.1 The Subjective Tests for the evaluation can be found in ACJ No.1 to JAR- FSTD H.030, and a suggested Subjective Test Profile is described in sub-paragraph 4.6 below.

2.2.2 Essentially the subjective test routine effectively denies the use of the FSTD for any other purpose.

2.3 Conclusion

To ensure adequate coverage of subjective and objective tests and to allow for cost effective rectification and re-test before departure of the inspection team, a sufficient number of consecutive days should be dedicated to an initial evaluation of a FSTD.

3 Recurrent Evaluations

3.1 Objective Testing

3.1.1 During recurrent evaluations, the Authority will wish to see evidence of the successful running of the QTG between evaluations. The Authority will select a number of tests to be run during the evaluation, including those, which may be cause for concern. Again adequate notification would be given when special equipment is required for the test.

3.1.2 Essentially the time taken to run the objective tests depends upon the need for special equipment and the test system, and the FSTD cannot be used for subjective tests or other functions whilst testing is in progress. For a FSTD incorporating an automatic test system, four (4) hours would normally be required. FSTDs, which rely upon manual testing, may require a longer period of time.

3.2 Subjective testing

3.2.1 Essentially the same subjective test routine should be flown as per the profile described in subparagraph 4.6 below with a selection of the subjective tests taken from ACJ No 1 to JAR-FSTD H.030.

3.2.2 Normally, the time taken for recurrent subjective testing is about four (4) hours, and the FSTD cannot perform other functions during this time.

3.3 Conclusion

To ensure adequate coverage of subjective and objective tests during a recurrent evaluation, a total of 8 hours should be allocated for a FSTD. However, it should be remembered that any FSTD deficiency, which arises during the evaluation could necessitate the extension of the evaluation period.

4 Functions and Subjective Tests - Suggested Test Routine

4.1 During initial and recurrent evaluations of a FSTD, the competent Authority will conduct a series of functions and subjective tests, which together with the objective tests complete the comparison of the FSTD with the helicopter (may be a generic helicopter for FNPT).

4.2 Whereas functions tests verify the acceptability of the simulated helicopter systems and their integration, subjective tests verify the fitness of the FSTD in relation to training, checking and testing tasks.

4.3 The FSTD should provide adequate flexibility to permit the accomplishment of the desired/required tasks while maintaining an adequate perception by the flight crew that they are operating in a real helicopter environment. Additionally, the operation of the Instructor Operating Station (IOS) should be simple enough to give the instructor spare capacity to observe the activities of the flight crew.

4.4 Section 1 of JAR-FSTD H sets out the requirements, and the ACJs in Section 2 the means of compliance for FSTD qualification. However, it is important that both the Authority and the FSTD operator understand what to expect from the routine of FSTD functions and subjective tests. It should be remembered that part of the subjective tests routine for a FSTD should involve an uninterrupted fly-out (except for FTD and level 1) comparable with the duration of typical training sessions in addition to assessment of flight freeze and repositioning). An example of such a profile is to be found in sub-paragraph 4.6 below.

4.5 JAA Authorities and FSTD operators who are unfamiliar with the evaluation process are advised to contact another JAA Authority, which is suitably experienced.

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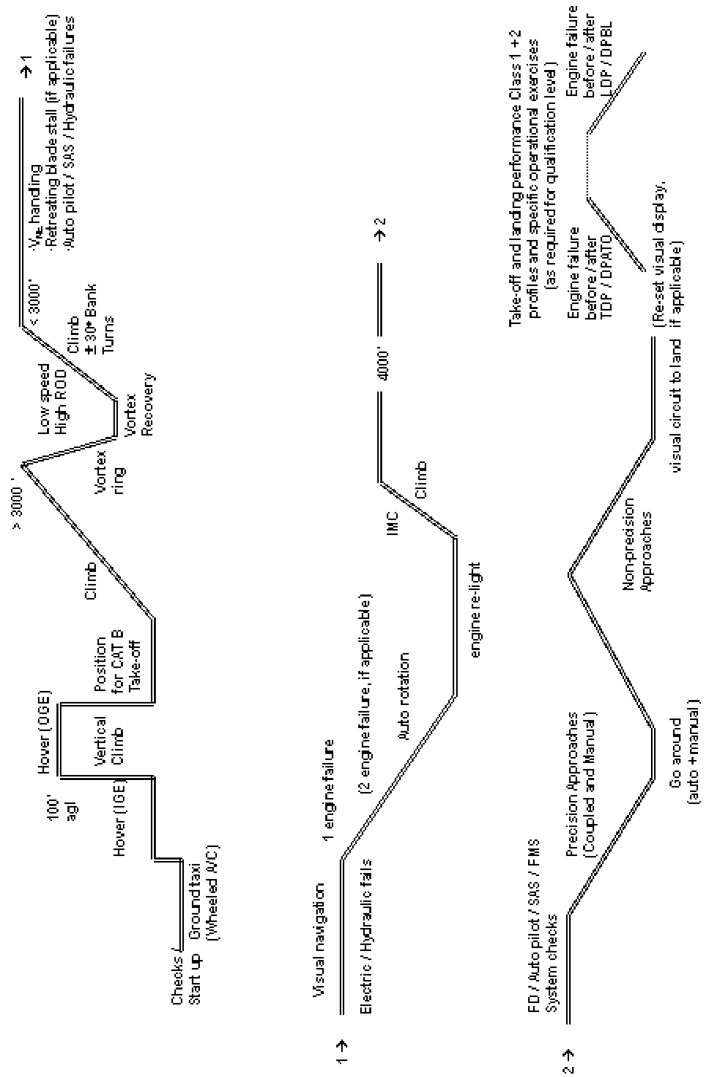
ACJ No. 2 to JAR-FSTD H.015 (continued)

4.5 Typical Test Profile for a FSTD H:



Note: The Typical Test Profile should be flown at helicopter masses at, or close to, the maximum allowable mass for the ambient atmospheric conditions. Those ambient conditions should be varied from Standard Atmosphere to test the validity of the limits of temperature and pressure likely to be required in the practical use of the FSTD. Visual exercises only apply to FSTDs fitted with a visual system.

ACJ to JAR-FSTD H.020 (acceptable means of compliance)
Validity of FSTD Qualification
See JAR-FSTD H.020

1. Prerequisites

1.1 On a case-by-case basis, the Authority may grant an extended validity of a FSTD qualification in excess of 12 months up to a maximum of 36 months, to a specific FSTD operator for a specific FSTD, provided:

a. an initial and at least one recurrent successful evaluation have been performed on this FSTD by the same Authority;

b. the FSTD operator has got a satisfactory record of successful regulatory FSTD evaluations over a period of at least 3 years;

c. the FSTD operator has established and successfully maintained a Quality System for at least 3 years;

d. the Authority performs a formal audit of the FSTD operator's Quality System every calendar year;

e. an accountable person of the FSTD operator with FSTD and training experience acceptable to the Authority (such as a type rated training captain), reviews the regular reruns of the QTG and conducts the relevant function and subjective tests every 12 months;

f. a report detailing the results of the QTG rerun tests and function and subjective evaluation will be signed and submitted by the accountable person described under subparagraph (e) above to the Authority.

2. Prerogative of the Authority

2.1 The Authority reserves the right to perform flight simulator evaluations whenever it deems it necessary.

ACJ No. 1 to JAR-FSTD H.025 (acceptable means of compliance)
Quality System
See JAR– FSTD H.025

1 Introduction

1.1 In order to show compliance with JAR– FSTD H.025, an FSTD operator should establish his Quality System in accordance with the instructions and information contained in the following paragraphs.

2 General

2.1 Terminology

a. The terms used in the context of the requirement for an FSTD operator’s Quality System have the following meanings:

(i) *Accountable Manager.* The person acceptable to the Authority who has corporate authority for ensuring that all necessary activities can be financed and carried out to the standard required by the Authority, and any additional requirements defined by the FSTD operator.

(ii) *Quality Assurance.* All those planned and systematic actions necessary to provide adequate confidence that specified performance, functions and characteristics satisfy given requirements.

(iii) *Quality Manager.* The manager, acceptable to the Authority, responsible for the management of the Quality System, monitoring function and requesting corrective actions.

2.2 Quality Policy

2.2.1 An FSTD operator should establish a formal written Quality Policy Statement that is a commitment by the Accountable Manager as to what the Quality System is intended to achieve. The Quality Policy should reflect the achievement and continued compliance with JAR– FSTD H together with any additional standards specified by the FSTD operator.

ACJ No. 1 to JAR- FSTD H.025 (continued)

2.2.2 The Accountable Manager is an essential part of the FSTD qualification holder's organisation. With regard to the above terminology, the term 'Accountable Manager' is intended to mean the Chief Executive/President/Managing Director/General Manager etc. of the FSTD operator's organisation, who by virtue of his position has overall responsibility (including financial) for managing the organisation.

2.2.3 The Accountable Manager will have overall responsibility for the FSTD qualification holder's Quality System including the frequency, format and structure of the internal management evaluation activities as prescribed in paragraph 4.9 below.

2.3 Purpose of the Quality System

2.3.1 The Quality System should enable the FSTD operator to monitor compliance with JAR– FSTD H, and any other standards specified by that FSTD operator, or the Authority, to ensure correct maintenance and performance of the device.

2.4 Quality Manager

2.4.1 The primary role of the Quality Manager is to verify, by monitoring activity in the fields of FSTD qualification, that the standards required by the Authority, and any additional requirements defined by the FSTD operator, are being carried out under the supervision of the relevant Manager.

2.4.2 The Quality Manager should be responsible for ensuring that the Quality Assurance Programme is properly established, implemented and maintained.

2.4.3 The Quality Manager should:

a. Have direct access to the Accountable Manager;

b. Have access to all parts of the FSTD operator's and, as necessary, any sub-contractor's organisation.

2.4.4 The posts of the Accountable Manager and the Quality Manager may be combined by FSTD operators whose structure and size may not justify the separation of those two posts. However, in this event, Quality Audits should be conducted by independent personnel.

3 Quality System

3.1 Introduction

3.1.1 The FSTD operator's Quality System should ensure compliance with FSTD qualification requirements, standards and procedures.

3.1.2 The FSTD operator should specify the structure of the Quality System.

3.1.3 The Quality System should be structured according to the size and complexity of the organisation to be monitored.

3.2 Scope

3.2.1 As a minimum, the Quality System should address the following:

a. The provision of JAR–FSTD H.

b. The FSTD operator's additional standards and procedures.

c. The FSTD operator's Quality Policy.

d. The FSTD operator's organisational structure.

e. Responsibility for the development, establishment and management of the Quality System.

f. Documentation, including manuals, reports and records.

g. Quality Procedures.

h. Quality Assurance Programme.

i. The provision of adequate financial, material and human resources.

j. Training requirements for the various functions in the organisation.

3.2.2 The Quality System should include a feedback system to the Accountable Manager to ensure that corrective actions are both identified and promptly addressed. The feedback system should also specify who is required to rectify discrepancies and non-compliance in each particular case, and the procedure to be followed if corrective action is not completed within an appropriate timescale.

3.3 Relevant Documentation

3.3.1 Relevant documentation should include the following:

a. Quality Policy.

b. Terminology.

c. Reference to specified FSTD technical standards.

d. A description of the organisation.

e. The allocation of duties and responsibilities.

f. Qualification procedures to ensure regulatory compliance.

g. The Quality Assurance Programme, reflecting:

(i) Schedule of the monitoring process.

(ii) Audit procedures.

(iii) Reporting procedures.

(iv) Follow-up and corrective action procedures.

(v) Recording system.

(vi) Document control.

4. Quality Assurance Programme

4.1 Introduction

4.1.1 The Quality Assurance Programme should include all planned and systematic actions necessary to provide confidence that all maintenance is conducted and all performance maintained in accordance with all applicable requirements, standards and procedures.

4.1.2 When establishing a Quality Assurance Programme, consideration should, at least, be given to the paragraphs 4.2 to 4.9 below.

4.2 Quality Inspection

4.2.1 The primary purpose of a quality inspection is to observe a particular event/action/document etc., in order to verify whether established procedures and requirements are followed during the accomplishment of that event and whether the required standard is achieved.

4.2.2 Typical subject areas for quality inspections are:

a. Actual FSTD operation.

b. Maintenance.

c. Technical standards.

d. FSTD safety features.

4.3 Audit

4.3.1 An audit is a systematic and independent comparison of the way in which an activity is being conducted against the way in which the published procedures say it should be conducted.

4.3.2 Audits should include at least the following quality procedures and processes:

a. A statement explaining the scope of the audit.

b. Planning and preparation.

c. Gathering and recording evidence; and

d. Analysis of the evidence.

4.3.3 Techniques which contribute to an effective audit are:

a. Interviews or discussions with personnel.

b. A review of published documents.

c. The examination of an adequate sample of records.

d. The witnessing of the activities which make up the operation; and

e. The preservation of documents and the recording of observations.

4.4 Auditors

4.4.1 An FSTD operator should decide, depending on the complexity and size of the organisation, whether to make use of a dedicated audit team or a single auditor. In any event, the auditor or audit team should have relevant FSTD experience.

4.4.2 The responsibilities of the auditors should be clearly defined in the relevant documentation.

4.5 Auditor's Independence

4.5.1 Auditors should not have any day to day involvement in the area of activity which is to be audited. An FSTD operator may, in addition to using the services of full-time dedicated personnel belonging to a separate quality department, undertake the monitoring of specific areas or activities by the use of part-time auditors. Due to the technological complexity of FSTDs, which requires auditors with very specialised knowledge and experience, an FSTD operator may undertake the audit function by the use of part-time personnel from within his own organisation or from an external source under the terms of an agreement acceptable to the Authority. In all cases the FSTD operator should develop suitable procedures to ensure that persons directly responsible for the activities to be audited are not selected as part of the auditing team. Where external auditors are used, it is essential that any external specialist is familiar with the type of device conducted by the FSTD operator.

4.5.2 The FSTD operator's Quality Assurance Programme should identify the persons within the company who have the experience, responsibility and authority to:

a. Perform quality inspections and audits as part of ongoing Quality Assurance.

b. Identify and record any concerns or findings, and the evidence necessary to substantiate such concerns or findings.

c. Initiate or recommend solutions to concerns or findings through designated reporting channels.

d. Verify the implementation of solutions within specific time scales.

e. Report directly to the Quality Manager.

4.6 Audit Scope

4.6.1 FSTD operators are required to monitor compliance with the procedures they have designed to ensure specified performance and functions. In doing so they should as a minimum, and where appropriate, monitor:

a. Organisation.

b. Plans and objectives.

c. Maintenance procedures.

d. FSTD Qualification Level.

e. Supervision.

f. FSTD technical status.

g. Manuals, logs, and records.

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h. Defect deferral.

i. Personnel training.

j. Helicopter modifications management.

4.7 Auditing scheduling

4.7.1 A Quality Assurance Programme should include a defined audit schedule and a periodic review. The schedule should be flexible, and allow unscheduled audits when trends are identified. Follow-up audits should be scheduled when necessary to verify that corrective action was carried out and that it was effective.

4.7.2 An FSTD operator should establish a schedule of audits to be completed during a specified calendar period. All aspects of the operation should be reviewed within every period of 12 months in accordance with the programme unless an extension to the audit period is accepted as explained below. An FSTD operator may increase the frequency of audits at his discretion but should not decrease the frequency without the agreement of the Authority.

4.7.3 When an FSTD operator defines the audit schedule, significant changes to the management, organisation, or technologies should be considered as well as changes to the regulatory requirements.

4.7.4 For FSTD operators whose structure and size may not justify the completion of a complex system of audits, it may be appropriate to develop a Quality Assurance Programme that employs a checklist. The checklist should have a supporting schedule that requires completion of all checklist items within a specified time scale, together with a statement acknowledging completion of a periodic review by top management.

4.7.5 Whatever arrangements are made, the FSTD operator retains the ultimate responsibility for the Quality System and especially the completion and follow up of corrective actions.

4.8 Monitoring and Corrective Action

4.8.1 The aim of monitoring within the Quality System is primarily to investigate and judge its effectiveness and thereby to ensure that defined policy, performance and function standards are continuously complied with. Monitoring activity is based upon quality inspections, audits, corrective action and follow-up. The FSTD operator should establish and publish a quality procedure to monitor regulatory compliance on a continuing basis. This monitoring activity should be aimed at eliminating the causes of unsatisfactory performance.

4.8.2 Any non-compliance identified as a result of monitoring should be communicated to the manager responsible for taking corrective action or, if appropriate, the Accountable Manager. Such non-compliance should be recorded, for the purpose of further investigation, in order to determine the cause and to enable the recommendation of appropriate corrective action.

4.8.3 The Quality Assurance Programme should include procedures to ensure that corrective actions are taken in response to findings. These quality procedures should monitor such actions to verify their effectiveness and that they have been completed. Organisational responsibility and accountability for the implementation of corrective actions resides with the department cited in the report identifying the finding. The Accountable Manager will have the ultimate responsibility for resourcing the corrective action and ensuring, through the Quality Manager, that the corrective action has re-established compliance with the standard required by the Authority, and any additional requirements defined by the FSTD operator.

4.8.4 Corrective action

a. Subsequent to the quality inspection/audit, the FSTD operator should establish:

b. The seriousness of any findings and any need for immediate corrective action.

c. Cause of the finding.

d. Corrective actions required to ensure that the non-compliance does not recur.

e. A schedule for corrective action.

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f. The identification of individuals or departments responsible for implementing corrective action.

g. Allocation of resources by the Accountable Manager, where appropriate.

4.8.5 The Quality Manager should:

a. Verify that corrective action is taken by the manager responsible in response to any finding of non-compliance.

b. Verify that corrective action includes the elements outlined in paragraph 4.8.4 above.

c. Monitor the implementation and completion of corrective action.

d. Provide management with an independent assessment of corrective action, implementation and completion.

e. Evaluate the effectiveness of corrective action through the follow-up process.

4.9 Management Evaluation

4.9.1 A management evaluation is a comprehensive, systematic, documented review of the Quality System and procedures by the management, and it should consider:

a. The results of quality inspections, audits and any other indicators.

b. The overall effectiveness of the management organisation in achieving stated objectives.

4.9.2 A management evaluation should identify and correct trends, and prevent, where possible, future non-conformities. Conclusions and recommendations made as a result of an evaluation should be submitted in writing to the responsible manager for action. The responsible manager should be an individual who has the authority to resolve issues and take action.

4.9.3 The Accountable Manager should decide upon the frequency, format, and structure of internal management evaluation activities.

4.10 Recording

4.10.1 Accurate, complete, and readily accessible records documenting the results of the Quality Assurance Programme should be maintained by the FSTD operator. Records are essential data to enable an FSTD operator to analyse and determine the root causes of non-conformity, so that areas of non-compliance can be identified and addressed.

4.10.2 The following records should be retained for a period of 5 years:

a. Audit schedules.

b. Quality inspection and audit reports.

c. Response to findings.

d. Corrective action reports.

e. Follow-up and closure reports; and

f. Management evaluation reports.

5 Quality Assurance responsibility for sub-contractors

5.1 Sub-contractors

5.1.1 FSTD operators may decide to sub-contract out certain activities to external agencies for the provision of services related to areas such as:

a. Maintenance.

b. Manual preparation.

5.1.2 The ultimate responsibility for the product or service provided by the sub-contractor always remains with the FSTD operator. A written agreement should exist between the FSTD operator and the sub-contractor clearly defining the services and quality to be provided. The sub-contractor's activities

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relevant to the agreement should be included in the FSTD operator's Quality Assurance Programme.

5.1.3 The FSTD operator should ensure that the sub-contractor has the necessary authorisation/approval when required, and commands the resources and competence to undertake the task. If the FSTD operator requires the sub-contractor to conduct activity which exceeds the sub-contractor's authorisation/approval, the FSTD operator is responsible for ensuring that the sub-contractor's Quality Assurance takes account of such additional requirements.

6 Quality System Training

6.1 General

6.1.1 An FSTD operator should establish effective, well planned and resourced quality related briefing for all personnel.

6.1.2 Those responsible for managing the Quality System should receive training covering:

a. An introduction to the concept of the Quality System.

b. Quality management.

c. Concept of Quality Assurance.

d. Quality manuals.

e. Audit techniques.

f. Reporting and recording; and

g. The way in which the Quality System will function in the organisation.

6.1.3 Time should be provided to train every individual involved in quality management and for briefing the remainder of the employees. The allocation of time and resources should be sufficient for the scope of the training.

6.2 Sources of Training

6.2.1 Quality management courses are available from the various national or international Standards Institutions, and an FSTD operator should consider whether to offer such courses to those likely to be involved in the management of Quality Systems. FSTD operators with sufficient appropriately qualified staff should consider whether to carry out in-house training.

7. Standard Measurements for Flight Simulator Quality

7.1 General

7.1.1 It is recognised that a Quality System tied to measurement of FSTD performance will probably lead to improving and maintaining training quality. One acceptable means of measuring FSTD performance is as defined and agreed by industry in ARINC report 433 (May 15th, 2001 or as amended) entitled "Standard Measurements for Flight Simulator Quality".

ACJ No. 2 to JAR-FSTD H.025
Installations
See JAR-FSTD H.025(c)

1 Introduction

1.1 This ACJ identifies those elements that are expected to be addressed, as a minimum, to ensure that the FSTD installation provides a safe environment for the users and operators of the FSTD under all circumstances.

2 Expected Elements

2.1 Adequate fire/smoke detection, warning and suppression arrangements should be provided to ensure safe passage of personnel from the FSTD.

ACJ No. 2 to JAR- FSTD H.025 (continued)

2.2 Adequate protection should be provided against electrical, mechanical, hydraulic and pneumatic hazards – including those arising from the control loading and motion systems to ensure maximum safety of all personnel in the vicinity of the FSTD.

2.3 Other areas that should be addressed include:

a. A two way communication system that remains operational in the event of a total power failure.

b. Emergency lighting

c. Escape exits and escape routes

d. Occupant restraints (seats, seat belts etc.).

e. External warning of motion and access ramp or stairs activity.

f. Danger area markings.

g. Guard rails and gates

h. Motion and control loading emergency stop controls accessible from either pilot or instructor seats; and

i. A manual or automatic electrical power isolation switch.

ACJ No. 1 to JAR-FSTD H.030 acceptable means of compliance
FSTDs qualified on or after 1 August 2008
See JAR–FSTD H.030

NOTE: The structure and numbering of this ACJ departs from JAA layout due to the complexity of the technical content and the need to retain harmonisation with the ICAO Manual of Criteria for the Qualification of Flight Simulators (1995 or as amended).

1 Introduction

1.1 Purpose. This ACJ 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 ACJ are the result of the experience and expertise of Authorities, operators, and manufacturers of helicopters and FSTDs (FFS, FTD and FNPT).

1.2.3 In showing compliance with JAR–FSTD H.030, the Authority expects account to be taken of the RAeS document entitled ‘Data Package Requirements for Design and Performance Evaluation of Rotary Wing Synthetic Training Devices’ – (2004 or as amended), as appropriate to the Qualification Level sought. In any case early contact with the Authority is advised at the initial stage of FSTD build to verify the acceptability of the data.

1.3 Levels of FSTD qualification.

1.3.1 Parts 2, and 3 of this ACJ describe the minimum requirements for qualifying Level A, B, C and D helicopter FFS, Level 1, 2 and 3 helicopter FTDs and FNPT levels I, II, IIMCC, III and IIIMCC for generic helicopters.

NOTE: Where an FTD Level 1 simulates a single helicopter system, it shall 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 ACJ are contained in ACJ to FSTD H.005.

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, touchdown; specific operations; control checks; flight deck and instructor station functions checks; and certain additional requirements depending on the complexity or Qualification Level of the FSTD. The motion and visual systems (where applicable) will be evaluated to ensure their proper operation.

1.5.2 The intent is to evaluate the FSTD as objectively as possible. Pilot acceptance, however, is also an important consideration. Therefore, the FSTD will be subjected to validation, and functions and subjective tests listed in Part 2 and 3 of this ACJ. Validation tests are used to compare objectively FSTD and 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 (Paragraph 2) of this ACJ are the maximum acceptable for FSTD qualification and should not be confused with FSTD design tolerances.

1.5.4 For initial qualification of FSTDs 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.

1.5.5 In the case of new aircraft programmes, the aircraft manufacturer's data partially validated by flight test data, may be used in the interim qualification of the FSTD. However, the FSTD should be re-evaluated following the release of the manufacturer's approved data. The schedule should be as agreed by the Authority, FSTD operator, FSTD manufacturer, and aircraft manufacturer.

1.5.6 FSTD operators seeking initial or upgrade evaluation of a 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 ACJ. In this instance it may be necessary for an operator to acquire additional flight test data.

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

1.5.8 Validation tests which do not meet the test criteria should be addressed to the satisfaction of the Authority.

1.6 Qualification Test Guide (QTG)

1.6.1 The QTG is the primary reference document used for evaluating a 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 ACJ.

1.6.2 The FSTD operator should submit a QTG which includes:

a. A title page with FSTD operator and approval Authority signature blocks.

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

(i) FSTD operator's FSTD identification number.
(ii) Helicopter model and series being simulated.
(iii) References to aerodynamic data or sources for aerodynamic model.
(iv) References to engine data or sources for engine model.
(v) References to flight control data or sources for flight controls model.
(vi) Avionic equipment system identification where the revision level affects the training and checking capability of the FSTD.

ACJ No.1 to JAR-FSTD H.030 (continued)

(vii) FSTD model and manufacturer.
(viii) Date of FSTD manufacture.
(ix) FSTD computer identification.
(x) Visual system type and manufacturer (if fitted).
(xi) Motion 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 Compliance (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. This should be short and definitive, based on the test title referred to in paragraph 2.3 of this ACJ;
(ii) Test objective. This should be a brief summary of what the test is intended to demonstrate;
(iii) Demonstration procedure. This is a brief description of how the objective is to be met;
(iv) References. These are the helicopter data source documents including both the document number and the page or condition number;
(v) Initial conditions. A full and comprehensive list of the test initial conditions is required;
(vi) Manual test procedures. Procedures should be sufficient to enable the test to be flown by a qualified pilot, using reference to flight deck instrumentation and without reference to other parts of the QTG or flight test data or other documents;
(vii) Automatic test procedures (if applicable).
(viii) Evaluation criteria. Specify the main parameter(s) under scrutiny during the test;
(ix) Expected result(s). The 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. Dated 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. 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. An acceptable means of easily comparing FSTD test results with the validation flight test data.

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 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. The test guide will provide the documented proof of compliance with the FSTD validation tests in the tables in paragraph 2. 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 and used in the initial evaluation should be included.

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 Qualification Level, 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 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. After review of these tests, the Authority will 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 Authority. As a minimum, the QTG tests should be run progressively in at least four approximately equal 3 monthly blocks on an annual cycle. Each block of QTG tests should be chosen to provide coverage of the different types of validation, functions & subjective tests. Results shall be dated and retained in order to satisfy both the FSTD operator as well as the Authority that the FSTD standards are being maintained. It is not intended that the complete QTG is run just prior to the annual evaluation.

2 FSTD Validation Tests

2.1 General

2.1.1 FSTD performance and system operation should be objectively evaluated by comparing the results of tests conducted in the FSTD with helicopter data unless specifically noted otherwise. To facilitate the validation of the FSTD, an appropriate recording device acceptable to the 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 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 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 Validation Tests in this ACJ 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 Computer Controlled Helicopter (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 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 Level 1 or FNPT Level I, a visual system, such equipment is expected to satisfy, as a minimum, tests as follows:

a. Visual system: where fitted to an FNPT Level I or FTD Level 1, validation tests are those specified for a FNPT Level II or for a FTD Level 2 respectively.

b. Motion system: where fitted to an FTD or FNPT, validation tests are those specified for a Level A FFS.

2.2 Test requirements

2.2.1 The ground and flight tests required for qualification are listed in the table of FSTD Validation Tests. 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. 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. Tolerances should be only applied in the validity domain of the parameter sensors.

2.2.2.1 Parameters, tolerances, and flight conditions.

a. 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:

b. 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%).

c. 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.

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

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 ‘Correct Trend and Magnitude’ (CT&M), the FSTD should be tested and assessed as representative of the helicopter to the satisfaction of the 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.

2.2.2.4 For the conditions where the design of the flight controls system does not imply any difference on the rotor blade pitch positions between augmented case and unaugmented case, unaugmented case validation data are not required for the unaugmented case. A rationale is to be provided to identify which tests are not performed.

2. 3 Table of FSTD Validation Tests

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 Flight Test Data. 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: It is accepted that tests and associated tolerances will only apply to a Level 1 FTD if that system or flight condition is simulated.

Note 2: For piston engines, suitable alternative parameters should be used, which have to be agreed with the Authority.

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TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
1. PERFORMANCE														
a. Engine Assessment														
(1) Start Operations (i) Engine Start and acceleration (transient)	Light Off Time ± 10% or ± 1 sec Torque ± 5% Rotor Speed ± 3% Fuel Flow ± 10% Gas Generator Speed ± 5% Power Turbine Speed ± 5% Turbine Gas Temp. ± 30°C	Ground Rotor Brake used / Not used	CT&M	✓	✓	✓	CT&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

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(ii) Steady State Idle and Operating RPM Conditions	Torque ± 3% Rotor Speed ± 1.5% Fuel Flow ± 5% Gas Generator Speed ± 2% Power Turbine Speed ± 2% Turbine Gas Temp. ± 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.
(2) Power Turbine Speed Trim	± 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)

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(3) Engine & Rotor Speed Governing	Torque ± 5% Rotor Speed ± 1.5%	Climb / Descent	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 Radius Turn	Helicopter turn radius ± 3ft (0.9m) or 20%	Ground		✓	✓	✓								If differential braking is used, brake force shall be set at the helicopter test flight value.
(2) Rate of Turn vs Pedal Deflection or nosewheel angle	Turn rate ± 10% or 2^{o} / sec	Ground		✓	✓	✓								Without use of wheel brake

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(3) Taxi	Pitch attitude ± 1.5° Torque ± 3% Longitudinal Control Position ± 5% Lateral Control Position ± 5% Directional Control Position ± 5% Collective Control Position ± 5%	Ground	C T & M	✓	✓	✓								Control Position & Pitch Attitude during ground taxi for a specific ground speed & direction, and density altitude
(4) Brake Effectiveness	Time : ± 10% or ± 1s and Distance : ± 10% or ± 30m (100ft)	Ground	C T & M	✓	✓	✓	C T & M	C T & M	C T & M					Record data Until full stop.
c. Take-off														

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(1) All engines	Airspeed ± 3 kt Altitude ± 20 ft (6.1 m) Torque ± 3% Rotor Speed ± 1.5% Pitch Attitude ± 1.5° Bank Attitude ± 2° Heading ± 2° Longitudinal Control Position ± 10% Lateral Control Position ± 10% Directional Control Position ± 10% Collective Control Position ± 10%	Ground/lift off and initial climb	C T & M	✓	✓	✓	C T & M	✓	✓		✓	✓	✓	Time history of takeoff flight path as appropriate to helicopter model simulated [running take off for FFS Level B & FTD Level 2. Takeoff from a hover for FS Level C & D or FTD Level 3]. For FFS Level B and FTD Level 2, criteria apply only to those segments at airspeeds above effective translational lift. Record data to at least 200 ft (61 meters)AGL/Vy whichever comes later
(2) One Engine Inoperative continued takeoff	See 1.c.(1) above for tolerances and flight conditions	Takeoff & initial climb	C T & M	✓	✓	✓	C T & M	✓	✓		✓	✓	✓	Time history of takeoff flight path as appropriate to helicopter model simulated. Record data to at least 200 ft (61 meters)AGL/Vy 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 rejected take off	Airspeed ± 3 kt Altitude ± 20 ft (6.1m) Torque ± 3% Rotor Speed ± 1.5% Pitch Attitude ± 1.5° Bank Attitude ± 1.5° Heading ± 2° Longitudinal Control Position ± 10% Lateral Control Position ± 10% Directional Control Position ± 10% Collective Control Position ± 10% Distance: ± 7.5% or ± 30m (100ft)	Ground/Takeoff	CT&M	CT&M	✓	✓		✓	✓			✓	✓	Time history from the take off point to touch down. Test conditions near limiting performance

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
d. Hover Performance	Torque ± 3% Pitch Attitude ± 1.5° Bank Attitude ± 1.5° Longitudinal Control Position ± 5% Lateral Control Position ± 5% Directional Control Position ± 5% Collective Control Position ± 5%	In Ground Effect (IGE) Out of Ground Effect (OGE) Stability augmentation on and off	CT&M	✓	✓	✓	CT&M	✓	✓		✓	✓	✓	Light/heavy gross weights. May be snapshot tests. Refer to point 2.4.2 below for additional guidance.
e. Vertical Climb Performance	Vertical Velocity ± 100 fpm (0.50 m/sec) or 10% Directional Control Position ± 5% Collective Control Position ± 5%	From OGE Hover Stability augmentation on and off	CT&M	✓	✓	✓	CT&M	✓	✓		✓	✓	✓	Light/heavy gross weights. 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	
f. Level Flight Performance and Trimmed Flight Control Position	Torque ± 3% Pitch Attitude ± 1.5° Sideslip Angle ± 2° Longitudinal Control Position ± 5% Lateral Control Position ± 5% Directional Control Position ± 5% Collective Control Position ± 5%	Cruise Stability Stability augmentation on or off	CT&M	✓	✓	✓	CT&M	✓	✓	✓	✓	✓	✓	Two combination of gross weight/cg and two speeds within the flight envelope. May be snapshot tests. For FNPT Level 1 changes in Cg are not required

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
g. Climb Performance and Trimmed Flight Control Position	Vertical Velocity ± 100fpm (0.50 m/sec) or 10% Pitch Attitude ± 1.5° Sideslip Angle ± 2° Longitudinal Control Position ± 5% Lateral Control Position ± 5% Directional Control Position ± 5% Collective Control Position ± 5% Speed ± 3kts	All engines operating One engine inoperative Stability augmentation on or off	CT&M	✓	✓	✓	CT&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 Approved Flight Manual values. For FNPT Level 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 Performance and trimmed Flight Control Position	Torque ± 3% Pitch Attitude ± 1.5° Sideslip Angle ± 2° Longitudinal Control Position ± 5% Lateral Control Position ± 5% Directional Control Position ± 5% Collective Control Position ± 5%	At or near 1000 fpm (5m/sec) Rate of Descent (RoD) at normal approach speed. Stability augmentation on or off	C T & M	✓	✓	✓	C T & M	✓	✓	✓	✓	✓	✓	Two gross weight/CG combinations For FNPT Level 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	
(2) Autorotation Performance and trimmed Flight Control Position	Vertical Velocity ± 100fpm (0.50 m/sec) or 10% Rotor Speed ± 1.5% Pitch Attitude ± 1.5° Sideslip Angle ± 2° Longitudinal Control Position ± 5% Lateral Control Position ± 5% Directional Control Position ± 5% Collective Control Position ± 5%	Steady descents Stability augmentation on or off	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 to at least maximum glide distance airspeed. May be a series of snapshot tests.
i. Auto-rotational Entry	Torque ± 3% Rotor speed ± 3% Pitch Attitude ± 2° Roll Attitude ± 3° Heading ± 5° Airspeed ± 5 kt Altitude ± 20ft (6.1m)	Cruise or climb	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														

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(1) All Engines	Airspeed ± 3 kt Altitude ± 20 ft (6.1m) Torque ± 3% Rotor Speed ± 1.5% Pitch Attitude ± 1.5° Bank Attitude ± 1.5° Heading ± 2° Longitudinal Control Position ± 10% Lateral Control Position ± 10% Directional Control Position ± 10% Collective Control Position ± 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 Level B / FTD Level 2, approach to a hover and to touchdown for FFS Level C & D / FTD Level 3). For FFS levels A & B, and FTD Levels 1 and 2, & FNPT Level II and IIIcriteria apply only to those segments at airspeeds above effective translational lift.
(2) One Engine Inoperative	See 1j(1) above for tolerances	Approach and landing	C T & M	✓	✓	✓	C T & M	✓	✓		✓	✓	✓	Include data for both Category A & Category B Approaches & landings as appropriate to the helicopter model being simulated. For FFS levels A & B, and FTD Levels 1 and 2, and FNPT Level II and III criteria apply to only those segments at airspeeds above effective translational lift

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(3) Balked Landing/missed approach	See 1j(1) above for tolerances	Approach, one engine inoperative		✓	✓	✓		✓	✓		✓	✓	✓	From a stabilized approach at the landing decision point (LDP).

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(4) Auto-rotational Landing with Touchdown	Airspeed ± 3kts Torque ± 3% Rotor Speed ±3% Altitude ± 20ft (6.1m) Pitch Attitude ± 2° Bank Attitude ± 2° Heading ± 5° Longitudinal Control Position ± 10% Lateral Control Position ± 10% Directional Control Position ± 10% Collective Control Position ± 10%	Approach and Touchdown			✓	✓		CT&M	CT&M					Time history of auto-rotational deceleration and touchdown from a stabilized 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, Static Trim On and Off Friction Off 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 be measured at the control. An alternate method acceptable to the 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, Static Trim On/Off Friction Off Stability augmentation on/off	✓	✓	✓	✓	CT&M	✓	✓	✓	✓	✓	✓	Uninterrupted control sweeps. This test is not required for aircraft hardware modular controllers. Collective and pedal position vs. force shall be measured at the control. An alternate method acceptable to the 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	
(3) Brake Pedal Force vs Position	± 5 lb (2.224 daN) or 10%	Ground, Static	CT&M	✓	✓	✓	CT&M	✓	✓					Simulator computer output results may be used to show compliance.
(4) Trim System Rate (all applicable axes)	Rate ± 10%	Ground, Static Trim on Friction off	✓	✓	✓	✓	CT&M	✓	✓	✓	✓	✓	✓	Tolerance applies to recorded value of trim rate.
(5) Control Dynamics (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 Cruise Trim on Friction off Stability augmentation on and off		✓	✓	✓		CT&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.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(6) Free play	± 0.10 in (2.5mm)	Ground, Static Friction Off		✓	✓	✓		✓	✓					Applies to all controls.
b. Low Airspeed Handling Qualities														
(1) Trimmed Flight Control Positions	Torque ± 3% Pitch Attitude ± 1.5° Bank Attitude ± 2° Longitudinal Control Position ± 5% Lateral Control Position ± 5% Directional Control Position ± 5% Collective Control Position ± 5%	Translational Flight IGE. Sideways, rearward and forward Stability augmentation on or off			✓	✓		✓	✓					Several airspeed increments to translational airspeed limits and 45 kt 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 Azimuth	Torque ± 3% Pitch Attitude ± 1.5° Bank Attitude ± 2° Longitudinal Control Position ± 5% Lateral Control Position ± 5% Directional Control Position ± 5% Collective Control Position ± 5%	Hover 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 realize this test with tests 2b (1) in order to ensure consistency between critical azimuth and other directions (forward, sideward and rearward)

ACJ No.1 to JAR-FSTD H.030 (continued)

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(3) Control Response														
(i) Longitudinal	Pitch Rate ± 10% or ± 2°/sec Pitch Attitude Change ± 10% or ± 1.5°	Hover Stability augmentation on and off			✓	✓		C T & M	✓					Step control input. Off axis response must show correct trend for unaugmented cases.
(ii) Lateral	Roll Rate ± 10% or ± 3°/sec Roll Attitude Change ± 10% or ± 3°	Hover Stability augmentation on and off			✓	✓		C T & M	✓					Step control input. Off axis response must show correct trend for unaugmented cases.
(iii) Directional	Yaw Rate ± 10% or ± 2°/sec Heading Change ± 10% or ± 2°	Hover Stability 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	
(iv) Vertical	Normal Acceleration ± 0.1g	Hover Stability 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 Response	Pitch Rate ± 10% or ± 2°/sec Pitch Attitude Change ± 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

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(2) Static Stability	Longitudinal Control Position ± 10% of change from trim or ± 0.25 in (6.3 mm) or Longitudinal Control Force ± 0.5 lb (0.224 daN) or ± 10%	Cruise or Climb and Autorotation Stability augmentation on or off	✓	✓	✓	✓	C T & M	✓	✓					Minimum of two speeds on each side of the trim speed. May be a series of snapshot tests.
(3) Dynamic Stability (i) Long Term Response	± 10% of Calculated Period ± 10% of Time to 1/2 or Double Amplitude or ± 0.02 of Damping Ratio	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.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(ii) Short Term Response	± 1.5° Pitch attitude or ± 2°/sec Pitch Rate ± 0.1 g Normal Acceleration	Cruise or Climb Stability augmentation on and off		✓	✓	✓		CT&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 Stability	Longitudinal Control Position ± 10% of change from trim or ± 0.25 in (6.3 mm) or Longitudinal Control Force ± 0.5 lb (0.224 daN) or ± 10%	Cruise or Climb Stability augmentation on or off Left and right turns	CT&M	✓	✓	✓	CT&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 data should be presented.
(5) Landing Gear Operating Time	± 1 sec	Takeoff (Retraction) Approach (Extension)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
d. Lateral & Directional Handling Qualities.														

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(1) Control Response (i) Lateral	Roll Rate ± 10% or ± 3°/sec Roll Attitude Change ± 10% or ± 3°	Cruise Stability 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 Change ± 10% or ± 2^{0}	Cruise Stability 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 Static Stability	Lateral Control Position ± 10% of change from trim or ± 0.25in (6.3 mm) , or , Lateral Control Force ± 0.5 lb (0.224 daN) or ± 10% Roll Attitude ± 1.5° Directional Control Position ± 10% of change from trim or ± 0.25 in (6.3 mm) or Directional Control Force ± 1 lb (0.448 daN) or ± 10% Longitudinal Control Position ± 10% of change from trim or ± .25in (6.3mm)	Cruise or (Climb and Descent) 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 Lateral and Directional Stability														

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(i) Lateral-Directional Oscillations	± 0.5 sec or ± 10% of Period ± 10% of Time to ½ or Double Amplitude or ± .02 of Damping Ratio ± 20% or ± 1 sec of Time Difference between peaks of Bank and Sideslip	Cruise or Climb 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 Stability	Correct trend on Bank - ±2° or ± 10% in 20 sec	Cruise or Climb 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.
(iii) Adverse/Proverse Yaw	Correct trend on side slip ±2°	Cruise or Climb 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.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
3. ATMOSPHERIC MODELS														
(1) A test to demonstrate turbulence models	N/A	Take-off, Cruise and Landing	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	
(2) Tests to demonstrate other atmospheric models to support the required training						✓			✓			✓	✓	
4. MOTION SYSTEM **[**]														
a. Motion Envelope														
(1) Pitch		N/A												
(i) Displacement														
± 20^0			✓	✓										
± 25$^{0/}$					✓	✓								
(ii) Velocity														
± 15^0/sec			✓	✓										

[**] 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	
±20°/sec					✓	✓								
(iii)Acceleration														
±75°/sec²			✓	✓										
± 100°/sec²					✓	✓								
(2) Roll		N/A												
(i) Displacement														
± 20°			✓	✓										
± 25°					✓	✓								
(ii) Velocity														
± 15°/sec			✓	✓										
±20°/sec					✓	✓								
(iii)Acceleration														
±75°/sec			✓	✓										
± 100°/sec					✓	✓								

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(3) Yaw		N/A												
(i) Displacement														
$\pm 25^0$				✓	✓	✓								
(ii) Velocity														
$\pm 15^0$/sec				✓										
$\pm 20^o$/sec					✓	✓								
(iii)Acceleration														
$\pm 75^o/sec^2$				✓										
$\pm 100^o/sec^2$					✓	✓								
(4) Vertical		N/A												
(i) Displacement														
± 22 in			✓	✓										
± 34 in					✓	✓								
(ii) Velocity														
± 16 in/sec			✓	✓										

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
± 24 in/sec					✓	✓								
(iii) Acceleration														
± 0.6g			✓	✓										
± 0.8g					✓	✓								
(5) Lateral		N/A												
(i) Displacement														
± 26in				✓										
± 45in					✓	✓								
(ii) Velocity														
± 20 in/sec				✓										
± 28 in/sec					✓	✓								
(iii) Acceleration														
± 0.4g				✓										
± 0.6g					✓	✓								

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(6) Longitudinal		N/A												
(i) Displacement														
± 27in				✓										
± 34in					✓	✓								
(ii) Velocity														
± 20in/sec				✓										
± 28in/sec					✓	✓								
(iii) Acceleration														
± 0.4g				✓										
± 0.6g					✓	✓								
(7) Initial Rotational Acceleration Rate		N/A												All relevant rotational axes
All Axes ± 225^0/sec²/sec			✓	✓										
± 300^0/sec²/sec					✓	✓								

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(8) Initial Linear Acceleration Rate		N/A												
(i) Vertical														
± 4g/sec			✓	✓										
± 6g/sec					✓	✓								
(ii) Lateral														
± 2g/sec				✓										
± 3g/sec					✓	✓								
(iii) Longitudinal														
± 2g/sec				✓										
± 3g/sec					✓	✓								
b. Frequency Response Band, Hz	Phase Amplitude Deg Ratio Db	N/A		✓	✓	✓								All six axis
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 Acceleration	1.5 deg 0.02g or 3deg/sec² (peak)	N/A		✓	✓	✓								The phase shift between a datum jack & any other jack shall be measured using a heave (vertical) signal of 0.5hz at ± 0.25g The acceleration in the other five axes should be measured using a heave (vertical) signal of 0.5hz at ± 0.1g
d. Turn Around	0.05g			✓	✓	✓								The motion base shall be driven sinusoidally in heave through a displacement of 6 in (150 mm) peak to peak at a frequency of 0.5Hz. Deviation from the desired sinusoidal acceleration shall be measured

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
e. Characteristic vibrations / buffet (1) Vibrations - Tests to include1/Rev and n/Rev vibrations where n is the number of rotor blades	+3 / -6db or ± 10% of nominal vibration level in flight cruise & correct trend (see comment)	On ground (idle Flt Nr); Low & High speed transition to & from hover; Level flight; Climb/descent (including vertical climb; Auto-rotation; Steady Turns				✓								Refer to section 1, appendix 1 to JAR-FSTD H 030 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 be demonstrated in the simulator.
(2) Buffet A test with recorded results is required for characteristic buffet motion which can be sensed in the cockpit	+3 / -6db 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 JAR-FSTD H.030 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

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
f. Motion Cue Repeatability	N/A			✓	✓	✓								See para 2.4.3.3 below
5. VISUAL SYSTEM Note: Refer to the table of functions & subjective tests for additional visual tests.														

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
a. Visual Ground Segment (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 height above touchdown zone elevation on glide slope at a RVR setting of 300 m (1 000 ft) or 350 m (1 200 ft) Static at 200 ft (61 m) landing gear height above touchdown zone on glide slope with 550 metres or 1805ft RVR	✓	✓	✓	✓								Visual Ground Segment. This test is designed to assess items impacting the accuracy of the visual scene presented to a pilot at DH on an ILS approach. Those items include 1) RVR, 2) Glideslope (G/S) and localiser modelling accuracy (location and slope) for an ILS, 3) For 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 Ground Segment (VGS) (continued)								✓	✓		✓	✓	✓	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 System Tests														

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
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: Not less than a total of 176º (including not less than 75º measured either side of the centre of the design eye point). Vertical FOV: Not less than a total of 56 º measured from the pilot’s and co-pilot’s eye point.	Not Applicable				✓								Field of view should be measured using a visual test pattern filling the entire visual scene (all channels) consisting of a matrix of black and white 5° squares. Installed alignment should be confirmed in a Statement of Compliance. The 75º minimums allows an offset either side of the horizontal field of view if required for the intended use.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
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: Not less than a total of 146º (including not less than 60º measured either side of the centre of the design eye point). Vertical FOV: Not less than a total of 56 º measured from the pilot's and co-pilot's eye point.	Not Applicable							✓			✓	✓	Field of view should be measured using a visual test pattern filling the entire visual scene (all channels) consisting of a matrix of black and white 5° squares. Installed alignment should be confirmed in a Statement of Compliance. The 60º minimums allows an offset either side of the horizontal field of view if required for the intended use.

ACJ No.1 to JAR-FSTD H.030 (continued)

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
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: Not less than a total of 146º (including not less than 60º measured either side of the centre of the design eye point). Vertical FOV: Not less than a total of 36 º measured from the pilot's and co-pilot's eye point.	Not Applicable			✓			✓			✓		✓	Field of view should be measured using a visual test pattern filling the entire visual scene (all channels) consisting of a matrix of black and white 5° squares. Installed alignment should be confirmed in a Statement of Compliance. The 60º minimums allows an offset either side of the horizontal field of view if required for the intended use.
1. (d) Visual field of view	visual system providing each pilot with 75º horizontal and 40º vertical field of view	Not Applicable		✓										

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
	visual system providing each pilot with 45º horizontal and 30º vertical field of view		✓											
2. Occulting Demonstrate 10 levels of occulting through each channel of the system	Demonstration model	Not applicable			✓	✓		✓	✓		✓	✓	✓	

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
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	✓	✓	✓	✓		✓	✓		✓	✓	✓	System geometry should be measured using a visual test pattern filling the entire visual scene (all channels) consisting of a matrix of black and white 5° squares with light points at the intersections. The operator should demonstrate that the angular spacing of any chosen 5° square and the relative spacing of adjacent squares are within the stated tolerances. The intent of this test is to demonstrate local linearity of the displayed image at either pilot eye-point.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
4. Surface Contrast Ratio	Not less than 5:1. 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 5º 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 foot-lamberts). Measure any adjacent dark squares. The contrast ratio is the bright square value divided by the dark square value. *Note. During contrast ratio testing, FSTD aft-cab and flight deck ambient light levels should be zero.*

ACJ No.1 to JAR-FSTD H.030 (continued)

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
5. Highlight Brightness	Not less than 20 cd/m2 (6 foot-Lamberts) from the display measured at the design eye point	Not Applicable			✓	✓								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.
	Not less than 17 cd/m2 (5 foot-Lamberts) from the display measured at the design eye point							✓	✓		✓	✓	✓	
6. Vernier Resolution	Not greater than 3 arc minutes	Not Applicable			✓	✓		✓	✓		✓	✓	✓	Vernier resolution should be demonstrated by a test of objects shown to occupy the required visual angle in each visual display used on a scene from the pilot's eye-point.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
7. Light point Size	Not greater than 6 arc minutes	Not Applicable			✓	✓			✓					Lightpoint size should be measured using a test pattern consisting of a centrally located single row of lightpoints reduced in length until modulation is just discernible in each visual channel. A row of 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						✓			✓	✓	✓	
8. Light point Contrast Ratio	Not less than 25:1	Not applicable			✓	✓			✓					Lightpoint contrast ratio 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. During contrast ratio testing, FSTD aft-cab and flight deck ambient light levels should be zero
	Not less than 5:1 Demonstration model							✓			✓	✓	✓	

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
6 FSTD SYSTEMS														
a Visual, Motion and Cockpit Instrument Response														
(1) Transport Delay	200 milliseconds or less after control movement						✓			✓				One test is required in each axis (Pitch, Roll & Yaw)
	150 milliseconds or less after control movement		✓	✓				✓			✓	✓	✓	
	100 milliseconds or less after control movement				✓	✓			✓					

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(1) Transport Delay (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 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.

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(1) Transport Delay (continued)														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), Instrument System response to an abrupt pilot controller input, compared to helicopter response for a similar input.	150 milliseconds or less after helicopter response’	Climb, Cruise and Descent	✓	✓										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 or less after helicopter response	Climb, Cruise, Descent and Hover (Hover 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. The test results in a comparison of a recording of the simulator's response with actual helicopter data
b Sound														
(1) Realistic engine and rotor sounds	Not applicable									✓				Statement of Compliance or demonstration of representative sounds

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(2) Establish amplitude & frequency of flight deck sounds	Not applicable	On ground all engines on and Hover and Straight and Level flight	✓	✓	✓			✓	✓		✓	✓	✓	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 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 Helicopter data set. The Helicopter and flight simulator results should be produced using comparable data analysis techniques. See ACJ No. 1 to JAR-FSTD H.030 para 2.4.5

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(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.
(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 Casess	Not Applicable					CT&M								Special cases identified as particularly significant to the pilot, important in training, or unique to a specific helicopter type or variant.

ACJ No.1 to JAR-FSTD H.030 (continued)

TESTS	TOLERANCE	FLIGHT CONDITIONS	FSTD LEVEL											COMMENTS
			FFS				FTD			FNPT				
			A	B	C	D	1	2	3	I	II	III	MCC	
(4) Flight Simulator Background noise	Initial evaluation: not applicable. Recurrent evaluation: ± 3dB per 1/3 octave band compared to initial evaluation					✓								Results of the background noise at initial qualification should be included in the QTG document and approved by the qualifying authority. The simulated sound will be evaluated to ensure that the background noise does not interfere with training. Refer to ACJ No. 1 to JAR-FSTD H.030 para 2.4.5.6. The measurements are to be made with the simulation running, the sound muted and a dead cockpit.
(5) Frequency Response	Initial evaluation: not applicable. Recurrent evaluation: cannot exceed ± 5 dB on three consecutive bands when compared to initial evaluation and the average of the absolute differences between initial and recurrent evaluation results cannot exceed 2 dB.				✓	✓								Only required if the results are to be used during recurrent evaluations according to ACJ No. 1 to JAR-FSTD H.030 para 2.4.5.7. The results shall be acknowledged by the authority at initial qualification.

2.4 Information for Validation Tests,

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 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 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 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 Response.

(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 be independently compared with the respective period of the helicopter control system and, consequently, will 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	First overshoot and ± 1 subsequent overshoots

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ACJ No.1 to JAR-FSTD H.030 (continued)

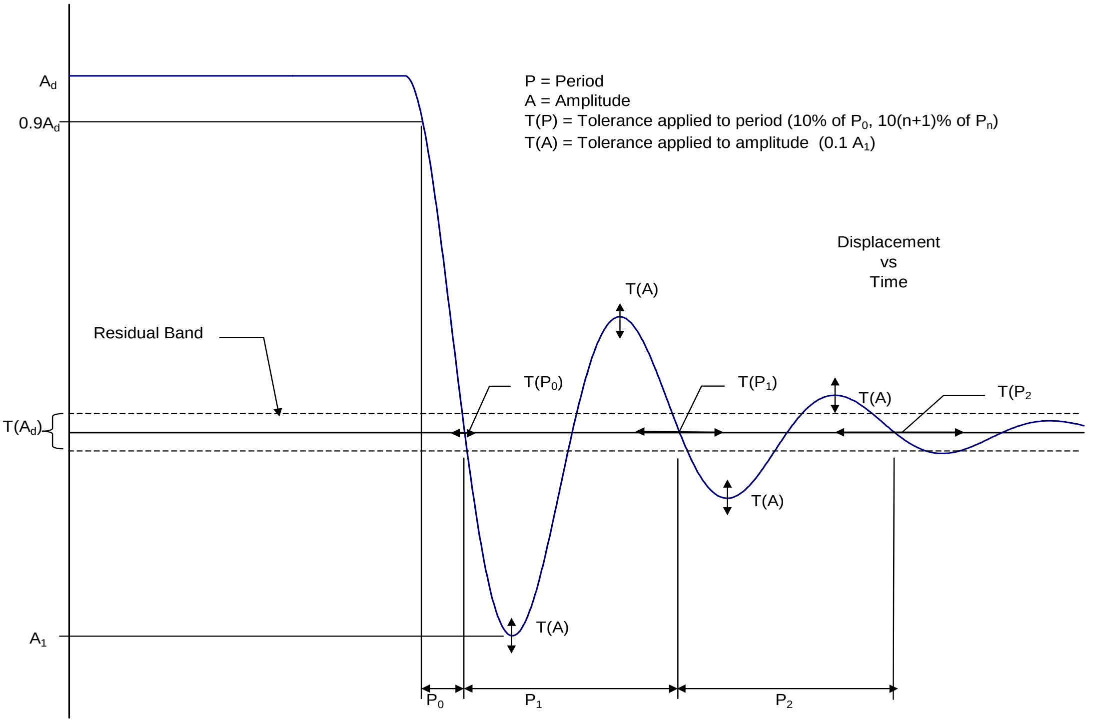

Figure 1: Underdamped step response

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ACJ No.1 to JAR-FSTD H.030 (continued)

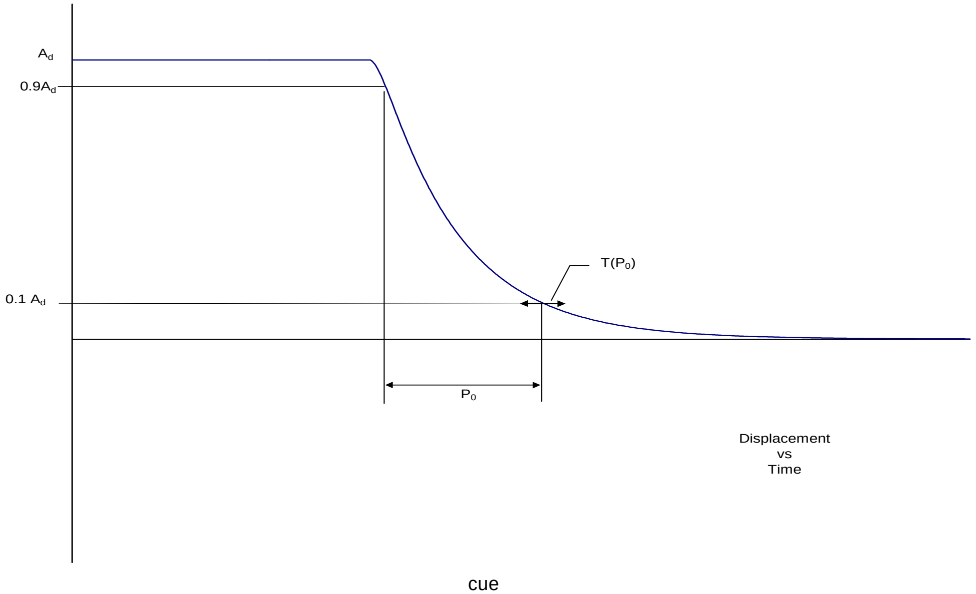


Figure 2: Critically damped step response

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 – Slowly move the control such that approximately 100 seconds are required to achieve a full sweep. A full sweep is defined as movement of the controller from neutral to the stop, usually aft or right stop, then to the opposite stop, then to the neutral position.

b. Slow dynamic test – Achieve a full sweep in approximately 10 seconds.

c. Fast dynamic test – Achieve a full sweep in approximately 4 seconds.

Note: Dynamic 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 validation tests.

b. Dynamic test – ± 0·9 daN (2 lbs) or ± 10% on dynamic increment above static test.

The 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 find that alternative methods do not result in satisfactory performance, then more conventionally accepted methods should be used.

2.4.2 Ground Effect

2.4.2.1 For a FSTD to be used for lift-off and touchdown 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 Ground Effect are:

ACJ No.1 to JAR-FSTD H.030 (continued)

a. Longitudinal, lateral, directional and collective control positions

b. Torque required for hover

c. Height

d. Airspeed

e. Pitch Attitude

f. Roll Attitude

A dedicated test should be provided which will 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:

a. Level fly-bys. 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. 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.

2.4.3 Motion System

2.4.3.1 General

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.

2.4.3.2 Motion System Checks.

The intent of tests as described in the table of FSTD validation tests, paragraph 2.3 - 4.a, Motion Enveloppe, 4.b, Frequency Response Band, 4.c, Leg Balance and 4.d, Turn Around, 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 Cue Repeatability Testing

The motion system characteristics in the table of Validation Tests 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 occurs in an aircraft for the same tasks, motion systems will 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 motion performance change from the initially qualified baseline can be measured objectively. An objective assessment of motion performance change will be accomplished at least annually using the following testing procedure:

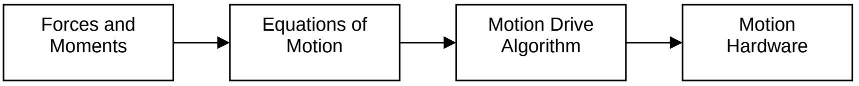
a. The current performance of the motion system should be assessed by comparison with the initial recorded data.

b. The parameters to be recorded should be the motion system drive algorithm acceleration command and the actual acceleration measured from the simulator accelerometers.

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

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.

NOTE: If the simulator weight or 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.



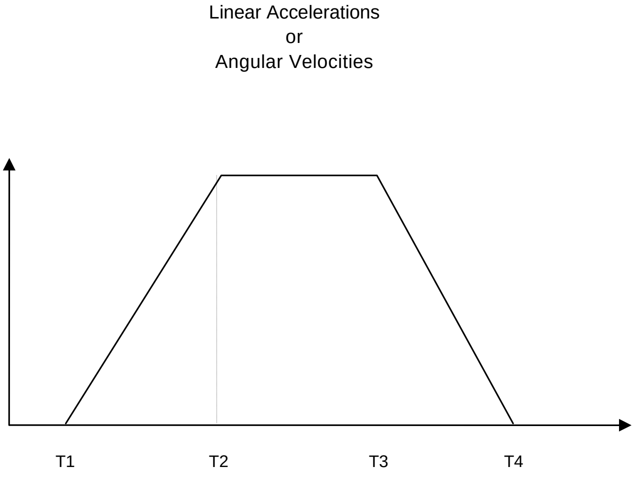


Figure 4

2.4.3.4 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 Power Spectral Density (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; however, if for subjective reasons the PSD plot was altered a rationale should be provided to justify the change. If the plot is on a logarithmic scale it may be difficult to interpret the amplitude of the buffet in terms of acceleration. A 1x10-3 grms2/Hz would describe a heavy buffet. On the other hand, a 1x10-6 grms2/Hz buffet is almost 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 System

2.4.4.1 Visual system

a. Contrast ratio (daylight systems). Should 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). Should 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 eyepoint. This should be confirmed by calculations in the statement of compliance. See paragraph 2.3.5.b.(5).

d. Lightpoint size (daylight systems) –should be measured in a test pattern consisting of a single row of lightpoints reduced in length until modulation is just discernible. See paragraph2.3.5.b.(6).

e. Lightpoint 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 View. 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 instruments.

b. The QTG should indicate the source of data, i.e. airport and runway used, ILS G/S antenna location (airport and helicopter), pilot eye reference point, flight deck cut-off angle, helicopter pitch attitude etc., used to make accurately 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 System

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 sounds are an important component of the flight deck operational environment and as such provide valuable information to the flight crew. These aural cues can either assist the crew, as an indication of an abnormal situation, or hinder the crew, as a distraction or nuisance. For effective training, the FSTD should provide flight deck sounds that are perceptible to the pilot during normal and abnormal operations, and that are comparable to those of the 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, 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 Data Collection System

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;
(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, 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):

(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 fall below this limit require careful review and may require lower limits on the background noise.

c. The background noise measurement may be rerun at the recurrent evaluation as stated in paragraph 2.4.5.8. The tolerances to be applied are that recurrent 1/3 octave band amplitudes cannot exceed ± 3 dB when compared to the initial results.

2.4.5.7 Frequency response - Frequency response plots for each channel should be provided at initial evaluation. These plots may be rerun at the recurrent evaluation as per paragraph 2.4.5.8. The tolerances to be applied are as follows:

a. recurrent 1/3 octave band amplitudes cannot exceed ± 5 dB for three consecutive bands when compared to initial results.

b. the average of the sum of the absolute differences between initial and recurrent results cannot exceed 2 dB (refer table 3).

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.

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;

d. extraneous sounds during recordings.

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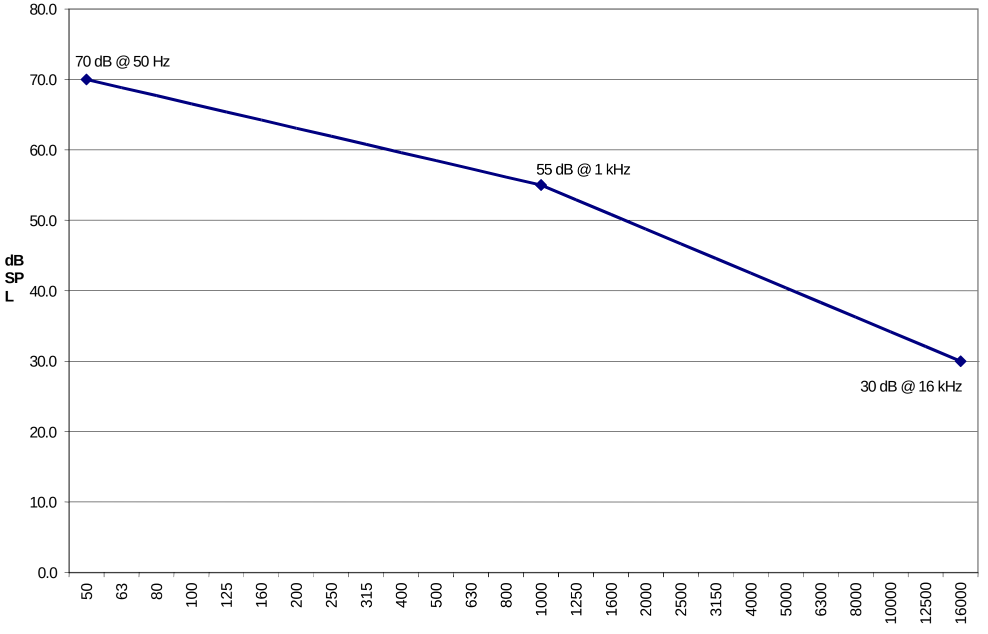

Figure 3. 1/3 Octave Band Frequency (Hz)

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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 Subjective Tests

3.1 Discussion

3.1.1 Accurate replication of helicopter systems functions will be checked at each flight crewmember position. This includes procedures using the operator's approved manuals, helicopter manufacturers approved manuals and checklists. Handling qualities, performance, and FSTD systems operation will be subjectively assessed. In order to assure the functions tests are conducted in an efficient and timely manner, operators are encouraged to coordinate with the appropriate Authority responsible for the evaluation so that any skills, experience or expertise needed by the 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 Qualification Level 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, 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 Line Oriented Flight Training (LOFT) scenario or special emphasis items in the operator's training programme. Unless directly related to a requirement for the current Qualification Level, the results of such an evaluation would not affect the FSTD's current status.

3.1.4 Functions tests will be run in a logical flight sequence at the same time as performance and handling assessments. This also permits real time FSTD running for 2 to 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 be assessed for normal and, where appropriate, alternate operations. Normal, abnormal, and emergency procedures associated with a flight phase will be assessed during the evaluation of manoeuvres or events within that flight phase. Systems are listed separately under 'any flight phase' to assure appropriate attention to systems checks.

3.2.4 When evaluating functions and subjective tests, the fidelity of simulation required for the highest level of qualification should be very close to the 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 should be tailored only to the systems and flight conditions which have been simulated. Similarly, many tests will 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 Qualification Level should be assessed to ensure the absence of any negative impact on the intended training and testing manoeuvres.

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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 effects

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-Flight: Accomplish a functions check of all switches, indicators, systems and equipment at crew members and instructors stations and determine that the flight deck design and functions are identical to that of the helicopter within the scope of simulation.	✓	✓	✓	✓	✓	✓	✓				
Pre-Flight: Accomplish a functions check of all switches, indicators, systems, and equipment at all crew members' and instructor's stations and determine that the flight deck design and functions represents those of a helicopter								✓	✓	✓	✓
b SURFACE OPERATIONS											
(1) Engine Start											✓
(a) Normal Start	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
(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) Ground resonance (if applicable on type).	✓	✓	✓	✓							

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD			FNPT			
	A	B	C	D	1	2	3	I	II	III	MCC
(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) Liftoff	*	✓	✓	✓							
(2) Hover	*	✓	✓	✓		✓	✓		✓	✓	✓
(3) Instrument response											
(a) Engine instruments	*	✓	✓	✓		✓	✓		✓	✓	✓
(b) Flight instruments	*	✓	✓	✓		✓	✓		✓	✓	✓
(4) Hovering turns	*	*	✓	✓		✓	✓		✓	✓	✓
(5) Hover power checks											
(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	*	✓	✓	✓		✓	✓		✓	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD			FNPT			
	A	B	C	D	1	2	3	I	II	III	MCC
(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) From hover	*	✓	✓	✓		✓	✓		✓	✓	
(II) Crosswind/tailwind	*	✓	✓	✓		✓	✓		✓	✓	✓
(III) MTOM	*	✓	✓	✓		✓	✓		✓	✓	✓
(IV) Confined area	*	✓	✓	✓			✓			✓	✓
(V) Slope	*	✓	✓	✓			✓			✓	✓
(VI) Elevated heliport/helideck	*	✓	✓	✓			✓			✓	✓
(VII) Vertical	*	✓	✓	✓							
(b) abnormal / emergency procedures											
(I) Engine failure during take-off (If single engine, up to initiation of the flare)	*	✓	✓	✓		✓	✓		✓1	✓	✓
(II) Forced landing (If single engine, up to initiation of the flare)	*	✓	✓	✓		✓	✓		✓1	✓	✓
(2) Cat A operation for all certified profiles	*	✓	✓	✓		✓1	✓		✓1	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD			FNPT			
	A	B	C	D	1	2	3	I	II	III	MCC
Take-off with engine failure											
(i) engine failure prior to TDP	*	✓	✓	✓		✓1	✓			✓	✓
(ii) engine failure at or after TDP	✓	✓	✓	✓		✓1	✓		✓1	✓	✓1
F CLIMB											
(1) Cat.B or single engine helicopters											
(a) Clear area	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(b) Obstacle clearance	✓	✓	✓	✓		✓	✓		✓	✓	✓
(c) Vertical	*	✓	✓	✓		✓	✓		✓	✓	✓
(d) Engine failure	✓	✓	✓	✓		✓	✓		✓	✓	✓
(2) Cat.A operation for all certified profiles with engine failure up to 300m (1000ft) above the level of the heliport	✓	✓	✓	✓		✓	✓		✓	✓	✓
G CRUISE											
(1) Performance characteristics	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
(2) Flying qualities	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(3) Turns											
(a) Turns at Rate 1 and 2	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
(b) Steep Turns	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD			FNPT			
	A	B	C	D	1	2	3	I	II	III	MCC
(4) Acceleration and decelerations	✓	✓	✓	✓							
(5) High airspeed vibration cues	✓	✓	✓	✓							
(6) Abnormal/emergency procedures											
(a) Engine fire	✓	✓	✓	✓		✓	✓		✓	✓	✓
(b) Engine failure	✓	✓	✓	✓		✓	✓		✓	✓	✓
(c) Inflight 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)											
(a) Straight in	*	✓	✓	✓		✓	✓		✓	✓	✓
(b) With turn	*	✓	✓	✓		✓	✓		✓	✓	✓
i VISUAL APPROACHES											

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD			FNPT			
	A	B	C	D	1	2	3	I	II	III	MCC
(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) Directional control failure	✓	✓	✓	✓		✓	✓		✓	✓	✓
(VI) Autorotation	*	✓	✓	✓		✓	✓		✓	✓	✓
(VII) Other	✓	✓	✓	✓		✓	✓				
(c) Balked landing											
(I) All engines operating	✓	✓	✓	✓		✓	✓		✓	✓	✓
(II) One or more engines inoperative	✓	✓	✓	✓		✓	✓		✓	✓	✓
(2) Cat.A operation for all certified profiles											
(a) from 300m (1000ft) above the level of the heliport to or after LDP	✓	✓	✓	✓		✓	✓		✓	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD			FNPT			
	A	B	C	D	1	2	3	I	II	III	MCC
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)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(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	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

ACJ No.1 to JAR-FSTD H.030 (continued)

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD			FNPT			
	A	B	C	D	1	2	3	I	II	III	MCC
(b) One or more engines inoperative	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(c) Approach procedures:	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(i) DGPS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
(ii) ILS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
• Manual without Flight Director, • Manual with Flight Director • 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 TOUCHDOWN											
(1) Cat B or single engine helicopters											
(a) Normal approach											
(i) To a hover	*	✓	✓	✓		✓1	✓		✓1	✓	✓
(ii) Elevated heliport/helideck		✓	✓	✓			✓			✓	✓
(iii) Confined area	*	✓	✓	✓			✓			✓	

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD			FNPT			
	A	B	C	D	1	2	3	I	II	III	MCC
(iv) Crosswind/tailwind	*	✓	✓	✓		✓1	✓		✓1	✓	✓
(v) Other	*	✓	✓	✓		✓1	✓		✓1	✓	✓
(b) Touchdown											
(i) From a hover	*	✓	✓	✓		✓1	✓		✓1	✓	✓
(ii) Running	*	✓	✓	✓		✓1	✓		✓1	✓	✓
(iii) Slope	*	*	✓	✓			✓			✓	
(c) Abnormal and emergency procedures during approach to landing and touchdown											
(i) One engine inoperative	✓	✓	✓	✓		✓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											
Landing with engine failure											
(i) engine failure prior to or at LDP	*	✓	✓	✓		✓1	✓		✓1	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD			FNPT			
	A	B	C	D	1	2	3	I	II	III	MCC
(ii) engine failure at or after LDP	*	✓	✓	✓		✓1	✓		✓1	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD			FNPT			
	A	B	C	D	1	2	3	I	II	III	MCC
I. ANY FLIGHT PHASE											
(1) Helicopter and powerplant systems operation (As 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) Stabilizer	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
(i) Flight controls/antitorque systems	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
(j) Fuel and oil	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
(k) Hydraulic	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
(l) Landing gear	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
(m) Power plant	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
(n) Transmission systems	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
(o) Rotor systems	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS		FFS				FTD			FNPT			
		A	B	C	D	1	2	3	I	II	III	MCC
(p)	Flight control computers	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
(q)	Stability and control augmentation systems (SAS)	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
(r)	Voice activated systems	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
(s)	Other	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
(2)	Flight management and guidance systems (as applicable)											
(a)	Airborne radar	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
(b)	Automatic landing aids	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
(c)	Autopilot	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
(d)	Collision avoidance systems (GPWS, 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	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD			FNPT			
	A	B	C	D	1	2	3	I	II	III	MCC
(c) Hazard avoidance (GPWS, TCAS, Weather radar, …) As applicable, except for Weather Radar required for MCC training in FNPT.	*	*	✓	✓		✓	✓		✓	✓	✓
(d) Retreating blade stall recovery (As applicable)	*	✓	✓	✓		✓	✓		✓	✓	✓
(e) Rotor mast bumping (As 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 groundspeed 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	*	✓	✓	✓							
(6) Representative cues resulting from touchdown	*	✓	✓	✓							

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD			FNPT			
	A	B	C	D	1	2	3	I	II	III	MCC
(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 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) Heliports											

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD			FNPT			
	A	B	C	D	1	2	3	I	II	III	MCC
(a)The distances at which heliport 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 definition, strobe lights, approach lights from 8km	✓	✓	✓	✓		✓	✓		✓	✓	✓
(ii) Visual approach Aids and FATO/LOF edge lights should be visible from 5km through approach angles up to 12 degrees	✓	✓	✓	✓		✓	✓		✓	✓	✓
(iii) FATO/LOF edge lights and taxiway definition from 3km	✓	✓	✓	✓		✓	✓		✓	✓	✓
(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 scenes which should be:											
(i) an airport	✓	✓	✓	✓		✓	✓		✓	✓	✓
(ii) a surface level confined area and		✓	✓	✓			✓			✓	✓
(iii) an elevated heliport		✓	✓	✓			✓			✓	✓
(c) Representative heliport scene content including the following:											
(i) Surfaces and markings on runways, heliport, taxiways and ramps	✓	✓	✓	✓		✓	✓		✓	✓	✓
(ii) Lighting for the FATO/TLOF, visual approach aids and approach lighting of appropriate colours	✓	✓	✓	✓		✓	✓		✓	✓	✓
(iii) Heliport perimeter and taxiway lighting	✓	✓	✓	✓		✓	✓		✓	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD			FNPT			
	A	B	C	D	1	2	3	I	II	III	MCC
(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 touchdown 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/nautical miles and RVR in meters/feet;	✓	✓	✓	✓		✓	✓		✓	✓	✓
(c) Airport/heliport selection;	✓	✓	✓	✓		✓	✓		✓	✓	✓
(d) Airport/heliport lighting;	✓	✓	✓	✓		✓	✓		✓	✓	✓
(e) ground 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, taxiways, ramps and terrain features).	*	✓	✓	✓		✓	✓		✓	✓	✓
(7) visual scene capability.											
(a) Twilight and night	✓	✓									
(b) Twilight, night and day			✓	✓		✓	✓		✓	✓	✓

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD			FNPT			
	A	B	C	D	1	2	3	I	II	III	MCC
(8) General terrain characteristics. Below 5000ft present realistic visual scene permitting navigation by sole reference to visual landmarks. Terrain contouring should be suitably represented.	*	✓	✓	✓		✓	✓			✓	✓
(9) At and below 610m (2000ft) height above the airport/heliport and within a radius of 16 kilometres (9NM) from the airport/heliport, weather representations, including the following;											
(a) Variable cloud density			✓	✓							
(b) Partial obscuration of ground scenes; the effect of a scattered to broken cloud deck			✓	✓		✓	✓			✓	✓
(c) Visual cues of speed through clouds				✓							
(d) Gradual break out			✓	✓		✓	✓			✓	✓
(e) Visibility and RVR measured in terms of distance.	✓	✓	✓	✓		✓	✓		✓	✓	✓
(f) Patchy fog			✓	✓							
(g) The effect of fog on airport/heliport 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.				✓							

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	FFS				FTD			FNPT			
	A	B	C	D	1	2	3	I	II	III	MCC
Note - Illusions may be demonstrated at a generic airport or specific aerodrome.											
(13) Special weather representations of light, medium, heavy precipitation and lighting near a thunderstorm on takeoff, approach and landing at and below an altitude of 610m (2000 feet) above the airport/heliport surface and within a radius of 16 kilometres (9 NM) from the airport/heliport.				✓							
(14) Wet and snow-covered landing areas including runway/heliport 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 lighting.	✓	✓	✓	✓		✓	✓		✓	✓	✓
(18) The visual scene should correlate with integrated helicopter systems, where fitted (e.g. terrain, traffic and weather avoidance systems and Head-up Guidance System (HGS)) (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 quantization (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 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 effects

Appendix 1 to ACJ No. 1 to JAR-FSTD H.030 (interpretative material)
Validation Test Tolerances

Background

1.1 The tolerances listed in ACJ No. 1 of JAR-FSTD H.030 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. Flight-test is subject to many sources of potential error, e.g. instrumentation errors and atmospheric disturbance during data collection;

b. Data that exhibit rapid variation or noise may also be difficult to match;

c. Engineering 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; 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. Hardware (avionics units and flight controls);

b. Iteration rates;

c. Execution order;

d. Integration methods;

e. Processor architecture;

f. Digital drift:

(i) Interpolation methods;
(ii) Data handling differences;
(iii) Auto-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. Flight test data could not reasonably be made available;

b. Data from engineering simulations made up only a small portion of the overall validation data set;

c. Key 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. Flight-test data are often not available due to sound technical reasons;

b. Alternative technical solutions are being advanced;

c. Cost is an ever-present issue.

Appendix 1 to ACJ No. 1 to JAR-FSTD H.030 (continued)

1.10 Guidelines are therefore needed for the application of tolerances to engineering-simulator-generated validation data.

2. Non-Flight-Test Tolerances

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 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.

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Appendix 2 to ACJ No.1 to JAR-FSTD H.030
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 authority as early as possible in the planning stages for any FSTD planned for qualification to the standards contained herein. The respective State 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 Joint Aviation Authorities' FSTD Steering Group 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 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 authority for obtaining deviations from QTG validation requirements.

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Appendix 2 to ACJ No. 1 to JAR-FSTD H.030 (continued)

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	Flight Controls POM Doc. # xxx456, NEW	Ground Handling POM Doc. # xxx789, Rev. B	Propulsion POM Doc. # xxx321, Rev. C	Integrated POM Doc. # xxx654, Rev. A	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 ACJ No. 1 to JAR-FSTD H.030, para 2.1
Rotor Aerodynamic Modelling Techniques

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 normalized 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 may occur in confined areas or in pinnacle training is problematic as the formulation assumes constant wind speed over the disk.

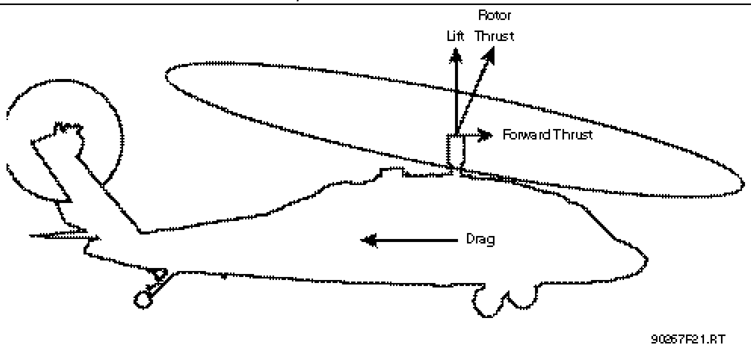

Figure 1

3. Rotor map models

3.1 Rotor map models, or coefficient models, are also not computationally demanding. In this method a database of coefficients or stability and control derivatives is used to compute aircraft forces and moments. The simulation will 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 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.

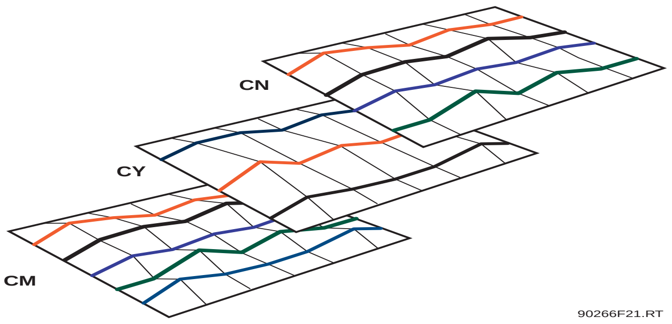

Figure 2

4 Blade Element Rotor Models

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 significantly more complex than a rotor disk, but offers 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.

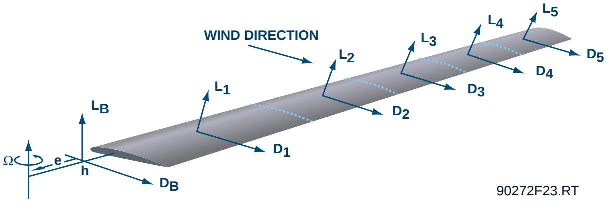

Figure 3

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 ACJ No. 1 to JAR-FSTD H.030 PARA 2.2
Vibration Platforms for Helicopter 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 harmonized 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 Degree-of-Freedom 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 Degree-of-Freedom 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 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 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 minimizes the risk of resonance.

Appendix 4 to ACJ No. 1 to JAR-FSTD H.030 para 2.2 (continued)

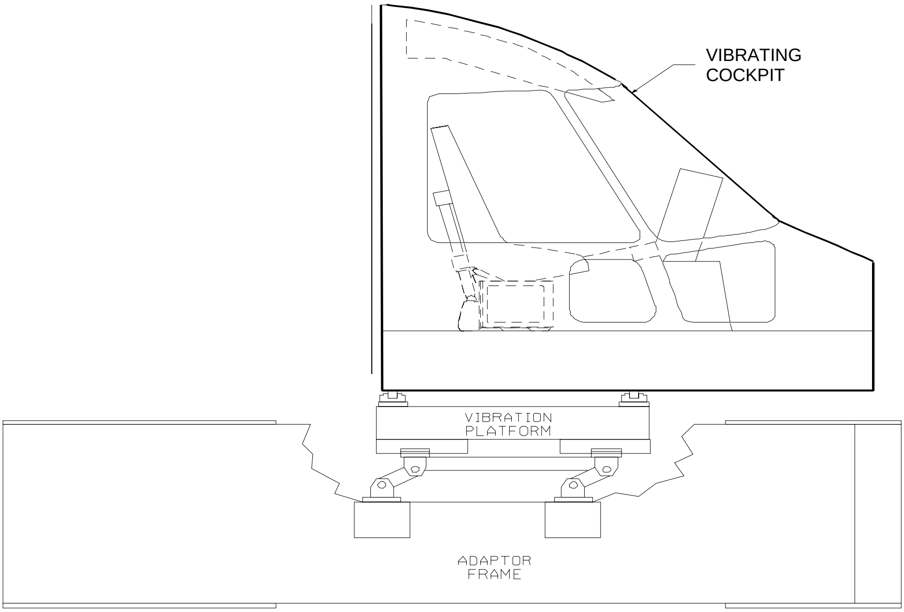

Figure 1: An Example of a three degree of freedom cockpit vibration system

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Appendix 5 To ACJ No.1 To JAR-FSTD H.030
Transport Delay Testing Method

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;

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 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 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 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 (See figure 4A). The display manufacturer shall provide this delay time.

1.12 Recorded signals. The signals recorded to conduct the transport delay calculations should be explained on a schematic block diagram. The FSTD manufacturer should also provide an explanation of why each signal was selected and how they relate to the above descriptions.

1.13 Interpretation of results. It is normal that FSTD results vary over time from test to test. This can easily be explained by a simple factor called ‘sampling uncertainty.’ All FSTDs run at a specific rate where all modules are executed sequentially in the host computer. The flight controls input can occur at any time in the iteration, but these data will not be processed before the start of the new iteration. For a FSTD running at 60 Hz a worst-case difference of 16·67 msec 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 occur before the end of the first video scan containing new information.

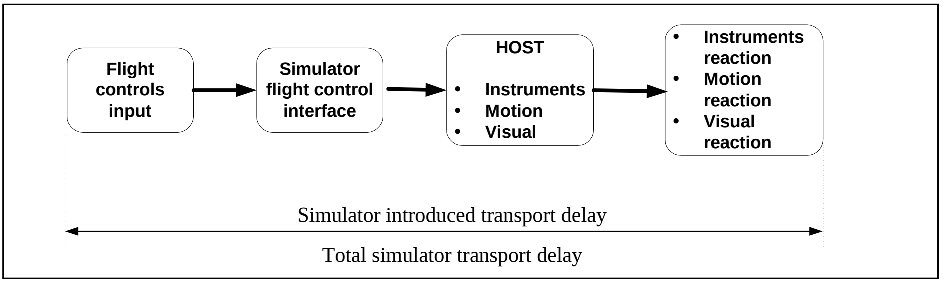

Figure 1: Transport Delay for simulation of classic non-computer controlled aircraft

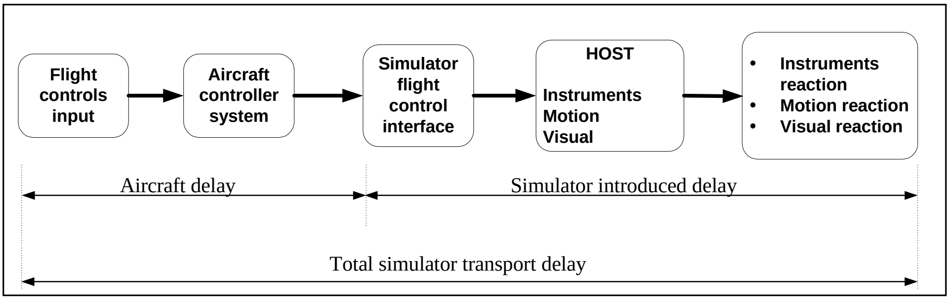

Figure 2: Transport Delay for simulation of computer controlled aircraft using real aircraft equipment

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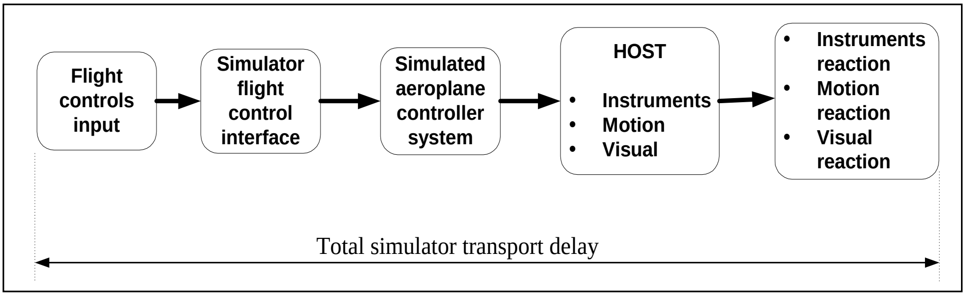

Figure 3: Transport Delay for simulation of computer controlled aircraft using software emulation of aircraft equipment

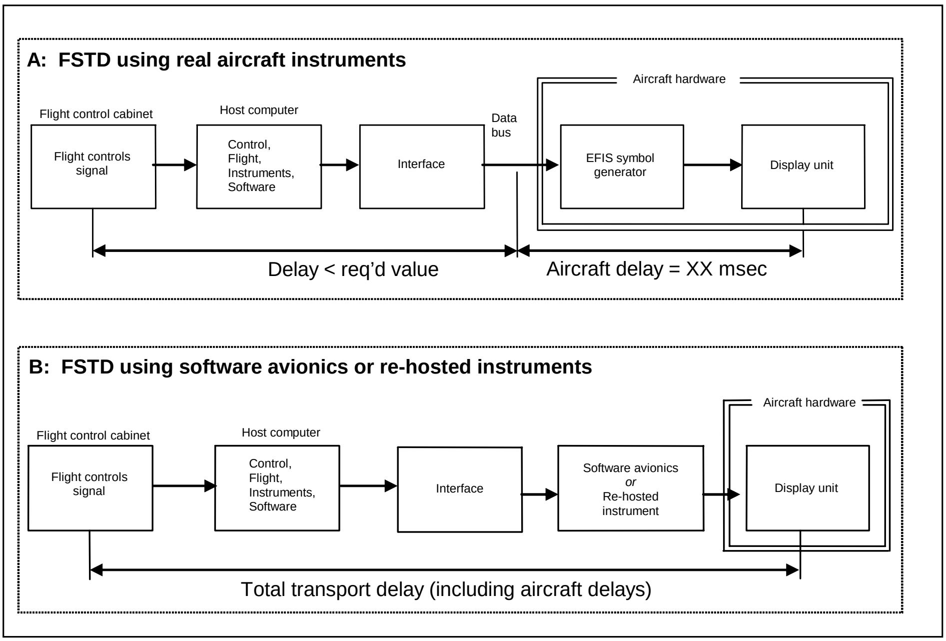

Figure 4A and 4B: Transport delay for simulation of aircraft using real or re-hosted instrument drivers

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Appendix 6 to ACJ No.1 to JAR-FSTD H.030
Recurrent Evaluations - Validation Test Data Presentation

1. Background

1.1 During the initial evaluation of a 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 authority are looking for any change in the FSTD performance since initial qualification.

2. Recurrent Evaluation Test Results Presentation

2.1 To promote a more efficient recurrent evaluation, FSTD operators are encouraged to over-plot recurrent validation test results with MQTG FSTD results recorded during the initial evaluation and as amended. Any change in a validation test will be readily apparent. In addition to plotting recurrent validation test and MQTG results, operators may elect to plot reference data as well.

2.2 There 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 ACJ), which 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 ACJ No. 5 to JAR-FSTD H.030 paragraph 5.4.

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Appendix 7 to ACJ No.1 to JAR- FSTD H.030
Applicability of JAR-FSTD Amendments to FSTD Data Packages for Existing Aircraft

Except where specifically indicated otherwise within ACJ No 1 to JAR-FSTD H.030 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 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 JAR-FSTD H, the provision of acceptable data to support the FSTD qualification process is a matter of planning and regulatory agreement (see ACJ to JAR-FSTD H.045 New Helicopter FSTD Qualification).

For helicopters certificated prior to the release of the current amendment of JAR-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, ACJ Nos 1 and 2 to JAR-FSTD H.030(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) Flight test at an alternate but near equivalent condition/configuration.

(b) Data from an audited engineering simulation as defined in ACJ JAR-FSTD H.005 Para 1.1.e from an acceptable source (for example meets the guidelines laid out in ACJ No 1 to JAR-FSTD H.030(c)(1) Para 2), or as used for aircraft certification.

(c) Aircraft Performance Data as defined in ACJ JAR-FSTD H.005 Para 1.1.b or other approved published sources (e.g., Production flight test schedule) for the following tests:-

  (i) 1d Hover performance (IGE, OGE)

  (ii) 1g Climb performance (AEO, OEI)

(d) Where 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 concerned taking into consideration the level of qualification sought for the FSTD …

  (iii) Unpublished but acceptable sources e.g., calculations, simulations, video or other simple means of flight test analysis or recording

  (iv) Footprint test data from the actual training FSTD requiring qualification validated by NAA 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 Validation Data Road map (VDR) in accordance with and as defined in Appendix 2 to ACJ No. 1 to JAR-FSTD H.030.

It should be recognized that there may come a time when there are so little compatible flight test data available that new flight test may be required to be gathered.

Appendix 8 to ACJ No. 1 to JAR-FSTD H.030
Visual Display Systems
See ACJ No. 1 to JAR-FSTD H.030

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 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 FSTD display provides an image located not closer than about 6-10m from the viewer, with the distance varying over the field of view. A schematic representations of a collimated display is provided in Figure 1 below.

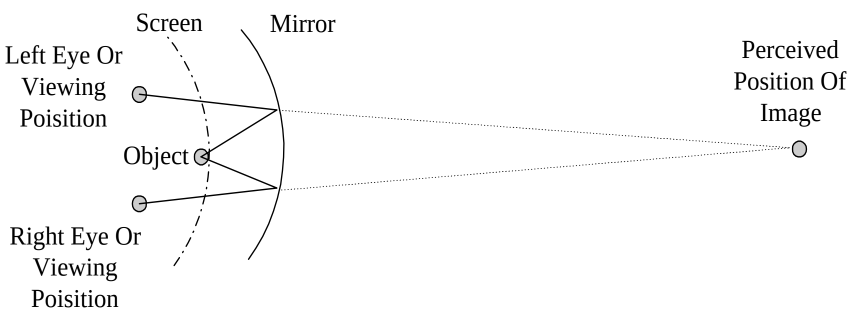

Figure 1 - Collimated display

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 Field of View (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.

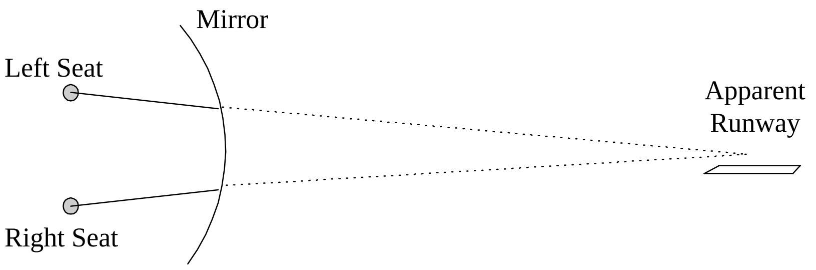

Figure 2 - Runway view in a collimated display

3. Basic principles of a 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 be directed towards the runway and this will be interpreted as the aircraft having some yaw offset.

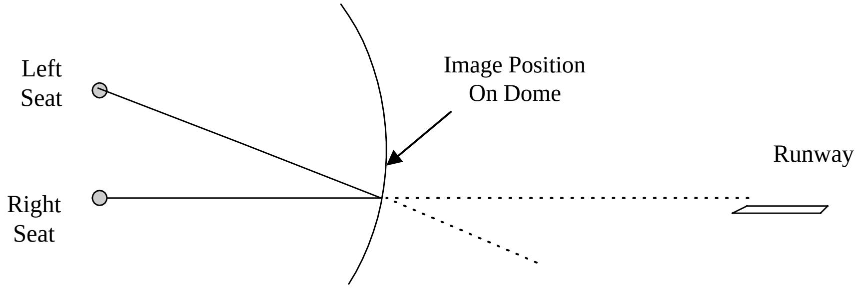

Figure 3 - Runway view in a dome display

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.

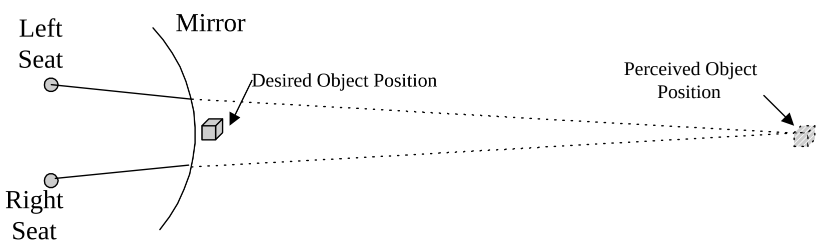

Figure 4 - Near field object in a collimated display

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.

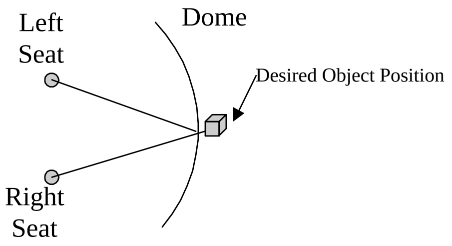

Figure 5 - Near field object in a dome display

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 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 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.

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Appendix 9 to ACJ No. 1 to JAR–FSTD H.030
General technical requirements for FSTD Qualification Levels

This Appendix summarizes the general technical requirements for FFS levels A, B, C and D, FTD levels 1, 2, and 3, FNPT levels I, II, IIMCC, III and IIIMCC.

Note: 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.

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Appendix 9 to ACJ No. 1 to JAR-FSTD H.030 (continued)

Table 1 – General technical requirements for JAA Level A, B, C and D FFS

Qualification Level	General Technical Requirements
A	(See also ACJ No.2 to JAR-FSTD H.030). The lowest level of FFS technical complexity. An enclosed full-scale replica of the helicopter flight deck with representative pilots seats, including simulation of all systems, instruments, navigational equipment, communications and caution and warning systems. An Instructor's station with seat shall be provided and at least one additional seat for inspectors/observers. Static control forces and displacement characteristics shall correspond to that of the replicated helicopter and they shall 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 Objective Tests shall be used. Generic Ground Effect and ground handling models are permitted. Motion, visual and sound systems sufficient to support the training, testing and checking credits sought are required. A motion system having a minimum of three degrees of freedom (pitch, roll, and heave) to accomplish the required training tasks shall be provided. The visual system shall 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 not be greater than 150 milliseconds more than that experienced on the helicopter.
B	As for Level A plus: Validation Flight Test Data shall 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 be derived from validation Flight Test Data. A reduced six-axis motion performance envelope is acceptable. The visual system shall provide at least 75 degrees horizontal and 40 degrees vertical field of view per pilot.
C	The second highest Level of simulator performance. As for Level B plus: A Daylight/Dusk/Night Visual 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 include the sounds of precipitation and significant helicopter noises perceptible to the pilot and shall be able to reproduce the sounds of a crash landing. The response to control inputs shall not be greater than 100 milliseconds more than that experienced on the helicopter. Turbulence and other atmospheric models shall be provided to support the training, testing and checking credit sought.
D	The highest Level of simulator performance. As for Level C plus: A full Daylight/Dusk/Night 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 be complete fidelity of sounds and motion buffets.

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

Qualification Level	General Technical Requirements
1	Type specific with at least one system fully represented to support the training task required. A flight-deck, 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 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 Authority'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 sounds.
2	As for level 1 with the following additions or amendments: - All systems fully represented. - Lighting environment as per helicopter. - Representative / generic aerodynamic data tailored to the specific helicopter with the fidelity to meet the objective tests. - Adjustable crewmember seats. - Flight control characteristics representative of the helicopter. - 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 visual data base sufficient to support the training requirements - Significant flight deck sounds. - On board Instructor station with control of atmospheric conditions and freeze and reset.
3	As for level 2 with the following additions or amendments: - Validation flight test data as the basis for objective testing of flight, performance and systems characteristics Visual 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.

Appendix 9 to ACJ No. 1 to JAR-FSTD H.030 (continued)

Table 3A - General technical requirements for JAA level I FNPTs

Qualification Level	General Technical Requirements
I	The lowest level of FNPT technical complexity. A flight deck 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 be located in a spatially correct position. Suitable arrangements for an instructor shall 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 enroute aids and appropriate heliports, with corresponding approach procedures. Control forces and control travel shall broadly correspond to those of a helicopter. Appropriate flight deck sounds shall 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

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Table 3B - General technical requirements for JAA level II FNPTs

Qualification Level	General Technical Requirements
II	As for Level I with the following additions or amendments: *Circuit breakers shall function correctly when involved in procedures or malfunctions requiring or involving flight crew response.* *Crewmembers seats with adequate adjustment.* *An additional observer seat.* Generic ground handling and aerodynamic ground effects models. Systems shall be operative to the extent that it shall 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 sounds, responding to pilot actions A Daylight, Dusk and Night Visual 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 be provided sufficient to support the training requirements, including at least (i) Specific areas within the database with higher resolution to support landings, take-offs and ground cushion exercises and training away from a heliport. (ii) Sufficient 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 JAA level III FNPTs

Qualification Level	General Technical Requirements
III	As for Type II with the following additions or amendments: A Daylight, Dusk and Night Visual system is required with a continuous field of view per pilot of not less than 150 degrees horizontal and 60 degrees vertical. Detailed high resolution visual data bases as required to support advanced training.

Table 3D - General Technical Requirements for JAA level IIMCC, IIIMCC FNPTs

Qualification Level	General Technical Requirements
IIMCC, IIIMCC	For use in Multi-Crew Co-operation (MCC) training - as for Levels II or III with additional systems, instrumentation and indicators as required for MCC training and operation. Reference Appendix 1 to JAR-FSTD H.030 .

ACJ No. 2 to JAR-FSTD H.030(interpretative material)
Guidance on Design and Qualification of Level 'A' Helicopter FFS

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) Type Specific Data Package,
(b) QTG Flight Test Data,
(c) Motion System,
(d) Visual System,
(e) Flight Controls and
(f) Aircraft Parts.

Note: To attempt to reduce the cost of ownership of a JAA Level A FFS , each element has been examined in turn and with a view to relaxing the requirements where possible whilst recognising the training, checking and testing credits allowed on such a device.

2 Data package

2.1 The cost of collecting specific Flight Test Data sufficient to provide a complete model of the aerodynamics, engines and flight controls can be significant. In the absence of type specific data packages the use of a class specific data package which 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 JAR-FSTD Steering Group as part of the qualification process. Note that for this lower level of FFS, the use of generic ground handling and generic Ground Effect models is allowed.

2.2 However specific Flight Test Data to meet the needs of each relevant test within the QTG will be required. Recognising the cost of gathering such data, two 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 "Correct Trend and Magnitude" (CT&M) thereby avoiding the need for specific Flight Test Data.
(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 Level 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 Level 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 be assessed subjectively to ensure that it is supporting the piloting task, including engine failures, and is in no way providing negative cueing.

3.2 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 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 be determined by its ability to support the flying tasks. e.g. "Visual cueing sufficient to support changes in approach path by using runway perspective".

4.2 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 Reversible Control Systems 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 Level 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.

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ACJ No. 3 to JAR-FSTD H.030 (explanatory material)
Guidance on Design and Qualification of Helicopter FTDs
See JAR-FSTD H.030

1 Basic Philosophy

1.1 The basic premises in defining FTDs were to follow the prescribed JAR-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 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 Level 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 Level 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 Level 2 would require the use of design & validation data similar to that for FTD Level 1 but all systems would have to be represented as well as a visual system meeting the requirements of an FNPT II. The FTD Level 2 criteria would permit the device to be used for part of the type rating training syllabus, for recency flying and IR revalidation.

1.6 The FTD 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 Level 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 Standards

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

2.1 The Flight Deck.

The flight deck 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 of the FTD I should be sufficiently enclosed to exclude any distractions. For both FTD Level 2 and 3 the flight deck 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 Level 1, if the rear of the device is open, it would be inappropriate to install this type of device in an 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 including the instructors’ station should be fully enclosed, and this enclosure should extend to include the roof. In the case of the FTD 2 and 3 the same interpretations should apply but an additional consideration is that the performance of the visual system will be adversely

ACJ No. 3 to JAR-FSTD H.030 (continued)

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 were the FTD to be installed in a separate room.

2.2 Flight Deck Components.

As with any training device, the components used within the flight deck area do not need to be helicopter parts: however, any parts used should be representative and should be robust enough to endure the training tasks. The use of CRTs or "Flat Panel" 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 Visual

3.1 There are two methods of establishing latency which is the relationship between the controls and the visual system, flight deck 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 Transport Delay 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 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 Level A FFS, see ACJ No. 2 to JAR-FSTD H.030

4.1 For Level A flight simulators, 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, 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 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 / Evaluation

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.

ACJ No. 3 to JAR-FSTD H.030 (continued)

5.2 The validation tests specified under ACJ No. 1 to JAR-FSTD H.030, 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 carefully derived and values are agreed with the 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 Manoeuvres" in ACJ No. 1 to JAR-FSTD H.030, para 3, should be flown out by a suitably qualified and experienced pilot. Subjective testing will review not only the interaction of all of the systems but the integration of the FTD with:

(a) Training environment
(b) Freezes and repositions
(c) Nav-aid environment
(d) Communications
(e) Weather 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 shall be in place. Such arrangements will 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 Level 1, 2 and 3 will be subject to evaluation and should meet the appropriate standards in JAR-FSTD.

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ACJ No. 4 to JAR-FSTD H.030 (explanatory material)
Use of Data for Helicopter FTDs
See ACJ No. 1 to JAR-FSTD H.030
See also ACJ to JAR-FSTD H.045

1. Two types of data are required for the development and qualification of a FSTD; namely, design data, which are used to develop simulation models, and the second, termed validation data, 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 JAR-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 manufacturers' 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 Level 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 Level 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 JAA will expect 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 proposed approach. Such demonstration will need to show the predicted simulation effects and that they are easily understood and defined. The JAA FSTD Steering Group will constitute an Authorities team to review any applications for the substitution of data other than that of the helicopter manufacturer's flown data.

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ACJ No. 5 to JAR-FSTD H.030 (interpretative material)
Guidance on Design and Qualification of Helicopter FNPTs
See also JAR-FSTD H.030

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.

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 JAR-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 Design Standards

There are five sets of design standards specified within JAR-FSTD H, FNPT I , II , IIMCC, III and IIIMCC.

2.1 Simulated Helicopter Configuration

Unlike FFS and FTD , 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 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 layout, seating, instruments and avionics, flying controls control forces and positions, performance, handling and powerplant.

2.2 The Flight Deck

The flight deck 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 of the FNPT I should be sufficiently enclosed to exclude any distractions. For both FNPT IIs and IIIs the flight deck 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 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 were the FNPT to be installed in a separate room.

2.3 Flight Deck Components

As with any training device, the components used within the flight deck 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.

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 for review.

2.4.1 Data Collection and Model Development

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) Helicopter design data
(b) Flight and Maintenance Manuals
(c) Observations on ground and in air

Data obtained on the ground and in flight can be measured and recorded using a range of simple means such as:

(a) Video
(b) Pencil and paper
(c) Stopwatch
(d) New technologies

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 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 Latency and Visual

There are two methods of establishing latency which is the relationship between the controls and the visual system, flight deck instruments (and initial motion system if fitted) response. These should be coupled closely to provide integrated sensory cues. For a generic FNPT, a Transport Delay 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 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).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 .

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

It need only be measured once in each axis.

3.2 Care should be taken when using the limited processing power of the lower cost visual systems to concentrate on the key areas which support the intended uses thereby avoiding compromising the visual model by including unnecessary features e.g. moving ground traffic, marshallers. The capacity of the visual model should be directed towards:

(a) Runway/Heliport surface
(b) Runway/Heliport lighting systems
(c) Approach guidance aids and lighting systems
(d) TLOF and FATO
(e) Detailed ground features where credits are required for navigation training
(f) Basic 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 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 Level A FFS, see ACJ No. 2 to JAR-FSTD H.030

4.1 For Level A flight simulators, 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, 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 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 and flight instruments.

5 Testing / Evaluation

5.1. General

The FNPT should be assessed in those areas which 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, and instructor station functions checks, and certain additional requirements depending on the complexity or Qualification Level of the

FNPT. The visual system (where applicable) will be evaluated against tests contained in the table of validation tests (ACJ 1 to JAR-FSTD H 030) .

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.

The validation tests specified (ACJ no 1 to JAR-FSTD H.030 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 be subjected to Validation, and Functions and Subjective Tests listed in (ACJ 1 to JAR-FSTD H 030). Validation Tests are used to compare objectively FNPT performances against Validation Data to ensure that they agree within design tolerances acceptable to the Authority. Functions and Subjective Tests provide a basis for evaluating FNPT capability to perform over a typical training period determining that the FNPT will satisfactorily meet each stated training objective and competently simulate 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 helicopter Flight Manual and Maintenance Manuals, 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 Subjective tests" (ACJ 1 to JAR-FSTD H.030) should be flown out by a suitably qualified and experienced pilot.

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

(a) Training environment
(b) Freezes and repositions
(c) Navaid environment
(d) Communications
(e) Weather and visual scene contents

5.4. Initial qualification

For initial qualification testing of FNPTs Validation Data will 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, 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 Authority, it will become the Validation Data that will be used as reference for subsequent recurrent evaluations.

For FNPT initial qualification, the tolerances listed for parameters in the validation list table (ACJ 1 to JAR-FSTD H 030) should be replaced by 'Correct Trend and Magnitude' (CT & M) and the FNPT should be tested and assessed as representative of a helicopter to the satisfaction of the Authority.

Tolerances listed for parameters in the validation tests table (ACJ 1 to JAR-FSTD H 030) 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 ACJ. 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 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 during initial FNPT evaluation an FSTD operator should be prepared to offer alternative test results which relate to the test in question.

Validation Tests which do not meet the test criteria should be addressed to the satisfaction of the Authority.

5.5. Maintenance

In parallel with this objective/subjective testing process it is envisaged that suitable maintenance arrangements as part of a Quality Assurance Programme shall be in place. Such arrangements will 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 be subject to evaluation and should be assessed to avoid negative training.

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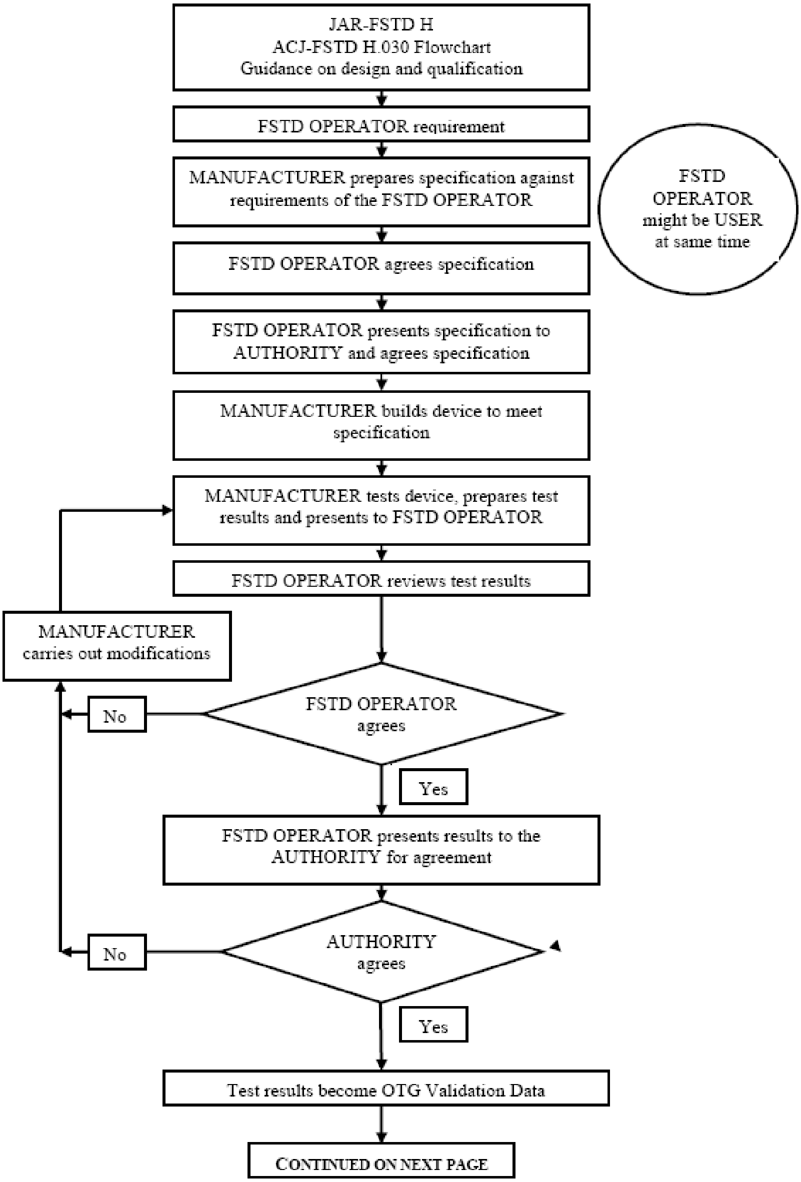
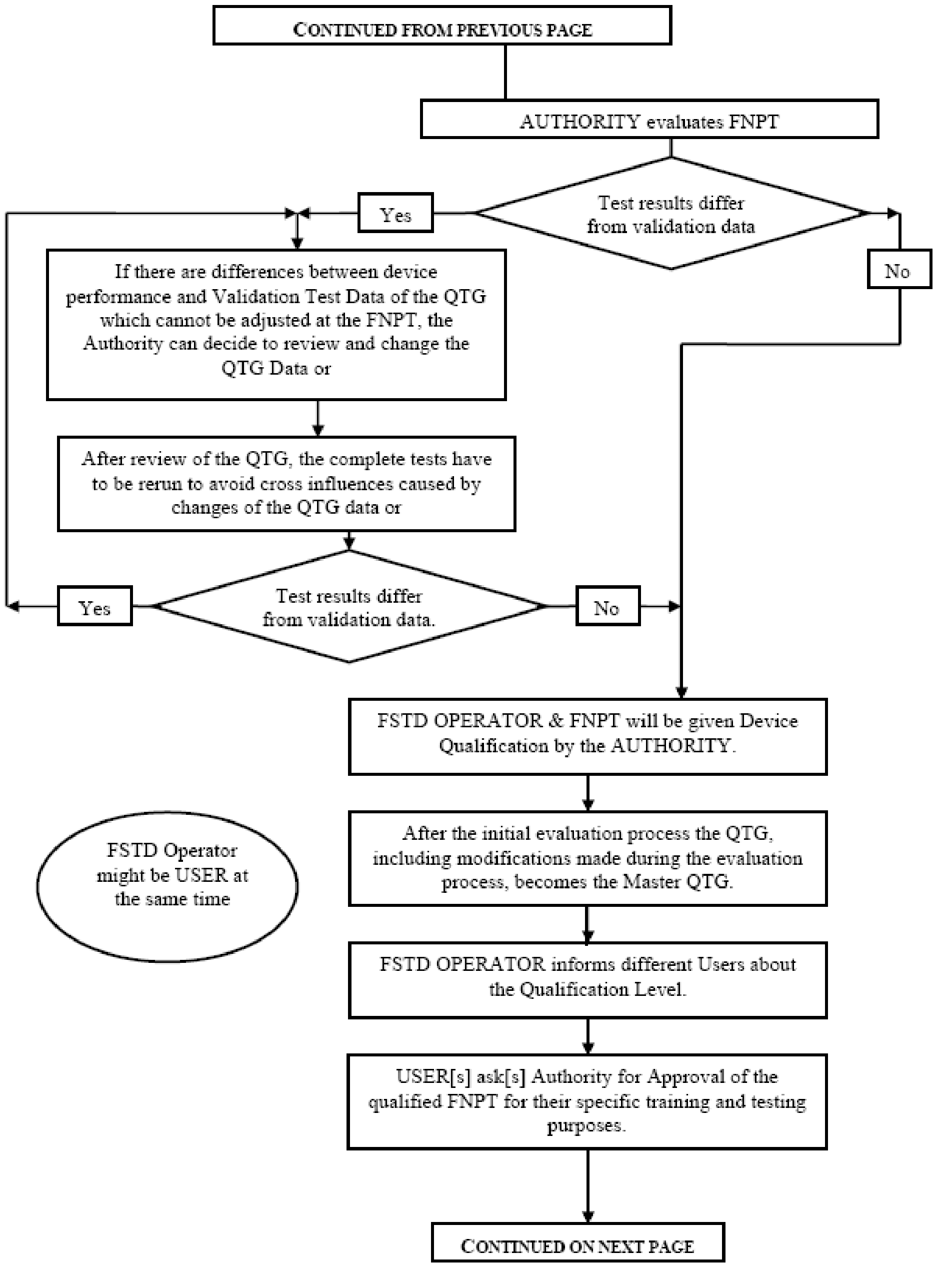
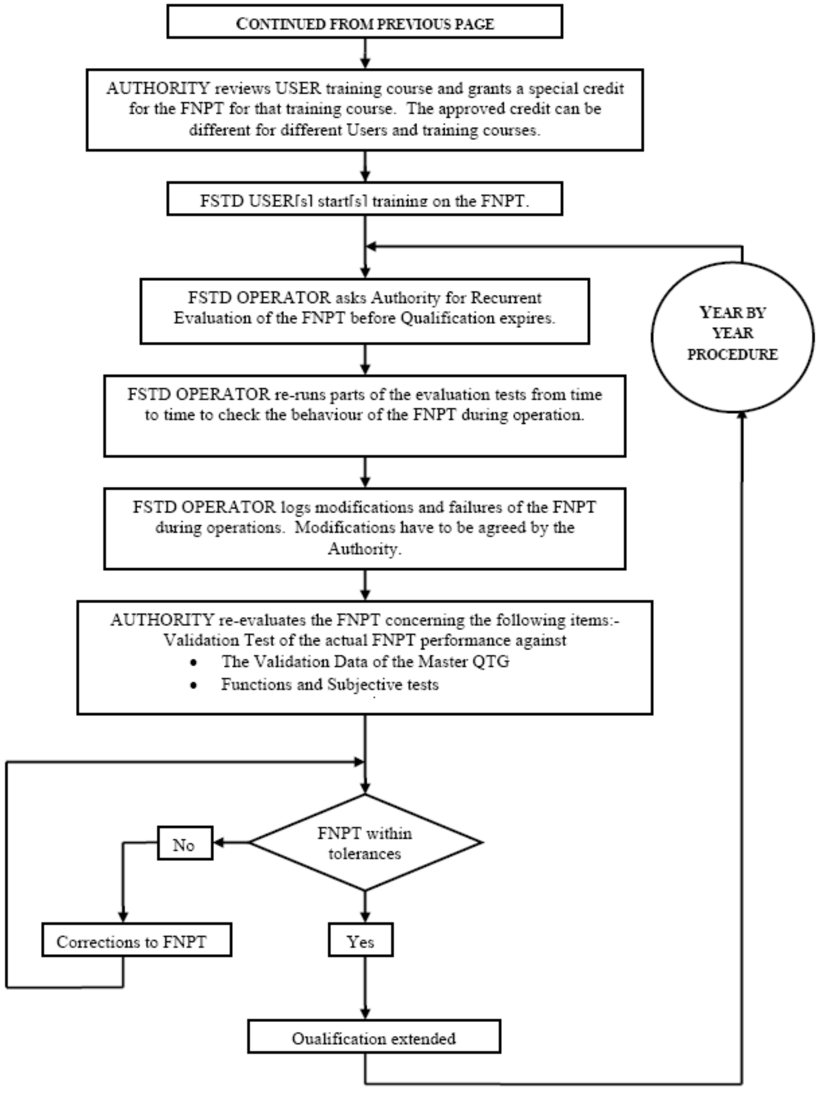

JAR-FSTD H
ACJ-FSTD H.030 Flowchart
Guidance on design and qualification
FSTD OPERATOR requirement
MANUFACTURER prepares specification against requirements of the FSTD OPERATOR
FSTD OPERATOR might be USER at same time
FSTD OPERATOR agrees specification
FSTD OPERATOR presents specification to AUTHORITY and agrees specification
MANUFACTURER builds device to meet specification
MANUFACTURER tests device, prepares test results and presents to FSTD OPERATOR
FSTD OPERATOR reviews test results
MANUFACTURER carries out modifications
No
FSTD OPERATOR agrees
Yes
FSTD OPERATOR presents results to the AUTHORITY for agreement
No
AUTHORITY agrees
Yes
Test results become OTG Validation Data
CONTINUED ON NEXT PAGE

ACJ No. 5 to JAR-FSTD H.030 (continued)




CONTINUED FROM PREVIOUS PAGE
AUTHORITY reviews USER training course and grants a special credit for the FNPT for that training course. The approved credit can be different for different Users and training courses.
FSTD USER[s] start[s] training on the FNPT.
FSTD OPERATOR asks Authority for Recurrent Evaluation of the FNPT before Qualification expires.
YEAR BY YEAR PROCEDURE
FSTD OPERATOR re-runs parts of the evaluation tests from time to time to check the behaviour of the FNPT during operation.
FSTD OPERATOR logs modifications and failures of the FNPT during operations. Modifications have to be agreed by the Authority.
AUTHORITY re-evaluates the FNPT concerning the following items:- Validation Test of the actual FNPT performance against
• The Validation Data of the Master QTG
• Functions and Subjective tests
FNPT within tolerances
No
Corrections to FNPT
Yes
Qualification extended

ACJ No. 1 to JAR-FSTD H.030(c)(1) (acceptable means of compliance)
Engineering Simulator Validation Data
See JAR-FSTD H.030(c)(1)

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, to supply validation data from an "audited" engineering simulator/simulation to supplement selectively flight test data.

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

2. To be qualified to supply engineering simulator validation data, an 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
   - has models which 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;
   (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 contact the Authority at the earliest opportunity.

4. For the initial application, each applicant should demonstrate his ability to qualify to the satisfaction of the JAA FSTD Steering Group, in accordance with the criteria in this ACJ and the corresponding ACJ No. 2 to JAR-FSTD H.030(c)(1).

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ACJ No. 2 to JAR-FSTD H.030(c)(1) (interpretative material)
Engineering Simulator Validation Data – Approval Guidelines
See JAR-FSTD H.030(c)(1)

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 Guidelines – for using Engineering Simulator Validation Data

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, 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.

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 used as part of a QTG, an essential match is expected as described in Appendix 1 to ACJ No. 1 to JAR-FSTD H.030

2.6 In cases where the use of engineering simulator data is envisaged, a complete proposal should be presented to the appropriate regulatory body(ies). Such a proposal would contain evidence of the aircraft manufacturer's past achievements in high fidelity modelling.

2.7 The process will be applicable to "one step" away from a fully flight validated simulation.

2.8 A configuration management process should be maintained, including an audit trail which clearly defines the simulation model changes step by step away from a fully flight validated simulation, so that it would be possible to remove the changes and return to the baseline (flight validated) version.

2.9 The Authorities will conduct technical reviews of the proposed plan and the subsequent validation data to establish acceptability of the proposal.

2.10 The procedure will be considered complete when an approval statement is issued. This statement will identify acceptable validation data sources.

2.11 To be admissible as an alternative source of validation data an engineering simulator would:

(a) Have to exist as a physical entity, complete with a flight deck representative of the affected class of aircraft, with controls sufficient for manual flight.
(b) Have a visual system; and preferably also a motion system.
(c) Where appropriate, have actual avionics boxes interchangeable with the equivalent software simulations, to support validation of released software.
(d) Have a rigorous configuration control system covering hardware and software.

(e) Have been found to be a high fidelity representation of the aircraft by the pilots of the manufacturers, operators and the 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) The original (baseline) simulation models should have been fully flight-test validated.
(b) The 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.
(c) These engineering simulation/simulators will 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 be restricted to those with “well understood effects”:

(a) Software (e.g., flight control computer, autopilot, etc.).
(b) Simple (in aerodynamic terms) geometric revisions (e.g., body length).
(c) Engines
(d) Control system gearing, rigging, deflection limits
(e) Brake, 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 proposed approach. Such analysis would show that the predicted effects of the change(s) were incremental in nature and both easily understood and well defined, confirming that additional flight test data were not required. In the event that the predicted effects were 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 be reviewed by an Authorities team established by the JAA FSTD Steering Group.

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ACJ to JAR-FSTD H.035
FFS Approved or Qualified before 1 April 2001
See JAR–FSTD H.035

1 Introduction

1.1 Under previous National Rules, FFS may have gained credits in accordance with primary reference documents which state appropriate technical criteria.

1.2 Other FFS may not have been monitored to the same extent, but may have documents or statements from their Authority giving broad or specific permission for them to be used for certain training, testing and checking manoeuvres.

1.3 It is intended that FFS should continue to maintain their Qualification Level and or approval granted prior to the adoption of JAR-STD 1H and subsequently JAR-FSTD H.

2 Recategorisation

Some of these FFS may be of a standard which permits them to be recategorised as if they were FFS presented for initial qualification on or after 1 April 2001.

3 Equivalent categories AG, BG, CG, DG

3.1 FFS that are not recategorised and that do have an acceptable primary reference document used for their original national qualification or national approval, will gain a JAA qualification based upon their original technical Qualification Level. The equivalent qualification will relate to permitted manoeuvres in the original national qualification or approval document providing that these older FFS continue to meet the original national criteria when evaluated by the Authority.

3.2 The letter G will be added to each originally issued Qualification Level to show that the existing Qualification Level deserves its credit under the grandfather right provisions. To comply with the rule, the primary reference document should have meaningful Validation, Functions and Subjective Tests criteria which reasonably cover the performance envelope of the FFS and in particular the manoeuvres for which the equivalent JAA Level of Qualification is given. The minimum acceptable standard is AC120-63 or equivalent.

4 Original national qualification

4.1 FFS that are not recategorised and that do not have an acceptable primary reference document may continue to enjoy credits for an agreed list of training, testing and checking manoeuvres, provided they maintain their performance in accordance with any Validation and Functions and Subjective Tests which have been previously established or a list of tests selected from ACJ to JAR-FSTD H.030 by agreement with the Authority. Again the tests should relate to the list of manoeuvres permitted under the original national qualification or approval document.

4.2 The award of credits to a FFS user should be at the discretion of the Authority. Current FFS users may retain the credits granted under their previous national criteria.

5 Grandfather rights summary

The following table summarises the arrangements for FFS approved or qualified before 1 April 2001 and which are not recategorised :

	JAA EQUIVALENT QUALIFICATION LEVEL	**PERFORMANCE CRITERIA**
Primary Ref. Doc	AG Maximum training, BG testing and checking CG Credits similar DG to A, B, C, D	Perform to the original National Validation Functions and Subjective Tests from Reference Doc.
No Primary Ref. Doc	<u>Special Categories</u> Unique list of Manoeuvres	Original Validation, Functions and Subjective Tests or a list of tests selected from ACJ N°1 to JAR-FSTD H.030 (by agreement)

ACJ to FSTD H.037
FNPT Approved or Qualified before 1 January 2003
See JAR–FSTD H.037

1 Introduction

1.1 Under previous national rules, FNPTs may have gained credits in accordance with primary reference documents which state appropriate technical criteria.

1.2 Other FNPTs may not have been monitored to the same extent, but may have documents or statements from their National Authority giving broad or specific permission for them to be used for certain training, testing and checking manoeuvres.

1.3 In any case, it is intended that FNPTs should continue to maintain their Qualification Level and or approval granted prior to the adoption of JAR–FSTD H in accordance with previous national criteria.

2 Recategorisation

Some of these FNPTs may be of a standard which permits them to be recategorised as if they were FNPTs presented for initial qualification on or after 1 January 2003.

3 Original national qualification

3.1 FNPTs that are not recategorised and that do not have an acceptable primary reference document may continue to enjoy credits for an agreed list of training, testing and checking manoeuvres, provided they maintain their performance in accordance with any validation, functions and subjective tests which have been previously established or a list of tests selected from ACJ N°1 to JAR-FSTD H.030 by agreement with the Authority. Again these tests should relate to the list of manoeuvres permitted under the original national qualification or approval document.

3.2 The award of credits to an FNPT user should be at the discretion of the Authority. Current FNPT users may retain the credits granted under their previous national criteria.

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ACJ to FSTD H.045 (explanatory material)
New Aircraft FFS/FTD Qualification – Additional Information
See JAR–FSTD H.045

1 It is usual that aircraft manufacturer's approved final data for performance, handling qualities, systems or avionics will not be available until well after a new or derivative aircraft has entered service. It is often necessary to begin flight crew training and certification several months prior to the entry of the first aircraft into service and consequently it may be necessary to use aircraft manufacturer-provided preliminary data for interim qualification of FSTDs.

2 In recognition of the sequence of events that should occur and the time required for final data to become available, the Authority may accept certain partially validated preliminary aircraft and systems data, and early release ('red label') avionics in order to permit the necessary programme schedule for training, certification and service introduction.

3 FSTD operators seeking qualification based on preliminary data should, however, consult the Authority as soon as it is known that special arrangements will be necessary or as soon as it is clear that the preliminary data will need to be used for FSTD qualification. Aircraft and FSTD manufacturers should also be made aware of the needs and be agreed party to the data plan and FSTD qualification plan. The plan should include periodic meetings to keep the interested parties informed of project status.

4 The precise procedure to be followed to gain Authority acceptance of preliminary data will vary from case to case and between aircraft manufacturers. Each aircraft manufacturer's new aircraft development and test programme is designed to suit the needs of the particular project and may not contain the same events or sequence of events as another manufacturer's programme or even the same manufacturer's programme for a different aircraft. Hence, there cannot be a prescribed invariable procedure for acceptance of preliminary data, but instead there should be a statement describing the final sequence of events, data sources, and validation procedures agreed by the FSTD operator, the aircraft manufacturer, the FSTD manufacturer, and the Authority.

NOTE: A description of aircraft manufacturer-provided data needed for flight simulator modelling and validation is to be found in the IATA Document 'Flight Simulator Design and Performance Data Requirements' – (Edition 6 2000 or as amended).

5 There should be assurance that the preliminary data are the manufacturer's best representation of the aircraft and reasonable certainty that final data will not deviate to a large degree from these preliminary, but refined, estimates. Data derived from these predictive or preliminary techniques should be validated by available sources including, at least, the following:

(a) Manufacturer's engineering report. Such report will explain the predictive method used and illustrating past success of the method on similar projects. For example, the manufacturer could show the application of the method to an earlier aircraft model or predict the characteristics of an earlier model and compare the results to final data for that model.

(b) Early flight tests results. Such data will often be derived from aircraft certification tests, and should be used to maximum advantage for early FSTD validation. Certain critical tests, which would normally be done early in the aircraft certification programme, should be included to validate essential pilot training and certification manoeuvres. These include cases in which a pilot is expected to cope with an aircraft failure mode including engine failures. The early data available will, however, depend on the aircraft manufacturer's flight test programme design and may not be the same in each case. However it is expected that the flight test programme of the aircraft manufacturer include provisions for generation of very early flight tests results for FSTD validation.

6 The use of preliminary data is not indefinite. The aircraft manufacturer's final data should be available within 6 months after aircraft first 'service entry' or as agreed by the Authority, the FSTD operator and the aircraft manufacturer, but usually not later than 1 year. In applying for an interim qualification, using preliminary data, the FSTD operator and the Authority should agree upon the update programme. This will normally specify that the final data update will be installed in the FSTD within a period of 6 months following the final data release unless special conditions exist and a different schedule agreed. The FSTD performance and handling validation would then be based on data derived from flight test. Initial aircraft systems data should be updated after

engineering tests. Final aircraft systems data should also be used for FSTD programming and validation.

7 FSTD avionics should stay essentially in step with aircraft avionics (hardware & software) updates. The permitted time lapse between aircraft and FSTD updates is not a fixed time but should be minimal. It may depend on the magnitude of the update and whether the QTG and pilot training and certification is affected. Permitted differences in aircraft and FSTD avionics versions and the resulting effects on FSTD qualification should be agreed between the FSTD operator and the Authority. Consultation with the FSTD manufacturer is desirable throughout the agreement of the qualification process.

8 The following describes an example of the design data and sources which might be used in the development of an interim qualification plan.

(a) The plan should consist of the development of a QTG based upon a mix of flight test and engineering simulation data. For data collected from specific aircraft flight tests or other flights the required designed model and data changes necessary to support an acceptable Proof of Match (POM) should be generated by the aircraft manufacturer.

(b) In order that the two sets of data are properly validated, the aircraft manufacturer should compare their simulation model responses against the flight test data, when driven by the same control inputs and subjected to the same atmospheric conditions as were recorded in the flight test. The model responses should result from a simulation where the following systems are run in an integrated fashion and are consistent with the design data released to the FSTD manufacturer:

(1) propulsion
(2) aerodynamics
(3) mass properties
(4) flight controls
(5) stability augmentation
(6) brakes and landing gear.

9 For the qualification of FSTD of new aircraft types, it may be beneficial that the services of a suitably qualified test pilot are used for the purpose of assessing handling qualities and performance evaluation.

NOTE: The Proof of Match should meet the relevant ACJ No. 1 to JAR-FSTD H.030 tolerances.

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