European Union Aviation Safety Agency

Notice of Proposed Amendment 2020-15

in accordance with

Articles 6(3), 7 and 8 (Standard procedure: public consultation) of MB Decision No 18-2015

Update of the flight simulation training device requirements

RMT.0196

EXECUTIVE SUMMARY

The objective of this Notice of Proposed Amendment (NPA) is to amend the EU regulatory framework with a view to maintaining a high level of aviation safety by applying an innovative approach to the capabilities classification of future flight simulation training devices (FSTDs) that ensures harmonisation with the guidance established in Doc 9625 'Manual of Criteria for the Qualification of Flight Simulation Training Devices' by the International Civil Aviation Organization (ICAO). In addition, it aims at introducing a paradigm shift into the regulatory framework for initial (Flight Crew Licensing (FCL)) and recurrent (Air Operations (OPS)) pilot training. Further to the paradigm proposed, training providers are required to identify the device capabilities (referred to as 'FSTD capability signature' (FCS)) based on analysing regulatory training task objectives against FSTD features and fidelity levels. The identified FCS is subsequently matched with training devices available on the market having at least the same FCS. This allows training providers to use the most appropriate and latest innovative training devices. The application of features and fidelity level criteria enables:

(a) more flexibility in obtaining training credits by using other types of training devices — different from a full flight simulator (FFS);

(b) improvement of the visibility from the training side on the capabilities of the different devices; and

(c) the use of new technologies in training thereby improving safety by making a clear link between FCL (type rating training) and OPS (operator recurrent training) and the Certification Specifications for Aeroplane Flight Simulation Training Devices (CS-FSTD(A)).

This NPA proposes the amendment of:

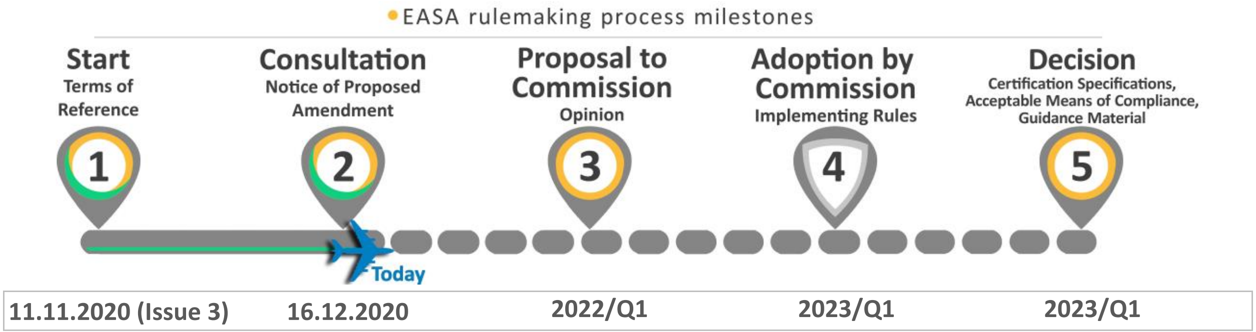
— the acceptable means of compliance (AMC) and guidance material (GM) to Appendix 9 to Annex I (Part-FCL) to Regulation (EU) No 1178/2011 (the 'Aircrew Regulation') by introducing a training matrix that defines the fidelity levels required to achieve the type-specific training objectives for each training task;

— Annex VI (Part-ARA) and Annex VII (Part-ORA) to the Aircrew Regulation and the associated AMC and GM; in particular, amendments are proposed to the qualification certificate (QC) and the equipment and specifications list (ESL) is introduced;

— CS-FSTD(A); in particular, as regards changes to the simulator levels. Furthermore, the structure of the CS has been reviewed to facilitate the set-up of standards in accordance with the European Union Aviation Safety Agency (EASA) rulemaking principles.

The proposed amendments are expected to maintain safety, promote more cost-effective training and ensure alignment with ICAO. The stakeholders mostly affected by the proposed changes will be aircraft manufacturers, FSTD data providers, FSTD manufacturers and organisations operating FSTDs. Competent authorities (CAs) and approved training organisations (ATOs) will be affected in a varying degree, depending on the type and qualification of the FSTD and its use in training.

Action area:	Human factors and competence of personnel		
Related rules:	Part-FCL, Part-ARA and Part-ORA of the Aircrew Regulation and the associated AMC and GM; CS-FSTD(A)		
Affected stakeholders:	CAs; approved training organisations (ATOs); air operators; organisations operating FSTDs; pilots; instructors; flight examiners; FSTD and aircraft original equipment manufacturers (OEMs)		
Driver:	Safety	**Rulemaking group:**	Yes
Impact assessment:	Yes	**Rulemaking Procedure:**	Standard



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1. About this NPA

1.1. How this NPA was developed

EASA developed this NPA in line with Regulation (EU) 2018/1139[1] (the 'Basic Regulation') and the Rulemaking Procedure[2]. This rulemaking activity is included in the European Plan for Aviation Safety (EPAS) 2020-2024 under rulemaking task (RMT).0196. The text of this NPA has been developed by EASA based on the input of the Rulemaking Group (RMG) for RMT.0196 and the Training Task Force[3] (TTF). It is hereby submitted to all interested parties for consultation[4].

1.2. How to comment on this NPA

Please submit your comments using the automated **Comment-Response Tool (CRT)** available at **http://hub.easa.europa.eu/crt/**[5].

The deadline for submission of comments is **31 March 2021**.

1.3. The next steps

Following the closing of the public commenting period, EASA will review all the comments received. Based on the comments received, EASA will consider the need to propose amendments to the Aircrew Regulation[6], and, if necessary, issue an opinion. A summary of the comments received will be provided in the opinion.

The opinion will be submitted to the European Commission, which will use it as a technical basis in order to take a decision on whether or not to amend the related regulation.

If the Commission decides that the related regulation should be amended, EASA will issue a decision that amends the certification specifications (CSs), AMC and GM to comply with the amendments introduced into the related regulation.

[1] Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010, (EU) No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC) No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91 (OJ L 212, 22.8.2018, p. 1) (https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1535612134845&uri=CELEX:32018R1139).

[2] EASA is bound to follow a structured rulemaking process as required by Article 115(1) of Regulation (EU) 2018/1139. Such a process has been adopted by the EASA Management Board (MB) and is referred to as the 'Rulemaking Procedure'. See MB Decision No 18-2015 of 15 December 2015 replacing Decision 01/2012 concerning the procedure to be applied by EASA for the issuing of opinions, certification specifications and guidance material (http://www.easa.europa.eu/the-agency/management-board/decisions/easa-mb-decision-18-2015-rulemaking-procedure).

[3] Extract from ToR RMT.0196 Issue 2 'an EASA-led Training Task Force (TTF) will develop guidance on the capability of each FSTD to define the use of the appropriate FSTDs in training in support of the changes to the latest amendment of Regulation (EU) 2018/1974 of 14 December 2018 (changes to Appendix 9 of Part-FCL), which will become applicable on the 20 December 2019'.

[4] In accordance with Article 115 of Regulation (EU) 2018/1139, and Articles 6(3) and 7 of the Rulemaking Procedure.

[5] In case of technical problems, please contact the CRT webmaster (crt@easa.europa.eu).

[6] Commission Regulation (EU) No 1178/2011 of 3 November 2011 laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (OJ L 311, 25.11.2011, p. 1) (https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1602674882987&uri=CELEX:32011R1178).

The comments received on this NPA and the EASA responses to them will be reflected in a comment-response document (CRD). The CRD will be published on the EASA website[7].

7 https://www.easa.europa.eu/document-library/comment-response-documents

2. In summary — why and what

2.1. Why we need to amend the rules — issue/rationale

The need to change the rules arises from regulatory discrepancies and barriers that currently limit the possibility to obtain training credits by using other types of training devices not certified under CS-FSTD(A) in type rating training (Appendix 9 to Part-FCL) and operator recurrent training (ORO.FC) of Regulation (EU) No 965/2012 (the 'Air OPS Regulation')[8]. Furthermore, it is the overall intent of EASA to enable a better recognition and crediting of existing, as well as emerging training device/tool capabilities in all FCL- and OPS-related pilot training requirements in due course.

Without this rule change, FFSs will continue to dominate the training industry, flight training devices (FTDs) will continue to have limited and unstandardised capabilities, and emerging innovative training devices/tools that are tailored to a specific training need will not obtain credits for regulatory training.

In the next Work Package (WP3), EASA aims at stimulating innovation and paving the way for emerging technologies, such as virtual reality and artificial intelligence, that offer new possibilities to obtain quality training whilst maintaining the safety level and cost efficiency.

Related safety issues

The following safety recommendations (SRs) addressed to EASA from aircraft accident investigation reports published by the designated safety investigation authority[9], are considered during this RMT. New SRs related to this task may be considered during the development of this RMT.

SR number	Summary of the SR text	How RMT.0196 has addressed this SR
FRAN-2016-006 (BEA)	EASA should evaluate the possibility of developing an alternative programme for complex high-performance single-pilot aeroplanes for which there is no adequate flight simulator — for example, by using a flight simulator from a similar aeroplane.	Both SRs are being addressed by the following RMTs: — RMT.0188 (FCL.002) Appendix 9 has been amended and will enable different levels of FSTDs to be used in training, and under certain conditions in combination with the aeroplane. — RMT.0599 Will also propose amendments that enable ORO.FC training to benefit from different levels of FSTDs — RMT.0196 Work Package 2 AMC & GM to Appendix 9 to Part-FCL will be proposed to support the changes in Appendix 9, and the proposed changes to
FRAN-2017-001 (BEA)	EASA should amend the regulations so as to authorise, in the context of FCL, the use of types of FSTD with a lower level than FFS during smoke or emergency descent training on Cessna 525B aeroplane types and, more generally, on complex high-performance aeroplanes.	

[8] Commission Regulation (EU) No 965/2012 of 5 October 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (OJ L 296, 25.10.2012, p. 1) (https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1602675419614&uri=CELEX:32012R0965).

[9] Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC (OJ L 295, 12.11.2010, p. 35) (http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1479716039678&uri=CELEX:32010R0996).

		CS FSTD(A).

Exemptions[10] **in accordance with Article 70 'Safeguard provisions'/Article 71 'Flexibility provisions' and/or Article 76 'Agency measures' of the Basic Regulation** (if applicable) pertinent to the scope of this RMT are:

There are no exemptions pertinent to the scope of this RMT.

Alternative means of compliance (AltMoC) relevant to the content of this RMT (if applicable)

There are no AltMoC relevant to the development of this RMT.

ICAO and third-country references relevant to the content of this RMT (if applicable)

References considered for alignment of the content of this RMT with ICAO Standards and Recommended Practices (SARPs), Federal Aviation Regulations (FARs), etc.

— ICAO Doc 9625, 'Manual of Criteria for the Qualification of Flight Simulation Training Devices', Fourth Edition, 2015.

References to differences between the content of this RMT and ICAO SARPs, FARs, etc. (if applicable)

No relevant references.

EU requirement not having yet relevant reference — stemming from a comparison between the intended content of this RMT with ICAO SARPs, FARs, etc.

No relevant references.

2.2. What we want to achieve — objectives

The overall objectives of the EASA system are defined in Article 1 of the Basic Regulation. This proposal will contribute to the achievement of the overall objectives by addressing the issues outlined in Section 2.1.

The specific objective of this proposal is to:

(a) ensure that FSTDs better facilitate current and future training needs by establishing the necessary simulation fidelity levels required to support training tasks specifically related to initial (FCL) and recurrent (OPS) training;

(b) cater for the application of new technologies;

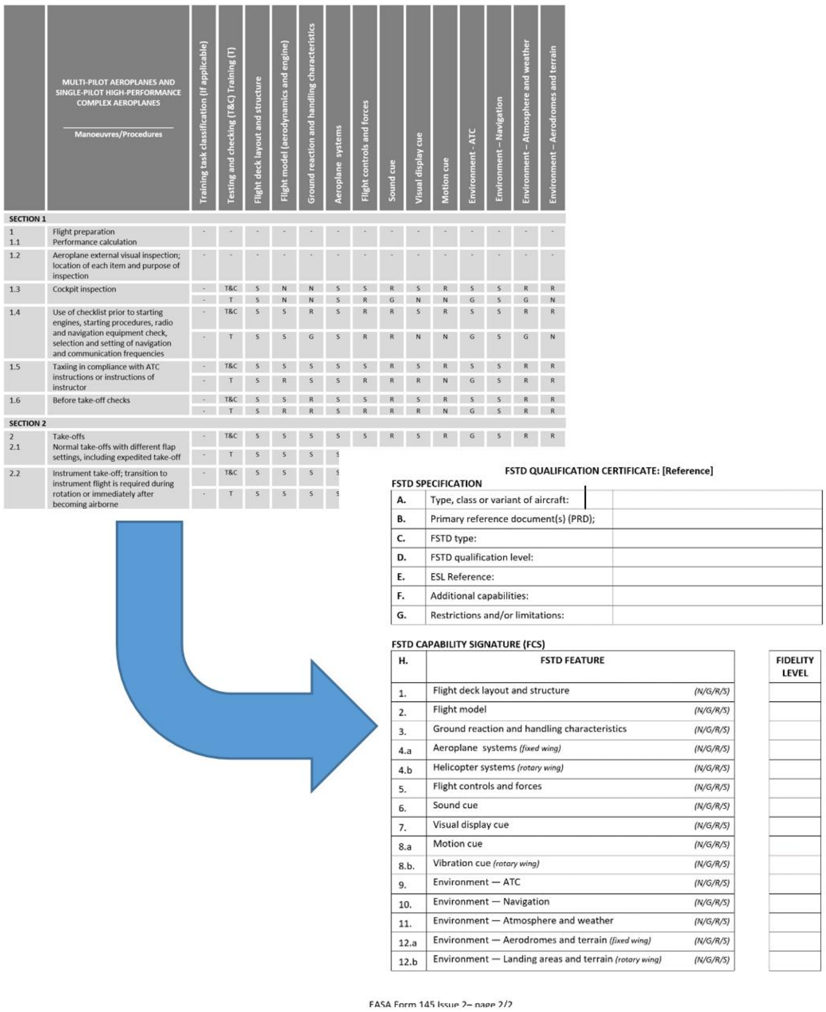
(c) reinforce the level of safety by addressing the low FSTD fidelity or lack of ability of an FSTD to conduct certain training tasks that may have been a contribution to previous incidents and accidents; and

[10] Exemptions having an impact on the development of this RMT content and referring to:
— Article 70(1): Measures taken as an immediate reaction to a safety problem
— Article 71(1): Limited in scope and duration exemptions from substantive requirements laid down in the Basic Regulation and its implementing rules in the event of urgent unforeseeable affecting any natural or legal person subject to the Basic Regulation or urgent operational needs of that person
— Article 71(3): Derogation from the rule(s) implementing the Basic Regulation where an equivalent level of protection to that attained by the application of the said rules can be achieved by other means
— Article 76(7): Individual flight time specifications schemes deviating from the applicable certification specifications which ensure compliance with essential requirements and, as appropriate, the related implementing rules

(d) standardise devices to have common criteria for FSTD qualification, based on industry-derived and agreed criteria adopted in ICAO Doc 9625.

2.3. How we want to achieve it — overview of the proposals

With this proposal, EASA aims to instil a new paradigm according to which training providers are required to identify FSTD capabilities — the training devices' FCS — based on analysing regulatory training task objectives compared to FSTD features and fidelity levels. The identified FCS is subsequently matched with a training device available on the market having at least the same FCS. This allows training providers to use the most appropriate and latest innovative training devices.



	MULTI-PILOT AEROPLANES AND SINGLE-PILOT HIGH-PERFORMANCE COMPLEX AEROPLANES Manoeuvres/Procedures	Training task classification (If applicable)	Testing and checking (T&C) Training (T)	Flight deck layout and structure	Flight model (aerodynamics and engine)	Ground reaction and handling characteristics	Aeroplane systems	Flight controls and forces	Sound cue	Visual display cue	Motion cue	Environment - ATC	Environment – Navigation	Environment – Atmosphere and weather	Environment – Aerodromes and terrain
SECTION 1															
1 1.1	Flight preparation Performance calculation	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.2	Aeroplane external visual inspection; location of each item and purpose of inspection	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.3	Cockpit inspection	-	T&C	S	N	N	S	S	R	S	R	S	S	R	R
		-	T	S	N	N	S	R	G	N	N	G	S	G	N
1.4	Use of checklist prior to starting engines, starting procedures, radio and navigation equipment check, selection and setting of navigation and communication frequencies	-	T&C	S	S	R	S	R	R	S	R	S	S	R	R
		-	T	S	S	G	S	R	R	N	N	G	S	G	N
1.5	Taxiing in compliance with ATC instructions or instructions of instructor	-	T&C	S	S	S	S	S	R	S	R	S	S	R	R
		-	T	S	R	S	S	R	R	R	N	G	S	R	R
1.6	Before take-off checks	-	T&C	S	S	R	S	S	R	S	R	S	S	R	R
		-	T	S	R	R	S	R	R	R	N	G	S	R	R
SECTION 2															
2 2.1	Take-offs Normal take-offs with different flap settings, including expedited take-off	-	T&C	S	S	S	S	S	R	S	R	G	S	R	R
		-	T	S	S	S	S								
2.2	Instrument take-off; transition to instrument flight is required during rotation or immediately after becoming airborne	-	T&C	S	S	S	S								
		-	T	S	S	S	S								

FSTD QUALIFICATION CERTIFICATE: [Reference]

FSTD SPECIFICATION

A.	Type, class or variant of aircraft:	
B.	Primary reference document(s) (PRD);	
C.	FSTD type:	
D.	FSTD qualification level:	
E.	ESL Reference:	
F.	Additional capabilities:	
G.	Restrictions and/or limitations:	

FSTD CAPABILITY SIGNATURE (FCS)

H.	**FSTD FEATURE**		**FIDELITY LEVEL**
1.	Flight deck layout and structure	*(N/G/R/S)*	
2.	Flight model	*(N/G/R/S)*	
3.	Ground reaction and handling characteristics	*(N/G/R/S)*	
4.a	Aeroplane systems *(fixed wing)*	*(N/G/R/S)*	
4.b	Helicopter systems *(rotary wing)*	*(N/G/R/S)*	
5.	Flight controls and forces	*(N/G/R/S)*	
6.	Sound cue	*(N/G/R/S)*	
7.	Visual display cue	*(N/G/R/S)*	
8.a	Motion cue	*(N/G/R/S)*	
8.b.	Vibration cue *(rotary wing)*	*(N/G/R/S)*	
9.	Environment — ATC	*(N/G/R/S)*	
10.	Environment — Navigation	*(N/G/R/S)*	
11.	Environment — Atmosphere and weather	*(N/G/R/S)*	
12.a	Environment — Aerodromes and terrain *(fixed wing)*	*(N/G/R/S)*	
12.b	Environment — Landing areas and terrain *(rotary wing)*	*(N/G/R/S)*	

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The bridge between Part-FCL and CS-FSTD(A): the FSTD capability signature (FCS)

This proposal introduces more flexibility in selecting the most appropriate FSTD for achieving the training objectives. The training needs and their evolution should take precedent in driving the development of FSTDs. Given the pace of technological innovations, the range of available FSTDs for training purposes has already exceeded the scope of the current FSTD certification specification minimum standards.

EASA endeavours to ensure harmonisation with ICAO material within this domain to facilitate the mutual recognition of devices and to ease the development of bilateral agreements.

2.3.1. Rationale behind the proposed changes at implementing rule, AMC and GM level

Training matrix

The training matrix in AMC3 to Appendix 9 provides a means to correlate the FCS of an FSTD with each training task, to ensure consistency with current approved initial and recurrent training programmes, and harmonisation with FSTD types in ICAO Doc 9625. This correlation provides to the ATOs and their CAs, objectivity, transparency and reproducibility in the choice of an FSTD. In the context of ORA.FSTD.135, with the support of the FSTD ESL, the ATO has the required information to demonstrate the adequacy between the FSTD specifications and the related training programme.

Format and details of the new FSTD qualification certificate

The administrative clarifications regarding the existing page 1 of the FSTD qualification certificate are based on feedback from standardisation and expert opinion. Page 2 has been simplified to only include those items relevant for qualification in accordance with the primary reference document (e.g. CS-FSTD(A) Issue 2). In addition, on page 2, the FCS is introduced specifying the 12 possible features covering both aeroplanes and helicopters. The empty column should specify whether the feature fidelity level is specific (S), representative (R), generic (G), or none/not installed (N). Training providers have the responsibility to determine whether the device is capable of achieving the training objectives in Appendix 9 taking into account the device-specific FCS and demonstrate this to their CA accordingly. Applicable amendment references: ARA.FSTD.110 and Appendix IV to Part-ARA.

2.3.2. Equipment and specifications list (ESL) declared by the organisation operating FSTDs

The ESL serves to specify all pertinent information summarising the capability of the FSTD in terms of its FCS for the benefit of users to determine its suitability for the intended use in training (e.g. such as information on the type of visual system, installed Global Positioning System (GPS), and head-up display (HUD) systems). The organisation operating FSTDs declares the information and is therefore responsible for ensuring that the list is complete and correct for each device at all times. The ESL is considered by the CA during the initial qualification; thereafter, changes to the ESL will become part of the continued oversight of the authority. Changes to the ESL will no longer require a change to the qualification certificate. Only the FCS on the qualification certificate provides an indication of the device capability that must be taken into account by the training provider when assessing usability in training. In contrast, the information contained in the ESL is for information purposes only.

2.3.3. Other clarifications regarding the qualification certificate and ESL

— New acronyms — Applicable amendment reference: GM to Part-ARA.

— FSTD dossier — updated information on what is expected by the CAs to support the discussion during the preliminary briefing, which is a first step of any initial or recurrent evaluation of an FSTD carried out by the CA.

2.3.4. Other elements proposed with this NPA not linked to the FCS concept

— ARA.FSTD.120 provides, under certain circumstances, the CAs with the possibility to extend the period between recurrent evaluations to up to 36 months.

— AMC2 ARA.FSTD.130 provides the means for CAs to be able to consider the approval of new FSTD technologies and refers to GM3 ORA.FSTD.210(a)(3) for alternate means of qualification of such new technologies. This new AMC opens up the possibility for a wider range of training devices and technologies being used for training and is in support of the other relevant changes made in this NPA.

2.3.5. Update of CS-FSTD(A)

The updated CS-FSTD(A) includes the term FSTD capability signature (FCS) and incorporates the tables of general requirements, FSTD validation tests, function and subjective tests of Part III of ICAO Doc 9625 Volume I, modified where necessary to reflect current operations and standards.

The explanatory material from Part II and Part III of ICAO Doc 9625 Volume I, is also incorporated in the CS-FSTD(A) where relevant.

Furthermore, CS-FSTD(A) creates a conversion table in CS FSTD(A).QB.101, 'FSTD capability signature (FCS) summary matrix', which links new FSTD types/levels and FCSs. It is possible of course that a FSTD may have a valid FCS that does not match a particular type/level combination. The types/levels are representative of the most common FCS combinations expected to provide the most benefit for use in different types of training (as specified in ICAO Doc 9625 Volume I Part I). Consequently, the mention of FSTD types and levels and type of training/licence is systematically replaced by 'features and fidelity levels'.

Finally, the structure of the CS has been reviewed. Some of the previous AMC have now been moved to CSs to ensure that the standards are set at the appropriate regulatory level. This has a twofold benefit, one the one hand, it should facilitate the user's navigation through the CS-FSTD(A) document and on the other hand, the new structure aligns the with the EASA rulemaking principles.

2.4. What are the expected benefits and drawbacks of the proposals

The expected benefits and drawbacks of the proposal are summarised below. For the full impact assessment of alternative options, please refer to Chapter 4.

The proposal for having FSTDs tailored to training needs is cost-effective and instils transformation of the system by applying an innovative approach that corresponds with ICAO provisions, and introduces this paradigm shift into the regulatory framework for initial (FCL) and recurrent (OPS) pilot training. The EU would be among the first globally in utilising the innovative possibilities provided by this latest revision of ICAO Doc 9625. The proposal strives for integrating flexibility in using the devices according to their actual capabilities and paving the way for further innovations when designing and producing new FSTDs.

Some of the costs that stakeholders will need to incur include the need to train FSTD inspectors and change the qualification certificate (QC) for CAs, and for FNPTs where there would be no short-term benefit in terms of increase of training credits until such time as the paradigm shift in training is introduced for all types of training.

Overall, the proposal is considered cost-effective, balancing the costs and the benefits for the whole training FSTD system.

3. Proposed amendments and rationale in detail

The text of the amendment is arranged to show deleted, new or amended, and unchanged text as follows:

— deleted text is ~~struck through~~;

— new or amended text is highlighted in blue;

— an ellipsis '[…]' indicates that the rest of the text is unchanged.

3.1. Draft acceptable means of compliance and guidance material (draft EASA decision)

Part-FCL

GM1 FCL.010 Definitions

CORRELATION TABLE REGARDING NEW FNPT CLASSIFICATION FOR AEROPLANES

With the issue of the Certification Specifications for Aeroplane Flight Simulation Training Devices (CS-FSTD(A) Issue 3, new flight and navigation procedures trainer (FNPT) qualification levels have been introduced.

FNPTs approved in accordance with CS-FSTD(A) Initial Issue and CS-FSTD(A) Issue 2 should continue to fall under the FNPT levels of qualification as referenced in Commission Regulation (EU) No 1178/2011 and associated AMC and GM.

FNPTs approved in accordance with CS-FSTD(A) Issue 3 or later revision should fall under the new FNPT levels of qualification as referenced in the left column of the table below.

CS-FSTD(A) Issue 3 and later revision(s)	**ICAO Doc 9625 FSTD type**	**Typical usage**	**CS-FSTD(A) Initial Issue and Issue 2**
N/A	N/A		BITD
FNPT Level B	II	Instrument rating	FNPT Level I
FNPT Level A	I	PPL,CPL, MPL Phase 1	FNPT Level II
FNPT Level D	IV	MPL Phase2, MCC	FNPT Level II and MCC
FNPT Level C	III	Class ratings, MCC	
FNPT Level E	VI	MPL Phase 3	N/A

Note to table: This table explains that an operator that operates an FNPT approved in accordance with CS-FSTD(A) Issue 3 (left column) will have the same credit as the FNPTs approved in accordance with CS-FSTD(A) Initial Issue and CS-FSTD(A) Issue 2 as referenced in Commission Regulation (EU) No 1178/2011.

Rationale:

As only elements of Part-FCL have been amended to reflect the new FCS approach, the correlation table enables existing FCL required FSTDs to be matched with the equivalent Issue 3 devices.

AMC3 to Appendix 9 Training, skill test and proficiency check for MPL, ATPL, type and class ratings, and proficiency check for IRs

TRAINING MATRIX

The matrix provides the minimum fidelity level per simulation feature the FSTD should have to demonstrate its adequacy to support a training task.

According to CS-FSTD(A), the simulation features are:

— Flight deck layout and structure

— Flight model (aerodynamics and engine)

— Ground reaction and handling characteristics

— Aeroplane systems

— Flight controls and forces

— Sound cue

— Visual display cue

— Motion cue

— Environment – ATC

— Environment – Navigation

— Environment – Atmosphere and weather

— Environment – Aerodromes and terrain

The fidelity levels of the simulation features are:

— S: Specific;

— R: Representative;

— G: Generic;

— N: Not required;

— -: Not applicable.

For each training task, two matrices are provided, one for the training (T) and one for the testing and checking (T&C).

In the column 'Training task classification (If applicable)', the following letters mean:

— A: System operation and indication;

— B: During take-off/landing;

— C: Other phases of flight.

	MULTI-PILOT AEROPLANES AND SINGLE-PILOT HIGH-PERFORMANCE COMPLEX AEROPLANES Manoeuvres/Procedures	Training task classification (If applicable)	Testing and checking (T&C) Training (T)	Flight deck layout and structure	Flight model (aerodynamics and engine)	Ground reaction and handling characteristics	Aeroplane systems	Flight controls and forces	Sound cue	Visual display cue	Motion cue	Environment - ATC	Environment – Navigation	Environment – Atmosphere and weather	Environment – Aerodromes and terrain
SECTION 1															
1 1.1	Flight preparation Performance calculation	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.2	Aeroplane external visual inspection; location of each item and purpose of inspection	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.3	Cockpit inspection	-	T&C	S	N	N	S	S	R	S	R	S	S	R	R
		-	T	S	N	N	S	R	G	N	N	G	S	G	N
1.4	Use of checklist prior to starting engines, starting procedures, radio and navigation equipment check, selection and setting of navigation and communication frequencies	-	T&C	S	S	R	S	R	R	S	R	S	S	R	R
		-	T	S	S	G	S	R	R	N	N	G	S	G	N
1.5	Taxiing in compliance with ATC instructions or instructions of instructor	-	T&C	S	S	S	S	S	R	S	R	S	S	R	R
		-	T	S	R	S	S	R	R	R	N	G	S	R	R
1.6	Before take-off checks	-	T&C	S	S	R	S	S	R	S	R	S	S	R	R
		-	T	S	R	R	S	R	R	R	N	G	S	R	R
SECTION 2															
2 2.1	Take-offs Normal take-offs with different flap settings, including expedited take-off	-	T&C	S	S	S	S	S	R	S	R	G	S	R	R
		-	T	S	S	S	S	S	R	R	N	G	S	R	R
2.2	Instrument take-off; transition to instrument flight is required during rotation or immediately after becoming airborne	-	T&C	S	S	S	S	S	R	S	R	G	S	R	R
		-	T	S	S	S	S	S	R	R	N	G	S	R	R
2.3	Crosswind take-off	-	T&C	S	S	S	S	S	R	S	R	G	S	R	R
		-	T	S	S	S	S	S	R	R	N	G	S	R	R
2.4	Take-off at maximum take-off mass (actual or simulated maximum take-off mass)	-	T&C	S	S	S	S	S	R	S	R	G	S	R	R
		-	T	S	S	S	S	S	R	R	N	G	S	R	R
2.5 2.5.1	Take-offs with simulated engine failure: shortly after reaching V2	-	T&C	S	S	S	S	S	R	S	R	G	S	R	R
		-	T	S	S	S	S	S	R	R	N	G	S	R	R
	(In aeroplanes which are not certified as transport category or commuter category aeroplanes, the engine failure shall not be simulated until reaching a minimum height of 500 ft above the runway end. In aeroplanes having the same performance as a transport category aeroplane regarding take-off mass and density altitude, the instructor may simulate the engine failure shortly after reaching V2).	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.5.2	Between V1 and V2	-	T&C	S	S	S	S	S	R	S	R	G	S	R	R
		-	T	S	S	S	S	S	R	R	N	G	S	R	R
2.6	Rejected take-off at a reasonable speed before reaching V1	-	T&C	S	S	S	S	S	R	S	R	G	S	R	R
		-	T	S	S	S	S	S	R	R	N	G	S	R	R
SECTION 3															
3	Flight manoeuvres and procedures Manual flight with and without flight	-	T&C	S	S	N	S	S	R	N	R	G	S	R	N

	MULTI-PILOT AEROPLANES AND SINGLE-PILOT HIGH-PERFORMANCE COMPLEX AEROPLANES Manoeuvres/Procedures	Training task classification (If applicable)	Testing and checking (T&C) Training (T)	Flight deck layout and structure	Flight model (aerodynamics and engine)	Ground reaction and handling characteristics	Aeroplane systems	Flight controls and forces	Sound cue	Visual display cue	Motion cue	Environment - ATC	Environment – Navigation	Environment – Atmosphere and weather	Environment – Aerodromes and terrain
3.1	directors (no autopilot, no autothrust/autothrottle, and at different control laws, where applicable)	-	T	S	S	N	S	S	R	N	N	N	N	N	N
3.1.1	At different speeds (including slow flight) and altitudes within the FSTD training envelope	-	T&C	S	S	N	S	S	R	N	R	G	S	R	N
		-	T	S	S	N	S	S	R	N	N	N	N	N	N
3.1.2	Steep turns using 45° bank, 180° to 360° left and right	-	T&C	S	S	N	S	S	R	N	R	G	S	R	N
		-	T	S	S	N	S	S	R	N	N	N	N	N	N
3.1.3	Turns with and without spoilers	-	T&C	S	S	N	S	S	R	N	R	G	S	R	N
		-	T	S	S	N	S	S	R	N	N	N	N	N	N
3.1.4	Procedural instrument flying and manoeuvring including instrument departure and arrival, and visual approach	-	T&C	S	S	N	S	S	R	N	R	G	S	R	N
		-	T	S	S	N	S	S	R	N	N	N	N	N	N
3.2	Tuck under and Mach buffets (if applicable), and other specific flight characteristics of the aeroplane (e.g. Dutch Roll)	-	T&C	S	S	N	S	S	R	N	R	G	S	R	N
		-	T	S	S	N	S	S	R	N	R	N	N	N	N
3.3	Normal operation of systems and controls engineer's panel (if applicable)	-	T&C	S	S	N	S	S	R	N	R	G	S	R	N
		-	T	S	S	N	S	S	R	N	N	N	S	N	N
3.4	Normal and abnormal operations of following systems:	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.4.0	Engine (if necessary propeller)	-	T&C	S	S	R	S	S	R	R	R	G	S	R	R
		A	T	G	R	N	S	N	G	N	N	N	N	N	N
		B	T	S	S	S	S	S	G	R	R	N	N	N	R
		C	T	S	S	N	S	S	G	R	R	N	N	N	N
3.4.1	Pressurisation and air conditioning	-	T&C	S	R	R	S	R	R	R	R	G	S	R	R
		-	T	S	R	N	S	R	R	R	N	N	N	G	N
3.4.2	Pitot/static system	-	T&C	S	S	R	S	S	R	S	R	G	S	R	R
		-	T	S	R	N	S	R	R	R	N	N	S	G	R
3.4.3	Fuel system	-	T&C	S	S	R	S	S	R	S	R	G	S	R	R
		-	T	S	R	N	S	R	R	R	N	G	S	N	N
3.4.4	Electrical system	-	T&C	S	S	R	S	S	R	S	R	G	S	R	R
		A	T	G	N	N	S	N	N	N	N	N	N	N	N
		B	T	S	R	S	S	S	N	R	R	N	N	N	R
		C	T	S	R	N	S	S	N	N	N	N	N	N	N
3.4.5	Hydraulic system	-	T&C	S	S	R	S	S	R	R	R	G	S	R	R
		A	T	G	N	N	S	N	N	N	N	N	N	N	N
		B	T	S	R	S	S	S	N	R	R	N	N	N	R
		C	T	S	R	N	S	S	N	N	N	N	N	N	N
3.4.6	Flight control and trim system	-	T&C	S	S	R	S	S	R	S	R	G	S	R	R
		A	T	G	N	N	S	R	N	N	N	N	N	N	N
		B	T	S	R	S	S	S	N	R	R	N	N	N	R
		C	T	S	R	N	S	S	N	N	N	N	N	N	N
3.4.7	Anti-icing/de-icing system, glare shield heating	-	T&C	S	S	R	S	S	R	S	R	G	S	R	R
		-	T	S	S	G	S	S	R	R	N	G	S	R	R
3.4.8	Autopilot/flight director	-	T&C	S	S	R	S	S	R	S	R	G	S	R	R

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	MULTI-PILOT AEROPLANES AND SINGLE-PILOT HIGH-PERFORMANCE COMPLEX AEROPLANES Manoeuvres/Procedures	Training task classification (If applicable)	Testing and checking (T&C) Training (T)	Flight deck layout and structure	Flight model (aerodynamics and engine)	Ground reaction and handling characteristics	Aeroplane systems	Flight controls and forces	Sound cue	Visual display cue	Motion cue	Environment - ATC	Environment – Navigation	Environment – Atmosphere and weather	Environment – Aerodromes and terrain
		A	T	G	N	N	S	N	N	N	N	N	N	N	N
		B	T	S	R	S	S	S	N	R	R	N	N	N	R
		C	T	S	R	N	S	S	N	N	N	N	N	N	N
3.4.9	Stall warning devices or stall avoidance devices, and stability augmentation devices	-	T&C	S	S	N	S	S	R	S	R	G	S	R	R
		A	T	G	G	N	S	G	N	N	N	N	N	N	N
		B	T	S	R	S	S	S	N	R	R	N	N	N	R
		C	T	S	R	N	S	S	N	N	N	N	N	N	N
3.4.10	Ground proximity warning system, weather radar, radio altimeter, transponder	-	T&C	S	S	N	S	S	R	S	R	G	S	R	R
		-	T	S	S	N	S	S	R	R	N	G	S	R	R
3.4.11	Radios, navigation equipment, instruments, FMS	-	T&C	S	S	N	S	S	R	S	R	G	S	R	R
		-	T	S	S	N	S	S	R	R	N	G	S	R	R
3.4.12	Landing gear and brake	-	T&C	S	S	S	S	S	R	S	R	G	S	R	R
		A	T	G	N	N	S	N	G	N	N	N	N	N	N
		B	T	S	R	S	S	S	G	R	R	N	N	N	R
		C	T	S	R	N	S	S	G	N	N	N	N	N	N
3.4.13	Slat and flap system	-	T&C	S	S	S	S	S	R	S	R	G	S	R	R
		A	T	G	N	N	S	N	N	N	N	N	N	N	N
		B	T	S	R	S	S	S	G	R	R	N	N	N	R
		C	T	S	R	N	S	S	G	N	N	N	N	N	N
3.4.14	Auxiliary power unit (APU)	-	T&C	S	S	N	S	R	R	S	R	G	S	R	R
		-	T	S	S	N	S	G	R	R	N	G	N	R	R
	Intentionally left blank	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.6	Abnormal and emergency procedures:	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.6.1	Fire drills, e.g. engine, APU, cabin, cargo compartment, flight deck, wing and electrical fires including evacuation	-	T&C	S	S	S	S	S	R	S	R	G	S	R	R
		-	T	G	N	N	S	N	G	N	N	N	N	N	N
		-	T	S	R	S	S	S	G	R	R	N	N	N	R
		-	T	S	R	S	S	R	G	R	N	G	S	R	R
3.6.2	Smoke control and removal	-	T&C	S	S	N	S	N	R	S	R	S	S	R	R
		-	T	S	R	N	S	N	G	N	N	G	N	N	R
3.6.3	Engine failures, shutdown and restart at a safe height	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	R	R	N	N	G	S	R	R
3.6.4	Fuel dumping (simulated)	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	S	R	N	N	G	S	N	R
3.6.5	Wind shear at take-off/landing	-	T&C	S	S	S	S	S	R	S	R	S	S	R	R
		-	T	S	S	S	S	S	R	R	N	G	S	R	R
3.6.6	Simulated cabin pressure failure/emergency descent	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	S	R	N	N	G	S	R	R
3.6.7	Incapacitation of flight crew member	-	T&C	S	S	S	S	R	R	R	R	S	S	R	R
		-	T	S	R	S	S	G	G	N	N	G	S	R	R
3.6.8	Other emergency procedures as outlined in the appropriate aeroplane flight manual (AFM)	-	T&C	S	S	S	S	S	R	S	R	S	S	R	R
		-	T	S	S	S	S	S	R	R	N	G	S	R	R
3.6.9	TCAS event	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	S	G	R	N	G	S	R	R
3.7 3.7.1	Upset recovery training Recovery from stall events in: – take-off configuration;	-	T&C	S	S	N	S	S	R	R	R	S	S	R	R

	MULTI-PILOT AEROPLANES AND SINGLE-PILOT HIGH-PERFORMANCE COMPLEX AEROPLANES Manoeuvres/Procedures	Training task classification (If applicable)	Testing and checking (T&C) Training (T)	Flight deck layout and structure	Flight model (aerodynamics and engine)	Ground reaction and handling characteristics	Aeroplane systems	Flight controls and forces	Sound cue	Visual display cue	Motion cue	Environment - ATC	Environment – Navigation	Environment – Atmosphere and weather	Environment – Aerodromes and terrain
	– clean configuration at low altitude; – clean configuration near maximum operating altitude; and – landing configuration.	-	T	S	S	N	S	S	G	R	N	N	N	N	R
3.7.2	The following upset exercises: – recovery from nose-high at various bank angles; and – recovery from nose-low at various bank angles	-	T&C	S	S	N	S	S	R	R	R	S	S	R	R
		-	T	S	S	N	S	S	G	R	N	N	N	N	R
3.8	Instrument flight procedures	-	T&C	S	S	N	S	S	R	N	R	S	S	R	R
		-	T	S	S	N	S	S	G	N	N	G	S	R	R
3.8.1	Adherence to departure and arrival routes and ATC instructions	-	T&C	S	S	N	S	S	R	N	R	S	S	R	R
		-	T	S	S	N	S	S	G	N	N	G	S	R	R
3.8.2	Holding procedures	-	T&C	S	S	N	S	S	R	N	R	S	S	R	R
		-	T	S	S	N	S	R	G	N	N	G	S	R	R
3.8.3	3D operations to DH/A of 200 ft (60 m) or to higher minima if required by the approach procedure	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	S	G	R	N	G	S	R	R
3.8.3.1	Manually, without flight director	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	S	R	R	N	G	S	R	R
3.8.3.2	Manually, with flight director	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	S	R	R	N	G	S	R	R
3.8.3.3	With autopilot	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	R	R	R	N	G	S	R	R
3.8.3.4	Manually, with one engine simulated inoperative during final approach, either until touchdown or through the complete missed approach procedure (as applicable), starting: (i) before passing 1 000 ft above aerodrome level; and (ii) after passing 1 000 ft above aerodrome level. In aeroplanes which are not certified as transport category aeroplanes (JAR/FAR 25) or as commuter category aeroplanes (SFAR 23), the approach with simulated engine failure and the ensuing go-around shall be initiated in conjunction with the 2D approach in accordance with 3.8.4. The go-around shall be initiated when reaching the published obstacle clearance height/altitude (OCH/A); however, not later than reaching an MDH/A of 500 ft above the runway threshold elevation. In aeroplanes having the same performance as a transport category aeroplane regarding take-off mass and density altitude, the instructor may simulate the engine failure in accordance with this exercise.	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	S	R	R	N	G	S	R	R
3.8.4	2D operations down to the MDH/A	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	S	R	R	N	G	S	R	R

	MULTI-PILOT AEROPLANES AND SINGLE-PILOT HIGH-PERFORMANCE COMPLEX AEROPLANES Manoeuvres/Procedures	Training task classification (If applicable)	Testing and checking (T&C) Training (T)	Flight deck layout and structure	Flight model (aerodynamics and engine)	Ground reaction and handling characteristics	Aeroplane systems	Flight controls and forces	Sound cue	Visual display cue	Motion cue	Environment - ATC	Environment – Navigation	Environment – Atmosphere and weather	Environment – Aerodromes and terrain
3.8.5	Circling approach under the following conditions: (a) approach to the authorised minimum circling approach altitude at the aerodrome in question in accordance with the local instrument approach facilities in simulated instrument flight conditions; followed by: (b) circling approach to another runway at least 90° off centreline from the final approach used in item (a), at the authorised minimum circling approach altitude. Remark: If (a) and (b) are not possible due to ATC reasons, a simulated low-visibility pattern may be performed.	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	R	R	R	N	G	S	R	R
3.8.6	Visual approaches	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	S	R	R	N	G	S	R	R
SECTION 4															
4	Missed approach procedures	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.1.	Go-around with all engines operating during a 3D operation on reaching decision height	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	S	R	R	N	G	S	R	R
4.2.	Go-around with all engines operating from various stages during an instrument approach	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	S	R	R	N	G	S	R	R
4.3.	Other missed approach procedures	-	T&C	S	S	S	S	S	R	S	R	S	S	R	R
		-	T	S	S	S	S	S	R	R	N	G	S	R	R
4.4	Manual go-around with the critical engine simulated inoperative after an instrument approach on reaching DH, MDH or MAPt	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	S	R	R	N	G	S	R	R
4.5.	Rejected landing with all engines operating: – from various heights below DH/MDH; – after touchdown (baulked landing) In aeroplanes which are not certified as transport category aeroplanes (JAR/FAR 25) or as commuter category aeroplanes (SFAR 23), the rejected landing with all engines operating shall be initiated below MDH/A or after touchdown.	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	S	R	R	N	G	S	R	R
SECTION 5															
5 5.1.	Landings Normal landings with visual reference established when reaching DA/H following an instrument approach operation	-	T&C	S	S	S	S	S	R	S	R	S	S	R	R
		-	T	S	S	S	S	S	R	R	N	G	S	R	R
5.2.	Landing with simulated jammed horizontal stabiliser in any out-of-trim	-	T&C	S	S	S	S	S	R	S	R	S	S	R	R

	MULTI-PILOT AEROPLANES AND SINGLE-PILOT HIGH-PERFORMANCE COMPLEX AEROPLANES Manoeuvres/Procedures	Training task classification (If applicable)	Testing and checking (T&C) Training (T)	Flight deck layout and structure	Flight model (aerodynamics and engine)	Ground reaction and handling characteristics	Aeroplane systems	Flight controls and forces	Sound cue	Visual display cue	Motion cue	Environment - ATC	Environment – Navigation	Environment – Atmosphere and weather	Environment – Aerodromes and terrain
	position	-	T	S	S	S	S	S	R	R	N	G	S	R	R
5.3.	Crosswind landings (aeroplane, if practicable)	-	T&C	S	S	S	S	S	R	S	R	S	S	R	R
		-	T	S	S	S	S	S	R	R	N	G	S	R	R
5.4.	Traffic pattern and landing without extended or with partly extended flaps and slats	-	T&C	S	S	S	S	S	R	S	R	S	S	R	R
		-	T	S	S	S	S	S	R	R	N	G	S	R	R
5.5.	Landing with critical engine simulated inoperative	-	T&C	S	S	S	S	S	R	S	R	S	S	R	R
		-	T	S	S	S	S	S	R	R	N	G	S	R	R
5.6.	Landing with two engines inoperative: – aeroplanes with three engines: the centre engine and one outboard engine as far as practicable according to data of the AFM; and – aeroplanes with four engines: two engines at one side	-	T&C	S	S	S	S	S	R	S	R	S	S	R	R
		-	T	S	S	S	S	S	R	R	N	G	S	R	R
SECTION 6															
	Additional authorisation on a type rating for instrument approaches down to a DH of less than 60 m (200 ft) (CAT II/III) The following manoeuvres and procedures are the minimum training requirements to permit instrument approaches down to a DH of less than 60 m (200 ft). During the following instrument approaches and missed approach procedures, all aeroplane equipment required for type certification of instrument approaches down to a DH of less than 60 m (200 ft) shall be used.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.1	Rejected take-off at minimum authorised runway visual range (RVR)	-	T&C	S	S	S	S	S	R	S	R	S	S	R	R
		-	T	S	S	S	S	S	R	R	N	G	S	R	R
6.2	CAT II/III approaches: in simulated instrument flight conditions down to the applicable DH, using flight guidance system. Standard procedures of crew coordination (task sharing, call-out procedures, mutual surveillance, information exchange and support) shall be observed.	-	T&C	S	S	S	S	S	R	S	R	S	S	R	R
		-	T	S	S	S	S	S	R	R	N	G	S	R	R
6.3	Go-around: after approaches as indicated in 6.2 on reaching DH. The training shall also include a go-around due to (simulated) insufficient RVR, wind shear, aeroplane deviation in excess of approach limits for a successful approach, ground/airborne	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	S	R	R	N	G	S	R	R

	MULTI-PILOT AEROPLANES AND SINGLE-PILOT HIGH-PERFORMANCE COMPLEX AEROPLANES Manoeuvres/Procedures	Training task classification (If applicable)	Testing and checking (T&C) Training (T)	Flight deck layout and structure	Flight model (aerodynamics and engine)	Ground reaction and handling characteristics	Aeroplane systems	Flight controls and forces	Sound cue	Visual display cue	Motion cue	Environment - ATC	Environment – Navigation	Environment – Atmosphere and weather	Environment – Aerodromes and terrain
	equipment failure prior to reaching DH, and go-around with simulated airborne equipment failure.														
6.4	Landing(s): with visual reference established at DH following an instrument approach. Depending on the specific flight guidance system, an automatic landing shall be performed.	-	T&C	S	S	N	S	S	R	S	R	S	S	R	R
		-	T	S	S	N	S	S	R	R	N	G	S	R	R

Rationale:

The training matrix provides a means to correlate FCS of an FSTD, available on the device qualification certificate, with each training task, to ensure consistency with Part-FCL Appendix 9 and current approved ATO training programmes as well as operator recurrent training, and harmonisation with FSTD types in ICAO Doc 9625. This correlation provides to the ATOs and their CAs, objectivity, transparency and reproducibility in the choice of an FSTD. In the context of ORA.FSTD.135, with the support of the FSTD ESL, the ATO has the required information to demonstrate the adequacy between the FSTD specifications and the related training programme.

GM2 to Appendix 9 Training, skill test and proficiency check for MPL, ATPL, type and class ratings, and proficiency check for IRs

GUIDANCE ON THE USE OF THE MATRIX

Column 1:

The numbers of different paragraphs of each section of the 'Manoeuvres/Procedures'.

Column 2:

The corresponding 'Manoeuvres/Procedures' for each paragraph.

Column 3:

Is the training task classification.

There are 4 classifications:

— System operation and indication;

— During take-off/landing;

— Other phases of flight;

— Not applicable (NA).

For each row with the different 'Manoeuvres/Procedures', which classifications are applicable is then indicated.

Column 4

In the rows for the different 'Manoeuvres/Procedures', there are two rows:

— T as Training;

— T&C as Training and checking.

Each row provides the minimum level of fidelity per feature that the FSTD is expected to provide. If the FSTD(A) provides at least the level of fidelity shown in the matrix, for each feature, the FSTD(A) is suitable to support the training task for training, for testing and checking or for both.

For each of the FSTD(A) features, the level of fidelity: N, G, R or S, will be indicated.

The four fidelity levels are as summarised below:

S (specific)	Highest level of required fidelity for a given FSTD feature
R (representative)	Intermediate level of required fidelity for a given FSTD feature
G (generic)	The lowest level of required fidelity for a given FSTD feature
N (none)	Feature is not installed or available for use in training.

Columns 5 to 13

In columns 5 to 13, all the 12 different FSTD(A) features (as stated in CS FSTD(A).QB.110 'FSTD general requirements for feature fidelity levels') are reflected.

LINK BETWEEN MATRIX AND FSTD QUALIFICATION CERTIFICATE

The relevant FSTD feature fidelity level codes (N, G, R or S) can be found on the FSTD qualification certificate page 2 in the 'Fidelity level' column of the FSTD capability signature (FCS) table in Section H 'FSTD feature' for each feature in turn.

The FSTD qualification certificate can be found in Appendix IV to Annex VI (Part-ARA).

3.2. Draft regulation (draft EASA opinion)

Draft text

Part-ARA

ARA.GEN.220 Record-keeping

(a) The competent authority shall establish a system of record-keeping providing for adequate storage, accessibility and reliable traceability of:

(1) the management system's documented policies and procedures;

(2) training, qualification and authorisation of its personnel;

(3) the allocation of tasks, covering the elements required by ARA.GEN.205 as well as the details of tasks allocated;

(4) certification and declaration processes as well as oversight of certified and declared organisations;

(5) processes for issuing personnel licences, ratings, certificates and attestations and for the continuing oversight of the holders of those licences, ratings, certificates and attestations;

(6) processes for issuing FSTD qualification certificates and for the continuing oversight of the FSTD and of the organisation operating it;

(7) oversight of persons and organisations exercising activities within the territory of the Member State, but overseen or certified by the competent authority of another Member State or the Agency, as agreed between these authorities;

(8) the evaluation and notification to the Agency of alternative means of compliance proposed by organisations and the assessment of alternative means of compliance used by the competent authority itself;

(9) findings, corrective actions and date of action closure;

(10) enforcement measures taken;

(11) safety information and follow-up measures;

(12) the use of flexibility provisions in accordance with Article 71 of Regulation (EU) 2018/1139; and

(13) the evaluation and authorisation process of aircraft laid down in points ORA.ATO.135 (a) and DTO.GEN.240 (a).

(b) The competent authority shall establish and keep an up-to-date ~~a~~ list of all:

(1) organisation certificates and FSTD qualification certificates it has issued;

(2) ~~and~~ personnel licences, certificates and attestations it has issued;

(3) DTO declarations it has received; and

(4) the DTO training programmes it has verified or approved for compliance with Annex I (Part-FCL), Annex III (Part-BFCL) to Commission Regulation (EU) 2018/395, or Annex III (Part-SFCL) to Commission Implementing Regulation (EU) 2018/1976.

(c) All records shall be kept for the minimum period specified in this Regulation. In the absence of such indication, records shall be kept for a minimum period of 5 years subject to applicable data protection law.

Rationale:

Linguistic and formatting improvements.

ARA.FSTD.100 Initial evaluation procedure

(a) Upon receiving an application for an FSTD qualification certificate, the competent authority shall:

(1) evaluate the FSTD submitted for initial evaluation or for upgrading against the applicable qualification basis;

(2) assess the FSTD in those areas that are essential to completing the flight crew member training, testing and checking process, as applicable;

(3) conduct objective, subjective and functions tests in accordance with the qualification basis and review the results of such tests to establish the qualification test guide (QTG); and

(4) verify if the organisation operating the FSTD is in compliance with the applicable requirements. ~~This does not apply to the initial evaluation of basic instrument training devices (BITDs).~~

(c)[…]

(2) Where an update to an FSTD involves a change of technology or the addition of a new system or equipment that is not covered by the qualification basis used for the existing qualification and an evaluation of such changes is not possible using the original qualification basis, the specific changes may be qualified by using newer certification specifications that apply to these changes, without affecting the overall qualification of the FSTD. The competent authority shall document the qualification of such changes and the certification specification used.

(d) The CAA shall issue an evaluation report upon completion of the evaluation.

[…]

Rationale:

The BITDs have been deleted as they are no longer within the scope of CS-FSTD(A) for initial qualifications from CS-FSTD(A) Issue 3 onwards.

ARA.FSTD.105 Certification specifications for FSTDs

(a) The Agency shall issue, in accordance with Articles 76(3) and 115 of Regulation (EU) 2018/1139, certification specifications that competent authorities, organisations and personnel may use to demonstrate compliance of FSTDs with the relevant essential requirements of Annex IV to Regulation (EU) 2018/1139.

(b) Such certification specifications shall be sufficiently detailed and specific to indicate to applicants the conditions under which qualification certificates will be issued or amended.

Rationale:

The existing provisions of ORA.FSTD.205 have been transferred to Part-ARA, for clarification purposes.

ARA.FSTD.110 Issue of an FSTD qualification certificate

~~After completion of an evaluation of the FSTD and when satisfied that the FSTD meets the applicable qualification basis in accordance with ORA.FSTD.210 and that the organisation operating it meets the applicable requirements to maintain the qualification of the FSTD in accordance with ORA.FSTD.100, the competent authority shall issue the FSTD qualification certificate of unlimited duration, using the form as established in Appendix IV to this Part.~~ After completion of an evaluation of the FSTD, the competent authority shall only issue the FSTD qualification certificate of unlimited duration, using the form as established in Appendix IV to this Part (EASA Form 145), when it has verified that:

(a) the organisation that operates the FSTD meets the applicable requirements to maintain the qualification of the FSTD in accordance with ORA.FSTD.100;

(b) the FSTD meets the applicable qualification basis in accordance with ORA.FSTD.210.

Rationale:

The text has been redrafted to improve clarity.

ARA.FSTD.115 Interim FSTD qualification

(a) In the case of the introduction of new aircraft programmes, when compliance with the requirements established in this Subpart for FSTD qualification is not possible, the competent authority may issue an interim FSTD qualification level or validate an interim FSTD capability signature (FCS) for a type-specific FSTD.

~~(b) For full flight simulators (FFS) an interim qualification level shall only be granted at level A, B or C.~~

~~(c)~~ (b) This interim qualification level shall be valid until a final qualification level or FSTD FCS can be issued and, in any case, shall not exceed 3 years.

Rationale:

Clarification of interim FSTD qualification levels for new aeroplane programmes to apply to FSTD qualification level and FCS for type-specific FSTDs. The previous levels A, B, C for FFSs are no longer applicable for initial evaluation under CS-FSTD(A) Issue 3.

ARA.FSTD.120 Continuation of an FSTD qualification

(a) The competent authority shall continuously monitor the organisation operating the FSTD, as part of the oversight programme, to verify that:

(1) the complete set of validation tests in the MQTG is rerun progressively over a 12-month period;

(2) the results of recurrent evaluations continue to comply with the qualification standards ~~and are dated and retained~~; and

(3) a configuration control system is in place to ensure the continued integrity of the hardware and software of the qualified FSTD.

(b) The competent authority shall conduct recurrent evaluations of the FSTD in accordance with the procedures detailed in ARA.FSTD.100. These evaluations shall take place:

(1) every year, in the case of a full flight simulator (FFS), flight training device (FTD) or flight and navigation procedures trainer (FNPT). The start for each recurrent 12-month period is the date of the initial qualification, or the last recurrent evaluation when agreed between the competent authority and the organisation operating the FSTD. The FSTD recurrent evaluation shall take place within the 60 days prior to the end of this 12-month recurrent evaluation period;

(2) every 3 years, in the case of a BITD.

(c) The FSTD oversight period of 12 months may be extended up to a maximum period of 36 months, in case all the following criteria are fulfilled:

(1) the FSTD has been subject to an initial and at least one recurrent evaluation that has established its compliance with the qualification basis;

(2) the organisation operating the FSTD has a satisfactory record of successful regulatory FSTD evaluations during the previous 36 months;

(3) The organisation operating the FSTD has a satisfactory record of regulatory audits and inspections during the previous 36 months and the competent authority performs an audit of the compliance monitoring system defined in ORA.GEN.200(a)(6) of the organisation every 12 months

Rationale:

The text has been moved here from ORA.FSTD.225 to clarify the circumstances under which CAs may extend the period between recurrent evaluations to up to 36 months. Besides, it is the intent to clarify roles and responsibilities of CAs and operators.

ARA.FSTD.125 Declaration of the equipment and specifications list (ESL) to the competent authority

(a) Upon receiving a declaration, or notification of a change to a declaration, from an organisation operating FSTDs regarding the equipment and specifications list (ESL) for an FSTD, the competent authority shall acknowledge receipt of the declaration.

(b) The content of an initial ESL shall be verified by the competent authority during the initial evaluation of the FSTD and shall be used as the basis for each recurrent evaluation.

Rationale:

This new IR formally establishes the requirement for CAs to deal with the organisations that operate FSTDs with declared ESLs. There is no need for further action from the CA once the acknowledgement of declaration is received. It becomes part of continued oversight and the certificate is not to be changed.

ARA.FSTD.130 Changes

(a) Upon receipt of an application for any changes to the FSTD qualification certificate, the competent authority shall comply with the applicable elements of the initial evaluation procedure requirements as described in ARA.FSTD.100(a), (b) and (c).

(b) The competent authority shall always conduct a special evaluation before granting a higher level of qualification or change of FCS to the FSTD.

(~~b~~c) The competent authority may decide to complete a special evaluation ~~following~~ after any of the following events:

(1) major changes to the FSTD in accordance with ORA.FSTD.110;

(2) ~~or~~ when an FSTD appears not to be performing at its initial qualification level;

(3) changes to an ESL declaration for an FSTD.

~~(c) The competent authority shall always conduct a special evaluation before granting a higher level of qualification to the FSTD.~~

Rationale:

The IR has been updated to include the requirement for the CA to conduct a special evaluation before granting a higher level of qualification or change of FCS to the FSTD. In addition, update of point (c) to require the CA to consider a special evaluation when there are changes to an ESL declaration for an FSTD.

ARA.FSTD.135 ~~Findings and corrective actions –~~ FSTD qualification certificate — Limitation, suspension and revocation

The competent authority shall limit, suspend or revoke, as applicable, an FSTD qualification certificate in accordance with ARA.GEN.350 in, but not limited to, any of the following circumstances:

(a) obtaining the FSTD qualification certificate by falsification of submitted documentary evidence;

(b) the organisation operating the FSTD can no longer demonstrate that the FSTD complies with its qualification basis;

(c) the organisation operating the FSTD no longer complies with the applicable requirements of Part-ORA~~.~~;

(d) the ESL declaration for an FSTD made by the organisation operating the FSTD is incomplete or incorrect.

Rationale:

The IR has been renamed and the new point (d) has been added regarding incomplete or incorrect ESL declarations detected during normal oversight processes.

ARA.FSTD.140 Record-keeping

In addition to the records required in ARA.GEN.220, the competent authority shall keep and update:

(a) a list of the qualified FSTDs under its supervision;

(b) the dates when evaluations are due and when such evaluations were carried out;

(c) a list of declarations regarding FSTD ESLs it receives from organisations operating FSTDs.

Rationale:

The new point (c) has been added regarding the requirements for the CAs to keep a list of declarations regarding FSTD ESLs it receives from organisations operating FSTDs.

Appendix IV to ANNEX VI (Part-ARA) – Flight simulation training device qualification certificate

~~Introduction~~

European Union (*)

Competent Authority

FLIGHT SIMULATION TRAINING DEVICE (FSTD) QUALIFICATION CERTIFICATE

Pursuant to Commission Regulation (EU) No 1178/2011 and subject to the conditions specified below, the [competent authority] hereby certifies that

FSTD [IDENTIFICATION]
[FSTD MANUFACTURER AND SERIAL NUMBER]
[AIRCRAFT REPRESENTED]

located at
[LOCATION OF THE DEVICE]
operated by
[HOLDER OF THE QUALIFICATION CERTIFICATE]
[ADDRESS OF THE PRINCIPAL PLACE OF BUSINESS OF OPERATOR]

has satisfied the qualification requirements in accordance with the applicable primary reference document(s) and Part-ORA, subject to the conditions of the attached FSTD specifications and FCS.
This qualification certificate shall remain valid subject to the FSTD and the holder of the qualification certificate remaining in compliance with the applicable requirements of Part-ORA, unless it has been surrendered, superseded, suspended or revoked.

Date of issue: ~~..........~~
For the [competent authority]
Signature: ~~.........~~

(*) 'European Union' to be deleted for non-EU Member States
EASA Form 145 Issue 2 – page 1/2

FSTD QUALIFICATION CERTIFICATE: [Reference]

FSTD SPECIFICATION

A.	Type, class or variant of aircraft:	
B.	Primary reference document(s) (PRD(s));	
C.	FSTD type:	
D.	FSTD qualification level:	

E.	ESL reference:	
F.	Additional capabilities:	
G.	Limitations:	

FSTD CAPABILITY SIGNATURE (FCS)

H.	**FSTD FEATURE**		**FIDELITY LEVEL**
1.	Flight deck layout and structure	*(N/G/R/S)*	
2.	Flight model	*(N/G/R/S)*	
3.	Ground reaction and handling characteristics	*(N/G/R/S)*	
4.a	Aeroplane systems *(fixed wing)*	*(N/G/R/S)*	
4.b	Helicopter systems *(rotary wing)*	*(N/G/R/S)*	
5.	Flight controls and forces	*(N/G/R/S)*	
6.	Sound cue	*(N/G/R/S)*	
7.	Visual display cue	*(N/G/R/S)*	
8.a	Motion cue	*(N/G/R/S)*	
8.b.	Vibration cue *(rotary wing)*	*(N/G/R/S)*	
9.	Environment — ATC	*(N/G/R/S)*	
10.	Environment — Navigation	*(N/G/R/S)*	
11.	Environment — Atmosphere and weather	*(N/G/R/S)*	
12.a	Environment — Aerodromes and terrain *(fixed wing)*	*(N/G/R/S)*	
12.b	Environment — Landing areas and terrain *(rotary wing)*	*(N/G/R/S)*	

EASA Form 145 Issue 2 – page 2/2

(a) EASA Form 145 shall be used for the FSTD qualification certificate. This document shall contain the FSTD Specification and FCS, where applicable, including any additional capabilities and limitation(s) ~~and special authorisation(s) or approval(s)~~ as appropriate to the FSTD concerned.

(b) The qualification certificate shall be printed in English and in any other language(s) determined by the competent authority.

(c) ~~Convertible FSTDs shall have a separate qualification certificate for each aircraft type.~~ Separate qualification certificates shall be issued for a convertible training device platform for each aircraft type represented and different qualification levels granted for one FSTD. Different engine and equipment fit on one FSTD shall not require separate qualification certificates.

(d) All qualification certificates shall carry a serial number prefixed by a code in letters, which shall be specific to that FSTD. The letter code shall be specific to the competent authority of issue.

(e) All FSTD qualifications shall be defined by the correct combination of primary reference document (PRD), FSTD type, qualification level or, as applicable to the PRD, a detailed FCS.

(f) The same FSTD qualification certificate shall be used for rotary wing and fixed wing FSTDs, of any type and qualification level, whether or not the FSTD concerned has an FCS in accordance with the relevant PRD used for the initial evaluation.

(g) Completion of qualification certificate for FSTDs without an FCS:

(1) On the FSTD qualification certificate page 2 in the 'FSTD specification' table, identify the PRD(s) used for the initial qualification and the FSTD type and qualification level as applicable.

(2) On the FSTD qualification certificate page 2 in the 'FSTD capability signature' table, the letters 'N/A', not applicable, shall be entered into each FSTD feature fidelity level box in preference to leaving it blank.

(h) Completion of qualification certificate for FSTDs with an FCS

(1) When the FSTD evaluation process validates the FCS declared in the application, or the attributed FSTD FCS in accordance with ARA.FSTD.100, then the relevant FSTD feature fidelity level codes (N, G, R or S) shall be entered on the FSTD qualification certificate page 2 in the 'Fidelity level' column of the 'FSTD Capability Signature (FCS)' table for each feature in turn.

(2) Where an FCS feature is not applicable for the FSTD type being evaluated then the letters 'N/A', for not applicable, shall be entered into the fidelity level box

(3) Where an FCS feature is either not available or assessed for the FSTD being evaluated, then the letter 'N', for none, shall be entered into the fidelity level box.

(4) FSTDs assigned an FCS shall still be assigned a type and qualification level in accordance with the relevant FCS against the FSTD type and qualification level matrix that is described in the PRD used for the evaluation. Where the FCS determined during the evaluation does not exactly match that defined in the PRD matrix for a specific FSTD type and level, but falls between two levels, then the lower FSTD qualification level shall be assigned.

Rationale:

The IR and FSTD qualification certificate EASA Form 145 have been updated to reflect the new approaches described within this NPA. Significant changes include:

— removal of training testing and checking considerations as these are now replaced by reference to operator-declared ESL;

— addition of the FCS table to record the evaluated FCS in addition to FSTD type and qualification level;

— addition of the address of the principal place of business of the organisation.

The IR also provides for completion of the FSTD qualification certificates for FSTDs with or without an FCS as applicable to avoid confusion as all FSTDs will be affected. The benefit is that a single certificate is still used for any type of FSTDs, and also the new format will support future changes and developments in the use of FCS for all training types for fixed and rotary wing.

3.3. Draft acceptable means of compliance and guidance material (draft EASA decision)

AMC1 ARA.GEN.200(a) Management system

GENERAL

(a) All of the following should be considered when deciding upon the required organisational structure:

(1) the number of certificates, attestations, authorisations and approvals to be issued;

(2) the number of declared training organisations;

(3) the number of organisations operating FSTDs and the number of FSTD's certificates to be issued;

(~~3~~4) the number of certified persons and organisations exercising an activity within that Member State, including persons or organisations certified by, or having made a declaration to, other competent authorities;

(~~4~~5) the possible use of qualified entities and of resources of other competent authorities to fulfil the continuing oversight obligations;

(~~5~~6) the level of civil aviation activity in terms of:

(i) number and complexity of aircraft operated;

(ii) size and complexity of the Member State's aviation industry;

(~~6~~7) the potential growth of activities in the field of civil aviation.

[…]

Rationale:

The AMC now includes the missing reference to FSTD activities.

AMC2 ARA.GEN.200(a)(2) Management system

QUALIFICATION AND TRAINING - INSPECTORS

[…]

(2) Additional qualification criteria:

(i) inspectors conducting sampling of training flights in aircraft or FSTD sessions should hold or have held a pilot licence and relevant ratings and certificates appropriate to the level of the training conducted;

(ii) inspectors conducting sampling of training flights in aircraft as a member of the flight crew should hold a pilot licence and relevant ratings and certificates appropriate to the level of the training conducted;

(iii) inspectors conducting sampling of theoretical-knowledge instruction should have a practical background in aviation in the areas relevant to the training provided as well as practical experience in instructional techniques;

(iv) inspectors approving training programmes should have relevant experience in the same area; ~~and~~

(v) flight inspectors conducting evaluations of FSTDs should hold or have held a pilot licence and relevant ratings appropriate to the FSTD type evaluated; and

~~(v)~~(vi) inspectors not involved in activities referred to in (i)-(iv) above should have a relevant background in aviation related to their duties.

GM3 ARA.GEN.200(a)(2) Management system

The meaning of 'relevant ratings and certificates appropriate to the level of the training conducted', as used in AMC2 ARA.GEN.200(a)(2), is explained below:

— the range of activities in an ATO may vary from instructions for the simple single-engined aircraft to type training for CS-25-certified multi-pilot aircraft;

— in the context of the general approval of the ATO, experience in similar types or classes of aircraft is acceptable;

— the inspector has the instructional experience in the same or similar types or the same class of aircraft intended to be flown within the ATO (e.g. a type rating to assess the type training programmes); and

— the experience in CS-25-certified multi-pilot aircraft will not, for example, equip the inspector to assess the training programme in an ATO operating only single-engine piston (SEP) (land) aircraft; similarly, experience as a PPL instructor will not necessarily equip the inspector to assess a type training course for a CS-25 aircraft; in both cases, additional appropriate training in the applicable environment is necessary.

For inspectors evaluating FSTDs, additional appropriate training might be necessary to cover the full range of class-specific (single-engine aircraft) or type-specific (CS-25 aircraft) FSTDs.

AMC1 ARA.ATO.120 Record-keeping

~~**FSTDs**~~

~~Records relating to FSTDs should include, as a minimum:~~

~~(a) the application for an FSTD qualification;~~

~~(b) the FSTD qualification certificate including any changes;~~

~~(c) a copy of the evaluation programme listing the dates when evaluations are due and when evaluations were carried out;~~

~~(d) initial and recurrent evaluation records;~~

~~(e) copies of all relevant correspondence;~~

~~(f) details of any exemption and enforcement actions; and~~

~~(g) any report from other competent authorities relating to initial and recurrent evaluations.~~

Rationale:

Deleted and transferred to AMC1 ARA.FSTD.140.

AMC1 ARA.FSTD.100(a)(1) Initial evaluation procedure

ASSESSMENT PROCESS LEADING TO THE ISSUE OF AN FSTD QUALIFICATION

(a) FSTDs require evaluation leading to qualification. The required process should be accomplished in two distinct steps. First, a check should be made to determine whether or not the FSTD complies with the applicable requirements. When making this check, the competent authority should ensure that accountability for the issue of an FSTD qualification is clearly defined. In all cases an individual department manager of the competent authority should be appointed under whose personal responsibility the issue of an FSTD qualification is to be considered. The second step should be the grant (or refusal) of an FSTD qualification.

(b) When checking compliance with the applicable requirements, the competent authority should ensure that the following steps are taken:

(1) Once an FSTD is contracted to be built, the organisation that is to operate the FSTD should ensure that the regulatory standard upon which the FSTD will eventually be qualified against is acceptable to the competent authority. This should be the current applicable version of CS-FSTD(A) or CS-FSTD(H) at the time of application.

(2) A written application for an FSTD qualification should be submitted, in a format according to ORA.FSTD.200, at least 3 months before the date of intended operation. However, the qualification test guide (QTG) and equipment and specifications list (ESL) may be submitted later, but not less than 30 days and 7 days respectively before the date of intended evaluation. The application form should be printed in English and any other language(s) of the competent authority's choosing.

[…]

Rationale:

The reference to the ESL is added in point (b)(2). It is considered that 7 days are enough for a CA provided that the legal delay is 3 months. However, EASA allows for a shorter delay which benefits the industry stakeholders. The AMC is related to AMC1 ORA.FSTD.200 Part C.

AMC2 ARA.FSTD.100(a)(1) Initial evaluation procedure

GENERAL

(a) During initial and recurrent FSTD evaluations, it should be necessary for the competent authority to conduct an appropriate sample of the objective and subjective tests described in Part-ORA and detailed in CS-FSTD(A) and CS-FSTD(H), as applicable. There may 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.

(b) Following an evaluation, it is possible that a number of defects are identified~~. Generally, these defects should be rectified and the competent 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~~ limitation ~~to the testing, training and checking considerations~~ otherwise inferred by the qualification level or FCS.

If any defect remains unattended without ~~good~~ acceptable reason ~~for a period greater than 30 days,~~ subsequent ~~downgrading~~ limitations may occur or the FSTD qualification may be revoked.

(c) For the evaluation of an FSTD the standard form as mentioned in AMC5 ARA.FSTD.100(a)(1) should be used.

Rationale:

'Downgrading' has been replaced with 'limitation(s)' as the CA cannot downgrade FSTDs; instead, it limits, suspends or revokes certificates as detailed in ARA.FSTD.135. Besides, FCS is added to the qualification level. As a result, there is a clarification of the process.

AMC4 ARA.FSTD.100(a)(1) Initial evaluation procedure

COMPOSITION OF THE EVALUATION TEAM

(a) The competent authority should appoint a technical team to evaluate an FSTD in accordance with a structured routine to gain a qualification level. The team should normally consist of at least the following personnel:

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

(2) One of the following:

(i) a flight inspector of the competent authority, or an accredited inspector from another competent authority, who is qualified in flight crew training procedures and holds a valid type rating on the aeroplane/helicopter (or for flight navigation procedures trainer (FNPT) and basic instrument training device (BITD), class rated on the class of aeroplane/type of helicopter) being simulated; or

(ii) a flight inspector of the competent authority who is qualified in flight crew training procedures, assisted by a type rating instructor holding a valid type rating on the aeroplane/helicopter (or for FNPT and BITD, class rated on the class of aeroplane/type of helicopter) being simulated; or, exceptionally,

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

(3) Where a designee is used as a substitute for one of the competent authority's inspectors, the other person shall be a properly qualified inspector of the competent authority or an accredited inspector from another Member State's competent authority.

(b) For ~~a~~ the lowest level flight training device (FTD) ~~level 1~~ and FNPT Type I, one suitably qualified inspector may combine the functions in (a)(1) and (a)(2).

~~(c) For a BITD this team should consist of an inspector from a competent authority and one from another competent authority, including the manufacturer's competent authority, if applicable.~~

~~(d)~~(c) Additionally, the following persons should be present:

(1) for a full flight simulator (FFS), FTD and FNPT, a type or class rated instructor from the ATO operating an FSTD or from the main FSTD user;

(2) for all types, sufficient FSTD support staff to assist with the running of tests and operation of the instructor's station.

Rationale:

Updated device types and level references for new CS-FSTD(A) Issue 3 types and levels. BITDs have been deleted as they are no longer relevant for initial evaluation.

AMC5 ARA.FSTD.100(a)(1) Initial evaluation procedure

~~**FSTD EVALUATION REPORT FOR INITIAL AND RECURRENT EVALUATION**~~

~~FSTD Evaluation Report~~

~~Date:..............................~~

~~[competent authority]~~

~~**FSTD EVALUATION REPORT**~~

~~EASA FSTD code (if applicable):~~
~~Aircraft type and variant:~~
~~Engine fit(s) simulated:~~

~~**[Member State] FSTD code (if applicable):**~~
~~**Class of aeroplane / type of helicopter:**~~

~~**Contents**~~

~~1. Flight simulation training device (FSTD) characteristics~~
~~2. Evaluation details~~
~~3. Supplementary information~~
~~4. Training, testing and checking considerations~~
~~5. Classification of items~~
~~6. Results~~
~~7. Evaluation team~~

~~The conclusions presented are those of the evaluation team. The competent authority reserves the right to change these after internal review.~~

~~1. Flight simulation training device (FSTD)~~		
~~(a) Organisation operating the FSTD:~~		
~~(b) FSTD Location:~~		
~~(c) FSTD Identification (Member State FSTD code / EASA FSTD Code):~~		
~~(d) FSTD Manufacturer and FSTD Identification serial number:~~		
~~(e) First entry into service (month/year):~~		
~~(f) Visual system (manufacturer and type):~~		
~~(g) Motion system (manufacturer and type) :~~		
~~(h) Aircraft type and variant:~~		
~~(i) Engine fit(s):~~		
~~(k) Engine instrumentation:~~	~~Flight instrumentation:~~	
~~2. Evaluation details~~		
~~(a) Date of evaluation:~~	~~(b) Date of previous evaluation:~~	
~~(c) Type of evaluation: initial recurrent special~~		
~~(d) FSTD Qualification Level recommended:~~ ~~FFS A B C D~~ ~~AG BG CG DG SC~~ ~~FTD 1 2 3~~ ~~FNPT I II III MCC~~ ~~BITD~~		
~~Validation data roadmap (VDR) ID-No.:~~		
~~3. Supplementary information~~		
~~Company representative(s) (FSTD operator, Main FSTD user)~~		
~~FSTD seats available~~		
~~Visual databases used during evaluation~~		
~~Other~~		
~~4. Training, testing and checking considerations~~		

~~CAT I RVR m DH ft~~	
~~CAT II RVR m DH ft~~	
~~CAT III RVR m DH ft~~ ~~(lowest minimum)~~	
~~LVTO RVR m~~	
~~Recency~~	
~~IFR-training/check~~	
~~Type rating~~	
~~Proficiency checks~~	
~~Autocoupled approach~~	
~~Autoland/Roll out guidance~~	
~~ACAS I / II~~	
~~Windshear warning system/predictive windshear~~	
~~WX-Radar~~	
~~HUD/HUGS~~	
~~FANS~~	
~~GPWS/EGPWS~~	
~~ETOPS capability~~	
~~RNP APCH LNAV~~	
~~RNP APCH LNAV/VNAV~~	
~~RNP APCH LPV~~	
~~RNP AR APCH~~	
~~Other~~	

~~5. Classification of items~~

~~UNACCEPTABLE~~

~~An item that fails to comply with the required standard and, therefore, affects the level of qualification or the qualification itself. If these items will not be corrected or clarified within a given time limit, the (competent authority) should have to vary, limit, suspend or revoke the FSTD qualification.~~

~~RESERVATION~~

~~An item where compliance with the required standard is not clearly proven and the issue will be reserved for a later decision. Resolution of these items will require either:~~

~~1. a competent authority policy ruling; or~~

~~2. additional substantiation.~~

~~UNSERVICEABILITY~~

~~A device that is temporarily inoperative or performing below its nominal level.~~

~~LIMITATION~~

~~An item that prevents the full usage of the FSTD according to the training, testing and checking considerations due to the unusable devices, systems or parts thereof.~~

~~RECOMMENDATION FOR IMPROVEMENT~~

~~An item that meets the required standard, but where considerable improvement is strongly recommended.~~

~~COMMENT~~

~~Self-explanatory~~

~~Period of Rectification~~

~~As set out in AMC2 ARA.FSTD.100(a)(1) point (b):~~
~~Following an evaluation, it is possible that a number of defects are identified. Generally, these defects should be rectified and the competent 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 a period greater than 30 days, subsequent downgrading may occur or the FSTD qualification could be revoked.~~

~~6. Results~~

~~6.1 Subjective/Functional~~

~~**A Unacceptable**~~

~~1~~	

~~**B Reservation**~~

~~1~~	

~~**C Unserviceability**~~

~~1~~	

~~**D Restriction**~~

~~1~~	

~~**E Recommendation for improvement**~~

~~1~~	

~~**F Comment**~~

~~1~~	

~~6.2 Objective~~

~~**A Unacceptable**~~

~~1~~	

~~**B Reservation**~~

~~1~~	

~~**E Recommendation for improvement**~~

~~1~~	

~~**F Comment**~~

~~1~~	

~~7. Evaluation Team~~

~~**Name**~~	~~**Position**~~	~~**Organisation**~~	~~**Signature**~~
	~~Technical Inspector or person designated by the competent authority~~		
	~~Flight Inspector or person designated by the competent authority~~		

		~~[FSTD User]~~	
		~~[Organisation operating the FSTD]~~	

☐ ☐

~~Signed: ……………………………………………………………… For the competent authority~~

Rationale:

The AMC has been deleted as it presents the old FSTD report format.

AMC1 ARA.FSTD.100(a)(3) Initial evaluation procedure

FUNCTION~~S~~ AND SUBJECTIVE TESTS – SUGGESTED TEST ROUTINE

(a) During the initial ~~and recurrent~~ evaluation~~s~~ of an FSTD, the competent authority should conduct a series of function~~s~~ and subjective tests that together with the objective tests complete the comparison of the FSTD with the aircraft, the class of aircraft or type of helicopter.

(b) Functions tests verify the acceptability of the simulated aircraft systems and their integration. Subjective tests verify the fitness of the FSTD in relation to training, checking and testing tasks.

(c) The FSTD should provide adequate flexibility to permit the accomplishment of the desired and required tasks while maintaining an adequate perception by the flight crew that they are operating in a real aircraft 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.

(d) It is important that both the competent authority and the organisation operating an FSTD understand what to expect from the routine of FSTD function~~s~~ and subjective tests. 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 under points (f) and (g). ~~(for BITD point (h)).~~

[…]

~~(h) Typical subjective test profile for BITDs (approximately 2 hours) – items and altitudes, as applicable:~~

~~(1) instrument departure, climb performance,~~

~~(2) level-off at 4 000 ft,~~

~~(3) fail engine (if applicable),~~

~~(4) engine out climb to 6 000 ft (if applicable),~~

~~(5) engine out cruise performance (if applicable), restart engine,~~

~~(6) all engine cruise performance with different power settings,~~

~~(7) descent to 2 000 ft,~~

~~(8) all engine performance with different configurations, followed by instrument landing system (ILS) approach,~~

~~(9) all engine go-around,~~

~~(10) non-precision approach,~~

~~(11) go-around with engine failure (if applicable),~~

~~(12) engine out ILS approach (if applicable),~~

~~(13) go-around engine out (if applicable),~~

~~(14) non-precision approach engine out (if applicable), followed by go-around,~~

~~(15) restart engine (if applicable),~~

~~(16) climb to 4 000 ft,~~

~~(17) manoeuvring,~~

~~(18) normal turns left and right,~~

~~(19) steep turns left and right,~~

~~(20) acceleration and deceleration within operational range,~~

~~(21) approaching to stall in different configurations,~~

~~(22) recovery from spiral dive,~~

~~(23) auto flight performance (if applicable),~~

~~(24) system malfunctions,~~

~~(25) approach.~~

Rationale:

The reference to recurrent evaluations has been removed as ARA.FSTD.100 deals with initial qualifications. BITD references have been deleted as BITDs are no longer valid for initial evaluation.

AMC1 ARA.FSTD.100(b) Initial evaluation procedure

FSTD EVALUATION REPORT

[Competent authority] **FSTD EVALUATION REPORT**
[FIXED WING / ROTARY WING]

Date of the report:	
Report issue number:	
FSTD code:	

Name of the organisation operating the FSTD:

Aircraft type and variant:

Class of aeroplane / type of helicopter

Engine fit(s) simulated:

Contents:

The conclusions presented are those of the evaluation team. The competent authority reserves the right to change these after internal review.

1. Flight simulation training device (FSTD) characteristics:		
(a) Organisation operating the FSTD (name and address):		
(b) FSTD location (address):		
(c) FSTD identification (Member State FSTD code / EASA FSTD code):		
(d) FSTD manufacturer and FSTD identification serial number:		
(e) First entry into service (mm/yy):	Initial qualification (mm/yy, in accordance with EU regulation):	Last upgrade (mm/yy):
(f) Visual system (manufacturer and type):		
(g) Motion system (manufacturer and type):		
(h) Aircraft type or class and/or variant:		
(i) Engine fit(s):		
2. Evaluation details		
(a) Date of evaluation:	dd/mm/yyyy	
(b) Date of previous evaluation:	dd/mm/yyyy	
(c) Type of evaluation:	Initial / Recurrent / Special	
(d) ESL reference, revision and date:		
(e) QTG reference, revision and date:		
(f) Validation data roadmap (VDR), or reference data roadmap (RDR) reference:		
(g) FSTD Primary Reference Document:	**(h) FSTD Type:**	**(i) FSTD Qual. Level:**
(j) 1. Flight deck layout and structure		N / G / R / S
2. Flight model		N / G / R / S
3. Ground reaction and handling characteristics		N / G / R / S

	4.a Aeroplane systems *(fixed wing)*	N / G / R / S
	4.b Helicopter systems *(rotary wing)*	N / G / R / S
	5. Flight controls and forces	N / G / R / S
	6. Sound cue	N / G / R / S
	7. Visual display cue	N / G / R / S
	8.a Motion cue	N / G / R / S
	8.b Vibration cue *(rotary wing)*	N / G / R / S
	9. Environment – ATC	N / G / R / S
	10. Environment – Navigation	N / G / R / S
	11. Environment – Atmosphere and weather	N / G / R / S
	12.a Environment – Aerodromes and terrain *(fixed wing)*	N / G / R / S
	12.b Environment – Landing areas and terrain *(rotary wing)*	N / G / R / S
3. Supplementary information:		
(a) Organisation representative(s) (Organisation operating the FSTD, main FSTD user):		
(b) FSTD seats available:		
(c) Visual databases used during evaluation:		
(d) Additional capabilities:		
(e) Other:		

4. Classification of items and period of rectification

During any evaluation, it is possible that a number of items will be identified that require operator resolution. While all items raised should be entered into the organisation's management system in accordance with ORA.GEN.150, not all items need their rectification to be reported to the competent authority. Items can therefore be classified into three distinct categories as follows:

<u>LEVEL A</u>

Items classified in this category have been identified by the competent authority as any of the following:

(a) a simulation feature, system, subsystem, component or part that fails to comply with the required PRD and, potentially therefore, affects the level of qualification, the FCS or the qualification itself. If these items are not corrected or clarified within a given time limit, the competent authority may have to limit, suspend or revoke the FSTD qualification;

(b) a simulation feature, system, subsystem, component or part where compliance with the required PRD is not clearly proven and the issue will be reserved for a later decision;

(c) an objective test result that fails to comply with the required PRD.

As set out in AMC1 ORA.FSTD.225(a), these defects should be rectified by the organisation operating the FSTD and the competent authority should be notified of the result of such rectifications within 30 days. With reference to AMC2 ARA.FSTD.100(a)(1) point (b), Level A defects could result in a limitation to the testing, training and checking considerations otherwise inferred by the qualification level or FCS. If any defect remains unattended without an acceptable reason for a period greater than 30 days, subsequent limitations may occur or the FSTD qualification may be revoked.

LEVEL B

Items classified in this category have been identified by the competent authority as any of the following:

(a) a simulation feature, system, subsystem, component or part which is temporarily inoperative or performing below its nominal level;

(b) an objective test result where compliance with the required standard is not clearly proven and the issue will be reserved for a later decision.

These items should be managed by the organisation operating the FSTD but rectification actions need not be reported to the competent authority.

REMARKS

Items classified in this category have been identified by the competent authority as any of the following:

(a) Items which meet the required standard, but where considerable improvement is strongly recommended;

(b) Any other comments.

These items should be managed by the organisation operating the FSTD but rectification actions need not be reported to the competent authority.

5. Evaluation results

5.1 LEVEL A items

1	

5.2 LEVEL B items

1	

5.3 REMARKS

1	

6. Limitations

As a consequence of the items recorded in Section 5 evaluation results, the following non-compliances (if any) with the requirements of the PRD will be recorded in the limitations section on the FSTD qualification certificate as they prevent the full usage of the FSTD due to the unusable devices, systems or parts thereof.

1	

7. FSTD performance metrics summary

(For recurrent or special evaluations only)

1	

8. Evaluation team

Name	Position	Organisation	Signature
	Technical inspector or person designated by the competent authority		
	Flight inspector or person designated by the competent authority		
		[FSTD user]	
		[Organisation operating the FSTD]	

Name:
Position:
Date:

Signed: ……………………………………………………………… On behalf of [the competent authority]

Rationale:

The text has been moved from AMC5 ARA.FSTD.100(a)(1) and a new evaluation report template created. This new report embodies the new FCS and ESL requirements reflected in other parts of this NPA such as in CS-FSTD(A) Issue 3. Of special note is that the classification of items discovered during an FSTD evaluation has been substantially simplified into three categories instead of six. Another benefit to industry is that it is now clarified which items need to have their rectification reported back to the CA post evaluation, and which do not. These modifications will also assist in EASA's ongoing move to paperless reporting systems using automated tools in the near future.

AMC1 ARA.FSTD.100(c) Initial evaluation procedure

ASSESSMENT OF FCS FOR FSTDs QUALIFED AGAINST PRIOR CERTIFICATION SPECIFICATIONS

When the competent authority receives an application for the assignment of an FCS to an FSTD, the competent authority should take any of the following actions:

(a) determine if there are any transitional arrangements in effect allowing such FSTDs to be attributed an FCS, without the need for an FSTD update or upgrade evaluation, for the relevant training, testing and checking tasks;

(b) evaluate the FCS of the FSTD by a document review against the provisions of CS-FSTD(A) applicable at the time of the evaluation/application;

(c) request the operator to apply for an initial evaluation in accordance with the latest applicable CS-FSTD(A).

GM1 ARA.FSTD.100(c) Initial evaluation procedure

ASSESSMENT OF FCS FOR FSTDs QUALIFIED AGAINST PRIOR CERTIFICATION SPECIFICATIONS

(a) There are several FSTDs currently used for accredited training, testing and checking that are qualified as an FSTD type and level in accordance with the relevant FSTD PRDs or certification standards that do not, or did not, refer to an FCS in the general requirements. It is also recognised that many of these devices (especially FTDs) have greater capability than if they had only been manufactured to meet the minimum standard in the version of the certification specifications they were originally qualified against.

(b) When it is necessary to determine the FCS for an FSTD qualified to a previous PRD (e.g. CS-FSTD(A) Initial issue FTD Level 2), then the competent authority may achieve this by means of a documentation review of the FSTD's current MQTG and other related documentation (e.g. technical specifications, ESL and other documents) against the technical requirements in the current certification specifications for features and fidelity levels, without needing to conduct an actual evaluation on the FSTD.

(c) As a prerequisite, the FSTD in question should maintain its qualification type and level in accordance with the version of the FSTD certification specification or PRD used for the FSTD's initial qualification, and as evidenced by the most recent successful recurrent evaluation report.

(d) The FCS for the device can then be determined from a desktop review of the following items against the current version of the FSTD certification specifications or PRD in force that refers to an FCS:

(1) Firstly, FSTD general requirements and statements of compliance in the existing MQTG document can be reviewed for compliance with those in the latest certification specifications for each simulation feature to determine its fidelity level.

(2) A review of the extent of the aircraft system simulation to determine if all systems are fully simulated or whether only some systems are present or partially simulated (e.g. no CB panels may be fitted, etc.)

(3) FSTD objective validation tests, as contained in the existing MQTG document, can be reviewed for compliance with those in the latest certification specification for relevant simulation features (aircraft simulation and cueing features) to determine their fidelity level from a model and validation test perspective. Most importantly, the flight, engine, ground handling flight controls and forces models and validation data packages used in the FSTD will define these features as being either type-specific, class representative or even generic.

(4) It should be noted however that the existing QTG will probably consist of only those tests that were required for its original type and level (e.g. FTD L1/FNPT II MCC) and thus certain features such as ground handling may not be validated at all and can then be considered as completely generic. Similarly, also take-offs and landings may well not be validated.

(e) For the purpose of evaluating the FCS, the fidelity of a set of integrated features is only as good as the lowest individual fidelity level found within that set of integrated features. So, by using this principle, taking the lowest individual fidelity levels of each feature, the FCS can be determined.

(f) It is quite probable that the resulting FCS from this document review may well mean restricted credits compared to those currently desired and consequently the organisation operating FSTDs may need to consider updating or upgrading the device and request an initial evaluation against the current FSTD certification specifications to achieve qualification of the FCS that is required to maximise the credits and training available for the device.

Rationale:

These new AMC and GM provide guidance to the CA to check for any transitional arrangements for assigning an FCS to a pre--Issue 3 CS-FSTD(A) FSTD, conduct a desktop review or to request the operator to apply for new initial evaluation against Issue 3.

AMC1 ARA.FSTD.110 Issue of an FSTD qualification certificate

~~**BASIC INSTRUMENT TRAINING DEVICE (BITD)**~~

~~(a) The competent authority should only grant a BITD qualification for the BITD model to a BITD manufacturer following satisfactory completion of an evaluation.~~

~~(b) This qualification should be valid for all serial numbers of this model without further technical evaluation.~~

~~(c) The BITD model should be clearly identified by a BITD model number. A running serial number should follow the BITD model identification number.~~

~~(d) The competent authority should establish and maintain a list of all BITD qualifications it has issued, containing the number of the BITD model with a reference to the hardware and software configuration.~~

Rationale:

The AMC has been deleted as after CS-FSTD(A) Issue 3 no more BITD initial evaluations are applicable.

AMC1 ARA.FSTD.115 Interim FSTD qualification

NEW AIRCRAFT ~~FFS/FTD~~ FSTD QUALIFICATION – ADDITIONAL INFORMATION

(a) Aircraft manufacturers' final data for performance, handling qualities, systems or avionics are seldom available until well after a new or derivative aircraft has entered service. Because it is often necessary to begin flight crew training and certification several months prior to the entry of the first aircraft into service, it may be necessary to use aircraft manufacturer-provided preliminary data for interim qualification of FSTDs. This is consistent with the possible interim approval of operational suitability data (OSD) relative to ~~FFS~~ FSTD in the type certification process under ~~Part-21~~ Part 21.

(b) […]

Rationale:

Terminology update — FFS/FTD have been replaced with FSTD.

GM1 ARA.FSTD.115 Interim FSTD qualification

NEW AIRCRAFT ~~FFS/FTD~~ FSTD QUALIFICATION – ADDITIONAL INFORMATION

[…]

AMC1 ARA.FSTD.120(c) Continuation of an FSTD qualification

SATISFACTORY AUDIT OR INSPECTION, SUCCESFULL FSTD EVALUATION

(a) An FSTD organisation is considered having satisfactory records of regulatory audits and inspections, when:

(1) no level 1 findings have been issued;

(2) all corrective actions have been implemented within the time period accepted or extended by the competent authority in accordance with ARA.GEN.350(d)(2);

(3) the organisation has continuously demonstrated in accordance with ORA.GEN.130 and ORA.FSTD.110 that it has full control over all changes;

(4) the organisation operating the FSTD has demonstrated an effective identification of aviation safety hazards and management of associated risks.

(b) An FSTD evaluation is considered successful if the FSTD qualification certificate is not suspended and no repeating issues have been identified.

(c) The competent authority may vary the evaluation period for only one, several, or all the FSTDs upon the results of the oversight on the organisation operating the FSTDs or upon FSTD evaluations.

Rationale:

New AMC to clarify for CAs what constitutes satisfactory audits, inspections and evaluations for extended evaluation period.

AMC1 ARA.FSTD.130 Changes

GENERAL

(a) The organisation operating an FSTD ~~who~~ that wishes to modify, upgrade, de-activate or relocate its FSTD should notify the competent authority. When considering applications for a change of the existing FSTD qualification level or FCS, the competent authority should ensure that accountability for the change is clearly defined.

(b) An individual department manager of the competent authority should be appointed under whose personal authority an FSTD qualification may be changed.

(c) The written application for a change, including appropriate extracts from the qualification test guide indicating the proposed amendments, should be submitted in a format and manner as specified by the competent authority. This application should be submitted no later than 30 days before the date of intended change, unless otherwise agreed with the competent authority.

(d) On receipt of an application for a change of the existing FSTD qualification level or FCS, the competent authority should conduct such evaluations and inspections as are necessary to ensure that the full implications of the request have been addressed by the organisation operating the FSTD.

(e) During the processing of a change request, the continued adequacy of the compliance monitoring should be reviewed.

(f) When the request has been considered and examined, the competent authority should decide on the depth of inspection of the FSTD that is required.

(g) The department manager, if satisfied that the organisation operating the FSTD remains competent and the qualification level or FCS of the FSTD can be maintained, should issue revised FSTD qualification documentation, as appropriate.

(h) The competent authority should inform the organisation operating the FSTD of its decision within 30 days of receipt of all documentation where no evaluation is required, or within 14 days of any subsequent evaluation.

(i) Such documentation includes the appropriate extracts from the QTG amended, when necessary, to the competent authority's satisfaction.

Rationale:

Minor text updates to include FCS.

AMC2 ARA.FSTD.130 Changes

QUALIFICATION OF NEW TECHNOLOGY OR SYSTEMS

(a) Where an update to an FSTD involves a change of technology or the addition of a new system or equipment that is not covered by the qualification basis used for the existing qualification, an evaluation of such changes may not be possible using this original qualification basis. For these cases, the specific changes may be qualified by using newer certification specifications that apply to these changes, without affecting the overall qualification of the FSTD. This approach should be documented.

(b) One such AMC is for the competent authority to support the process as described in GM3 ORA.FSTD.210(a)(3) Qualification basis - guidance on alternate means of qualification for new technologies, for dealing with these cases.

Rationale:

This new AMC provides the means for CAs to be able to consider the approval of new FSTD technologies and refers to GM3 ORA.FSTD.210(a)(3) for alternate means of qualification of such new technologies. Obvious benefit is that this opens up the possibilities of a wider range of training devices and technologies being used for training and is in support of the other relevant changes made in this NPA.

AMC1 ARA.FSTD.130(b) Changes

SPECIAL EVALUATION CONSIDERATIONS FOR FSTD CHANGES AFFECTING AN FCS

(a) FSTDs qualified with an FCS, either through initial evaluation against the applicable PRD, or, having been attributed an FSTD FCS through applicable transition arrangements, should be subjected to a special evaluation as specified in ARA.FSTD.130(b) when an operator request is received to change the qualification certificate that also results in a change (raising) of the applicable FCS of an FSTD.

(b) The competent authority should consider the following factors to assist in scoping and scheduling an appropriate level of special evaluation:

(1) FSTD feature(s) fidelity level changes should be assessed against the current certification specification PRD requirements.

(2) Whether the FCS changes will mean a change of FSTD qualification level where appropriate and if so, then a full initial evaluation is required.

(3) The impact of the changes upon the declared ESL.

(4) Any material impact upon the MQTG. Changes considered significant to the MQTG, thus requiring objective as well as subjective evaluation, may include:

(i) updated validation data in the respective validation data roadmap for type-specific devices or reference data report for non-type-specific devices;

(ii) updated validation tests and tolerances for the change in FCS requested;

(iii) updated general requirements statements of compliance for the change in FCS requested.

GM1 ARA.FSTD.130(b) Changes

AIRCRAFT SIMULATION

(a) The aircraft simulation group of FSTD simulation features comprises, amongst others, the 'flight model', 'ground handling' as well as 'flight controls and forces' features. Changes to these feature fidelity levels usually directly affect handling and performance qualities and will result in updates to the QTG that would merit an in-depth special evaluation covering objective as well as subjective testing.

(b) Aircraft simulation also includes the features 'flight deck layout and structure' as well as 'aircraft systems'. Changes in these feature fidelity levels certainly require subjective evaluation but may still require updates to the QTG documentation for general requirements and statements of compliance even if there are no objective validation tests affected.

CUEING SIMULATION

The cueing simulation FSTD group of features comprises 'visual display' cues, 'motion' cues and 'sound' cues. Changes to all these cueing systems feature fidelity levels will in all likelihood impact the QTG general and objective testing requirements and will require both objective and subjective evaluation at the discretion of the competent authority. Some visual display cue feature updates may simply comprise mirror re-skins and/or projector replacements for which the competent authority may not require a special evaluation unless the FCS is affected.

ENVIRONMENT SIMULATION

The environment simulation FSTD group of features comprises 'ATC', 'navigation', 'atmosphere and weather' as well as 'aerodromes and terrain'. Changes to these feature fidelity levels will probably only require functional and subjective evaluation against the operators declared and updated ESL.

Rationale:

Changes to an FCS feature fidelity level will require some sort of evaluation by a CA. This AMC provides information to CAs on things to consider in scoping a special evaluation for changes to an FCS. Benefits should be that such special evaluations can be tailored appropriately thus saving cost and time for all concerned.

GM1 ARA.FSTD.130 Changes

~~**QUALIFICATION OF NEW TECHNOLOGY OR SYSTEMS**~~

~~Where an update to an FSTD involves a change of technology or the addition of a new system or equipment that is not covered by the qualification basis used for the existing qualification, an evaluation of such changes may not be possible using this original qualification basis. For these cases, the specific changes can be qualified by using newer Certification Specifications, new AMCs or alternative means of compliance, that apply to these changes, without affecting the overall qualification of the FSTD. This approach should be documented.~~

Rationale:

The GM has been deleted and replaced by AMC2 ARA.FSTD.130.

AMC1 ARA.FSTD.135 FSTD qualification certificate – Limitation, suspension and revocation

[...]

AMC2 ARA.FSTD.135 FSTD qualification certificate – Limitation, suspension and revocation ~~Findings and corrective actions – FSTD qualification certificate~~

[...]

AMC3 ARA.FSTD.135 FSTD qualification certificate – Limitation, suspension and revocation ~~Findings and corrective actions – FSTD qualification certificate~~

[...]

AMC1 ARA.FSTD.140 Record-keeping

FSTDs

Records relating to FSTDs should include, as a minimum, all the following:

(a) the application for an FSTD qualification;

(b) the FSTD qualification certificate including any changes;

(c) the planning of the evaluations listing the dates when evaluations are due and when evaluations were carried out;

(d) copies of all revisions of the ESL declared by operator;

(e) initial and recurrent evaluation records;

(f) copies of all relevant correspondence;

(g) details of any exemption and enforcement actions;

(h) any report from other competent authorities relating to initial and recurrent evaluations.

Rationale:

New AMC taking existing AMC text under ARA.ATO.120; it provides clarification regarding all the FSTD records that are expected to be kept by CA.

3.4. Draft regulation (draft EASA opinion)

Part-ORA

ORA.ATO.135 Training aircraft and FSTDs

(a) The ATO shall use an adequate fleet of training aircraft or FSTDs appropriately equipped for the training courses provided. The fleet of aircraft shall be composed of aircraft that comply with all requirements defined in Regulation (EU) 2018/1139. Aircraft that fall under points (a), (b), (c) or (d) of Annex I to Regulation (EU) 2018/1139, may be used for training if all of the following conditions are met:

(1) during an evaluation process the competent authority has confirmed a level of safety comparable to the one defined by all essential requirements laid down in Annex II to Regulation (EU) 2018/1139;

(2) the competent authority has authorised the use of the aircraft for training in the ATO.

(b) The ATO shall only provide training in FSTDs when it demonstrates to the competent authority:

(1) the adequacy between the FSTD specifications, the FSTD capability signature and the related training programme;

(2) that the FSTDs used comply with the relevant requirements of Part-FCL ;

~~(3)~~ ~~in the case of full flight simulators~~ that the FSTDs ~~(FFSs), that the FFS~~ adequately represent~~s~~ the relevant type of aircraft; and

(3)~~(4)~~ that it has put in place a system to adequately monitor changes to the FSTD and to ensure that those changes do not affect the adequacy of the training programme.

(c) If the aircraft used for the skill test is of a different type to the ~~FFS~~ FSTD used for the visual flight training, the maximum credit shall be limited to that allocated for flight and navigation procedures trainer II (FNPT II) for aeroplanes and FNPT II/III for helicopters in the relevant flight training programme.

(d) Flight test training organisations. Aircraft used for flight test training shall be appropriately equipped with flight testing instrumentation, according to the purpose of the training.

Rationale:

Minor updates — corrected terminology.

ORA.ATO.335 Full flight simulator FSTD

(a) The ~~FFS~~ FSTD approved for ZFTT shall be serviceable according to the management system criteria of the ATO.

(b) The motion and the visual system of the ~~FFS~~ FSTD shall be fully serviceable, in accordance with the applicable certification specifications for FSTD as mentioned in ORA.FSTD.205.

Rationale:

Change of title to read ‘FSTD’ rather than ‘FFS’ for consistency.

ORA.FSTD.100 General

~~(a)~~ The applicant for an FSTD qualification certificate shall demonstrate to the competent authority that it has established a management system in accordance with ORA.GEN Section II. This demonstration shall ensure that the applicant has, directly or through contract, the capability to maintain the performance, functions and other characteristics specified for the FSTD’s qualification level and to control the installation of the FSTD.

~~(b) If the applicant is the holder of a qualification certificate issued in accordance with this Part, the FSTD specifications shall be detailed:~~

~~(1) in the terms of the ATO certificate; or~~

~~(2) in the case of an AOC holder, in the training manual.~~

Rationale:

Point (b) has been deleted as not relevant to subsection FSTD in Part-ORA.

ORA.FSTD.105 Maintaining the FSTD qualification

~~(a)~~In order to maintain the qualification of the FSTD, an ~~an FSTD qualification certificate holder~~ organisation operating FSTDs shall:

(a) maintain the FSTD in a condition that allows full usage of the device through:

(1) correcting the defaults identified during the authority evaluations;

(2) addressing the issues reported during the use of the FSTD during the training;

(b) ~~R~~run the complete set of validation tests contained within the master qualification test guide (MQTG) ~~and functions and subjective tests~~ progressively over a 12-month period. ~~(b)~~ The results shall be dated, marked as analysed and evaluated, and retained in accordance with ORA.FSTD.240, in order to demonstrate that the FSTD standards are being maintained.

(c) maintain a configuration control system ~~shall be established~~ to ensure the continued integrity of the hardware and software of the qualified FSTD; and~~.~~

(d) maintain an equipment and specifications list (ESL) to provide available features and capability information for each FSTD operated.

Rationale:

Clarification for an organisation operating an FSTD of the conditions that need to be met in order to maintain the qualification of the FSTD.

ORA.FSTD.110 Modifications

(a) ~~The~~ An organisation operating FSTDs ~~holder of an FSTD qualification certificate~~ shall establish and maintain a system to identify, assess and incorporate any important modifications into the FSTDs it operates, especially:

(1) any aircraft modifications that are essential for training, testing and checking, whether or not enforced by an airworthiness directive; and

(2) any modification of an FSTD, including motion and visual systems, when essential for training, testing and checking, as in the case of data revisions.

(b) 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 and MQTG.

(c) The organisation shall prepare amendments for any affected validation tests and shall inform the competent authority of any such major changes to determine if the tests to be carried out are satisfactory.

(d) The organisation shall test the FSTD ~~to~~against the new ~~criteria~~ applicable certification specifications and shall inform the competent authority of any changes to a declared ESL as a result of the modification.

(~~c~~ e) The organisation shall inform the competent authority ~~in advance~~ of any major changes~~: to determine if the tests carried out are satisfactory~~:

(1) prior to scheduling the modification;

(2) after completion and acceptance of the modification.

(c) The competent authority shall determine if a special evaluation of the FSTD is necessary prior to returning it to training following the modification.

Rationale:

Added references to include the ESL for consistency.

ORA.FSTD.115 Installations

(a) The holder of an FSTD qualification certificate shall ensure that:

(1) the FSTD is housed in a suitable environment that supports safe and reliable operation;

(2) all FSTD occupants and maintenance personnel are briefed on FSTD safety to ensure that they are aware of all safety equipment and procedures in the FSTD in case of an emergency; ~~and~~

(3) the FSTD and its installations comply with the local regulations for health and safety~~.~~; and

(4) the qualification certificate and the ESL are accessible for all FSTD users.

(b) The FSTD safety features, such as emergency stops and emergency lighting, shall be checked at least annually and recorded.

Rationale:

As the operator-declared ESL now contains important information for FSTD users, then the ESL should be displayed along with the qualification certificate and be permanently visible for all FSTD users to review.

ORA.FSTD.120 ~~Additional equipment~~ Equipment and specifications list

(a) The organisation operating FSTDs shall submit an equipment and specifications list (ESL) declaration to the competent authority listing the equipment and specifications of the FSTD.

(b) Where additional equipment has been added to the FSTD, even though not required for qualification, it shall be assessed by the competent authority to ensure that it does not adversely affect the quality of training.

Rationale:

This IR and the associated AMC and GM cover the ESL general requirements, provide a template ESL for organisations operating FSTDs to consider using, plus guidance material for completing the ESL. The ESL is now a declaration from the organisation operating the FSTD of the FSTD capability that is additional to the authority-issued FSTD qualification certificate and will assist other FSTD users in meeting their obligation to check that selected FSTDs are suitable for use in their training programmes.

ORA.FSTD.200 Application for FSTD qualification

(a) The application for an FSTD qualification certificate shall be made, in a form and manner established by the competent authority, by the organisation intending to operate the FSTD.~~:~~

~~(1) in the case of basic instrument training devices (BITDs), by the BITD manufacturer;~~

~~(2) in all other cases, by the organisation intending to operate the FSTD.~~

(b) Applicants for an ~~initial~~ FSTD qualification shall provide the competent authority with documentation demonstrating how they will comply with the requirements established in this Regulation. Such documentation shall include the procedure established to ensure compliance with ORA.GEN.130 and ORA.FSTD.230.

(c) The request for qualification shall include the ESL and a declaration that the organisation operating the FSTD has thoroughly tested the FSTD and that it meets the criteria described in the relevant PRD. The applicant shall further attest that all the QTG checks for the requested qualification level and FCS have been achieved and that the FSTD is representative of the respective aeroplane or class of aeroplane as appropriate.

Rationale:

All BITD references in ORA.FSTD.200 have been removed as BITDs are no longer relevant for initial qualification when this update comes into force given that BITDs are no longer a valid device type for initial qualification in CS-FSTD(A) Issue 3. Point (c) has been added to require reference to QTG and attestations.

ORA.FSTD.205 Certification specifications for FSTDs

~~(a) The Agency shall issue, in accordance with Article 19 of Regulation (EC) No 216/2008, Certification Specifications as standard means to show compliance of FSTDs with the Essential Requirements of Annex III to Regulation (EC) No 216/2008.~~

~~(b) Such Certification Specifications shall be sufficiently detailed and specific to indicate to applicants the conditions under which qualifications will be issued.~~

Rationale:

The text of this IR has been moved to Part-ARA as this was an authority and not an organisation requirement.

ORA.FSTD.225 Duration and continued validity

(a) The ~~full flight simulator (FFS), flight training device (FTD) or flight and navigation procedures trainer (FNPT)~~FSTD qualification, except for BITD qualification, shall remain valid subject to:

(1) the FSTD and the operating organisation remaining in compliance with the applicable requirements;

(2) the competent authority being granted access to the organisation as defined in ORA.GEN.140 to determine continued compliance with the relevant requirements of Regulation (EU) 2018/1139 and its delegated and implementing acts; and

(3) the qualification certificate not being surrendered or revoked.

(b) If the period ~~of 12 months~~ established in ARA.FSTD.120(b)(1) ~~may be~~ is extended beyond 12 months ~~up to a maximum of 36 months, in the following circumstances~~:

~~(1) the FSTD has been subject to an initial and at least one recurrent evaluation that has established its compliance with the qualification basis;~~

~~(2) the FSTD qualification certificate holder has a satisfactory record of successful regulatory FSTD evaluations during the previous 36 months;~~

~~(3) the competent authority performs a formal audit of the compliance monitoring system defined in ORA.GEN.200(a)(6) of the organisation every 12 months; and~~

~~(4)~~ an assigned person ~~of~~ by the organisation with adequate experience shall:

(1) review~~s~~ the regular reruns of the qualification test guide (QTG);

(2) conduct ~~the~~ a relevant evaluation ~~functions and subjective tests~~ every 12 months;~~,~~ and

(3) send~~s~~ a report of the results to the competent authority.

(c) A BITD qualification shall remain valid subject to regular evaluation for compliance with the applicable qualification basis by the competent authority in accordance with ARA.FSTD.120.

(d) Upon surrender or revocation, the FSTD qualification certificate shall be returned to the competent authority.

Rationale:

The first point has been modified to refer to FSTD rather than FFS/FTD/FNPT. Besides, the extended evaluation interval was moved to Part-ARA.

ORA.FSTD.230 Changes to the qualified FSTD

(a) The holder of an FSTD qualification certificate shall inform the competent authority of any proposed changes to the FSTD, such as:

(1) major modifications;

(2) relocation of the FSTD; and

(3) any de-activation of the FSTD.

(b) In case of an upgrade of the FSTD qualification level or change to the FCS, the organisation shall apply to the competent authority for an upgrade evaluation. The organisation shall run all validation tests for the requested qualification level or modified FCS. Results from previous evaluations shall not be used to validate FSTD performance for the current upgrade.

(c) When an FSTD is moved to a new location, the organisation shall inform the competent authority before the planned activity along with a schedule of related events.

Prior to returning the FSTD to service at the new location, the organisation shall perform at least one third of the validation tests, and function~~s~~ 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 competent authority.

The competent authority may perform an evaluation of the FSTD after relocation. The evaluation shall be in accordance with the original qualification basis of the FSTD.

(d) If an organisation plans to remove an FSTD from active status for prolonged periods, the competent authority shall be notified and suitable controls established for the period during which the FSTD is inactive.

The organisation shall agree with the competent authority a plan for the de-activation, any storage and re-activation to ensure that the FSTD can be restored to active status at its original qualification level.

Rationale:

Addition of FCS. Changes to an FSTD affecting qualification level and FCS are now taken into consideration.

ORA.FSTD.240 Record-keeping

The holder of an FSTD qualification certificate shall keep records of:

(a) all documents describing and proving the initial qualification basis level or FCS of the FSTD for the duration of the FSTD's lifetime; and

(b) any recurrent documents and reports related to each FSTD and to compliance monitoring activities for a period of at least 5 years.

Rationale:

Minor edit to include a reference to FCS.

3.5. Draft acceptable means of compliance and guidance material (draft EASA decision)

~~GM1 ORA.GEN.200(a)(5) Management system~~

~~**ORGANISATION'S MANAGEMENT SYSTEM DOCUMENTATION**~~

~~(a) It is not required to duplicate information in several manuals. The information may be contained in any of the organisation manuals (e.g. operations manual, training manual), which may also be combined.~~

~~(b) The organisation may also choose to document some of the information required to be documented in separate documents (e.g. procedures). In this case, it should ensure that manuals contain adequate references to any document kept separately. Any such documents are then to be considered an integral part of the organisation's management system documentation.~~

Rationale:

Minor edit. Moved from after AMC1 to after AMC2.

AMC~~1~~2 ORA.GEN.200(a)(5) Management system

COMPLEX ORGANISATIONS – ORGANISATION'S SAFETY MANAGEMENT MANUAL

[…]

Rationale:

Minor edit. Renumbered as it was incorrectly AMC1.

GM1 ORA.GEN.200(a)(5) Management system

ORGANISATION'S MANAGEMENT SYSTEM DOCUMENTATION

(a) It is not required to duplicate information in several manuals. The information may be contained in any of the organisation manuals (e.g. operations manual, training manual), which may also be combined.

(b) The organisation may also choose to document some of the information required to be documented in separate documents (e.g. procedures). In this case, it should ensure that manuals contain adequate references to any document kept separately. Any such documents are then to be considered an integral part of the organisation's management system documentation.

AMC1 ORA.GEN.200(b) Management system

SIZE, NATURE AND COMPLEXITY OF THE ACTIVITY

(a) An organisation should be considered as complex when it has a workforce of more than 20 full time equivalents (FTEs) involved in the activity subject to Regulation (EU) ~~216/2008~~[11] 2018/1139 and ~~its Implementing Rules~~ the delegated and implementing acts adopted on the basis thereof.

(b) Organisations with up to 20 full time equivalents (FTEs) involved in the activity subject to Regulation (EU) ~~216/2008~~ 2018/1139 and ~~its Implementing Rules~~ the delegated and implementing acts adopted on the basis thereof, may also be considered complex based on an assessment of the following factors:

(1) in terms of complexity, the extent and scope of contracted activities subject to the approval;

(2) in terms of risk criteria, whether any of the following are present:

(i) operations requiring the following specific approvals: performance-based navigation (PBN), low-visibility operation (LVO), extended range operations with two-engined aeroplanes (ETOPS), helicopter hoist operation (HHO), helicopter emergency medical service (HEMS), night vision imaging system (NVIS) and dangerous goods (DG);

(ii) different types of aircraft used;

(iii) the environment (offshore, mountainous area, etc.);

(3) for an organisation operating FSTDs :

(i) the number of FSTDs operated and their qualification level;

(ii) the number of aircraft types simulated;

(iii) the number of locations.

[…]

Rationale:

Clarification criteria have been added for considering an FSTD organisation as a complex organisation based on feedback from industry.

AMC1 ORA.ATO.105 Application

APPLICATION FORM

APPLICATION FORM FOR AN ATO CERTIFICATE		
N°	Question	Supplementary information

~~[11] Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC. OJ L 79, 19.3.2008, p. 1.~~

1.	Name of training organisation under which the activity is to take place	address, fax number, e-mail, URL
2.	Training courses offered	theory and/or flight training
3.	Name of head of training	type and number of licence full/part-time
4.	Name of chief flight instructor	as (3)
5.	Name of chief theoretical knowledge instructor	as (3)
6.	Name of flight instructor(s), where applicable	as (3)
7.	Aerodrome(s) / operating site(s) to be used	IFR approaches, if applicable night flying, if applicable air traffic control flight testing facilities, if applicable data reply facilities, if applicable
8.	Flight operations accommodation	location, number and size of rooms
9.	Theoretical instruction facilities	location, number and size of rooms
10.	Description of training devices (as applicable)	~~FFS, FNPT I, II and III, FTD 1, 2 and 3, and 3, and BITD~~ FSTD type, qualification level and primary reference document(s) (PRD(s)) as provided on the qualification certificate of the FSTD
11.	Description of aircraft	Class/type(s) of aircraft registration of aircraft IFR equipped, if applicable Flight test instrumentation, if applicable
12.	Proposed administration and manuals: (submit with application if required)	(a) course programmes (b) training records (c) operations manual (d) training manual
13.	Details of proposed compliance monitoring system	

Note 1: If answers to any of the above questions are incomplete, the applicant should provide full details of alternative arrangements separately.
Note 2: instrument flight rules (IFR)~~, full flight simulator (FFS), flight and navigation procedures trainer (FNPT), flight training device (FTD), basic instrument training device (BITD)~~

I, (name), on behalf of (name of training organisation) certify that all the above-named persons are in compliance with the applicable requirements and that all the above information given is complete and correct. (Date) (Signature)

Rationale:

FSTD specific types and levels have been replaced with more generic wording that is consistent with the new approach in CS-FSTD(A).

AMC2 ORA.ATO.125 Training programme

[…]

FLIGHT TRAINING

(j) Flight simulation training devices (FSTDs)

A type rating course for a multi-pilot aeroplane should include FSTD training.

The amount of training required when using FSTDs will depend on the complexity of the aeroplane concerned, and to some extent on the previous experience of the pilot. Except for those courses giving credit for previous experience (c.2.), a minimum of 32 hours of FSTD training should be programmed for a crew of a multipilot aeroplane, of which at least 16 hours should be in an FFS operating as a crew. FFS time may be reduced if the training objectives can be achieved by other type-specific FSTDs having the required FSTD capability signature (FCS). ~~other qualified FSTDs used during the flight training programme accurately replicate the cockpit environment, operation and aeroplane response. Such FSTDs may typically include flight management computer (FMC) training devices using hardware and computer programmes identical to those of the aeroplane.~~

(k) Aeroplane training with ~~FFS~~ FSTDs

(1) with the exception of courses approved for ZFTT, certain training exercises normally involving take-off and landing in various configurations should be completed in the aeroplane rather than in an ~~FFS~~ FSTD. Unless otherwise specified in the OSD established in accordance with Regulation (EU) No 748/2012, this take-off and landing training should include:

(A) at least four landings in the case of MPAs where the student pilot has more than 500 hours of MPA experience in aeroplanes of similar size and performance or, in all other cases, at least six landings;

(B) at least one full-stop landing; and

(C) one go-around with all engines operating.

This aeroplane training may be completed after the student pilot has completed the FSTD training and has successfully undertaken the type rating skill test, provided it does not exceed 2 hours of the flight training course.

(2) courses approved for ZFTT

(i) During the specific simulator session before line flying under supervision (LIFUS), consideration should be given to varying conditions, for example:

(A) runway surface conditions;

(B) runway length;

(C) flap setting;

(D) power setting;

(E) crosswind and turbulence conditions; and

(F) maximum take-off mass (MTOM) and maximum landing mass (MLM).

(ii) At least one landing should be conducted as full-stop landing. The session should be flown in normal operation. Special attention should be given to the taxiing technique.

(iii) A training methodology should be agreed with the competent authority that ensures the trainee is fully competent with the exterior inspection of the aeroplane before conducting such an inspection un-supervised.

(iv) The LIFUS should be performed as soon as possible after the specific ~~FFS~~ FSTD session.

(v) The licence endorsement should be entered on the licence after the skill test, but before the first four take-offs and landings in the aeroplane. At the discretion of the competent authority, provisional or temporary endorsement and any restriction should be entered on the licence.

(vi) Where a specific arrangement exists between the ATO and the commercial air transport operator, the operator proficiency check (OPC) and the ZFTT specific details should be conducted using the operator's standard operating procedures (SOPs).

(3) All training exercises should be designed to remain within the training envelope as determined by the ATO (Note: Further guidance regarding the training envelope can be found in GM1 ORA.ATO.125 point (f)).

(l) Aeroplane without FFS

(1) Flight training conducted:

(i) in a combination of another FSTD and the aeroplane, should cover all type rating training items.

(ii) solely in an aeroplane without the use of FSTDs. In such cases, the ATO should demonstrate to the competent authority that adequate training in crew resource management (CRM) and multicrew cockpit (MCC) aspects of MPA flight training, and all emergency and abnormal aircraft operation required for the training can be achieved by other means. ~~cannot cover the crew resource management (CRM) and multicrew cockpit (MCC) aspects of MPA flight training, and for safety reasons cannot cover all emergency and abnormal aircraft operation required for the training and skill test. In such cases, the ATO should demonstrate to the competent authority that adequate training in these aspects can be achieved by other means. For training conducted solely on an MPA where two pilots are trained together without the use of an FSTD, a minimum of 8 hours of flight training as pilot flying (PF) for each pilot should normally be required.~~

(iii) For training on a single-pilot aeroplane, 10 hours of flight training should ~~normally~~ be required. It is accepted that for some relatively simple single or multi-engine aircraft without systems such as pressurisation, flight management system (FMS) or electronic cockpit displays, this minimum may be reduced.

[…]

SKILL TEST

(m) Upon completion of the flight training, the pilot will be required to undergo a skill test with an examiner to demonstrate adequate competence~~y~~ of aircraft operation for issue of the type rating. The skill test should be separate from the flight training syllabus, and provision for it cannot be included in the minimum requirements or training hours of the agreed flight training programme. ~~The skill test may be conducted in an FFS, the aeroplane or, in exceptional circumstances, a combination of both.~~

[…]

Rationale:

'FFS' has been replaced by 'FSTD' following the FCS concept; specifically, in regard to training with FFS, the option of another FSTD and aeroplane is added.

AMC1 ORA.ATO.135 Training aircraft and FSTDs

ALL ATOs, EXCEPT THOSE PROVIDING FLIGHT TEST TRAINING

[…]

(6) each FSTD should meet ~~be equipped as required in~~ the minimum fidelity level required per simulation feature to support the course training objectives in which it is used. ~~training specifications concerning~~.

Rationale:

With the new approach to defining the FCS, it is possible to complete type rating training in other appropriately qualified FSTDs than just FFS devices.

AMC1 ORA.FSTD.100 General

MANAGEMENT SYSTEM – COMPLIANCE MONITORING PROGRAMME – ORGANISATIONS~~s~~ OPERATING FSTDs

~~(a) Introduction.~~

~~(1) The purpose of this AMC is to provide additional and specific information to an organisation operating FSTDs on how to establish a compliance monitoring programme (CMP) that enables compliance with the applicable requirements.~~

~~(b)~~(a) Compliance monitoring programme

~~(1)~~ Typical subject areas for inspections are the following:

(~~i~~1) actual FSTD operation;

(~~ii~~2) maintenance;

(~~iii~~3) technical standards

(~~iv~~4) FSTD safety features.

(b ~~c~~) Audit scope

~~(1)~~ Organisations operating FSTDs 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 the following:

(~~i~~1) organisation;

(~~ii~~2) plans and objectives;

(~~iii~~3) maintenance procedures;

(~~iv~~4) FSTD qualification level or FCS, as applicable;

(~~v~~5) supervision;

(~~vi~~6) FSTD technical status;

(~~vii~~7) manuals, logs and records;

(~~viii~~8) defect deferral;

(~~ix~~9) personnel training;

(~~x~~10) aircraft modifications;

(~~xi~~11) FSTD configuration management~~.~~;

(12) fly-outs: Regularly programmed FSTD flight, including subjective and functional checks, and compliance verification. This includes uninterrupted flights, spot checks, and training capabilities assessments (fly-outs).

Rationale:

FCS has been added in point (c)(4) as it is not just about FSTD qualification level but also about FCS.

Point (c)(12) on fly-outs has been added.

AMC2 ORA.FSTD.100 General

MANAGEMENT SYSTEM ~~COMPLIANCE MONITORING PROGRAMME~~ – ORGANISATIONS~~s~~ OPERATING FSTDs

~~One acceptable means of measuring FSTD performance is contained in ARINC report 433-1 (December 14th, 2007 or as amended) Standard Measurements for Flight Simulation Quality~~.

(a) FSTD performance evaluation should be performed by recording the following metrics:

(1) Scheduled training time

The time the FSTD is scheduled to deliver training. The information should be available month by month per user.

(2) Support time

The support time is the addition of the following times:

— Maintenance: preventative and corrective;

— Engineering: development, improvement of the FSTD;

— Regulatory: authority evaluation, QTG rerun, self-evaluation, fly-out;

— Configuration: change of configuration, time between two FSTD sessions;

— Out of service: scheduled out of service because of major update or closure of the training centre.

(3) FSTD utilisation, which is calculated as follows:

*(scheduled training time)/(length of the year*24h - support time – FSTD down time) * 100*

(4) Average FSTD Quality Rating (Instructor and/or Crew)- Rating Scale of 1 to 5

1 = Unsatisfactory: No training completed

2 = Poor: Some training completed

3 = Acceptable: All training completed, many workarounds and or many interrupts

4 = Good: All training completed, few workarounds and or few interrupts

5 = Excellent: All training completed, no workarounds and no interrupts

(5) FSTD failure time during scheduled training time

This time is measured by the FSTD support team. This metric takes into account FSTD-specific failures only. Failure time during crew breaks should be recorded.

(6) FSTD downtime during scheduled training time

This time is measured by the FSTD support team. This metric takes into account all events that could affect the availability of the FSTD (e.g. FSTD failure time, installation issue (electric, air conditioning), users wrong input). Downtime during crew breaks should be recorded.

(7) Number of interrupts during scheduled training time

An interrupt is considered an event that suspends a flight crew's (or other users') FSTD session.

(8) Number of discrepancies raised by FSTD users

(9) FSTD availability, which is calculated as follows:

*(scheduled training time - FSTD down time) / (scheduled training time) * 100*

(10) FSTD reliability is calculated as follows:

*(scheduled training time - FSTD failure time) / (scheduled training time) * 100*

(b) The metrics should be provided to the competent authority once a year.

Rationale:

The AMC has been developed based on Arinc 433-1 industry standard and further adapted by EASA. It provides as a benefit the standardisation of the performance metrics provided by organisations operating FSTDs which results in the improvement of the risk-based performance oversight conducted by EASA.

AMC4 ORA.FSTD.100 General

COMPLIANCE MONITORING SYSTEM — PREPARATION FOR THE EVALUATION BY THE COMPETENT AUTHORITY

(a) Introduction

To support the discussion during the preliminary briefing, which is a first step of any initial or recurrent evaluation of an FSTD carried out by a competent authority, the FSTD organisation should provide relevant information in the form of a dossier. Requirements for a special evaluation should be discussed with the competent authority on a case-by-case basis.

(b) The dossier for an initial or special evaluation should contain at least the following documents and information:

(1) Type of FSTD, qualification level or FCS requested;

(2) Evaluation agenda: including date of evaluation, name of people involved, contact details for the organisation operating the FSTD, schedules for the subjective flight profile and QTG rerun;

(3) FSTD identification and detailed technical specification including type of FSTD, manufacturer, manufacturer serial number, date of entry into service, host computer, type of instructor operating station (IOS), simulated version(s), and standards of all the aircraft computers, if applicable. Manuals needed for an evaluation (e.g. flight manuals, system manuals, acceptance test manual, IOS user manual, etc. — if applicable) may already be provided as part of the dossier in an electronic format;

(4) Planned modifications;

(5) Subjective open defect(s);

(6) List of airport visual databases available to the FSTD users, including for each visual scene, name of the airport, IATA and ICAO codes, type of visual scene (specific or generic), additional capabilities (e.g. snow model, RNP APCH AR);

(7) QTG status: the list should include for each QTG objective test available, the status of the tests following the organisation operating FSTDs and competent authority reviews;

(8) Functional and subjective test list completed for applicability and results; and

(9) ESL declaration.

(c) The dossier for a recurrent evaluation should contain at least the following documents and information:

(1) Type of FSTD, qualification level or FCS requested;

(2) Evaluation agenda, including date of recurrent evaluation, name of people involved, contact details for the operator, schedules for the subjective flight profile, QTG rerun and QTG review;

(3) FSTD identification, including type of FSTD, manufacturer, manufacturer serial number, date of entry into service, date of initial qualification by EU Member State/EASA, host computer, type of IOS, simulated version(s), standards of all the aircraft computers, if applicable;

(4) Status of items raised during the last evaluation and date of closure;

(5) Reliability data: training hours month by month during the past year, numbers of complaints recorded in the technical log, training hours lost, availability rate;

(6) Operational data: a list of FSTD users over the previous 12 months should be provided, with the number of training hours;

(7) Failure tabulation including categorisation of failures;

(8) Details of main failures leading to training interruption or multiple occurrences of some failures;

(9) Hardware and/or software updates or changes since last evaluation and planned hardware and/or software updates or changes;

(10) Subjective open defect(s);

(11) List of the airport visual databases available to the FSTD users, including for each visual scene, name of the airport, IATA and ICAO codes, type of visual scene (specific or generic), additional capabilities (e.g. snow model, RNP APCH AR);

(12) QTG status: the list should include for each QTG test available, the date run during the past year, date and sign off for review against MQTG, any comment, and the status of the tests;

(13) Results of scheduled internal CMS audits and additional quality inspections (if any) since the last evaluation and a summary of the actions taken; and

(14) ESL declaration if updated.

Rationale:

The AMC and GM have been updated to eliminate ambiguities and confusion concerning organisation management systems, compliance management and compliance monitoring. It provides clarification on CA expectations with regard to these subjects based on previously received industry and CA feedback.

GM1 ORA.FSTD.100 General

ORGANISATION MANAGEMENT SYSTEM – ORGANISATIONS OPERATING FSTDs – GENERAL

(a) The competent authority should be satisfied that the accountable manager is able to adequately provide the required level of resources to properly support the FSTD operation. Detailed knowledge of FSTD requirements is not necessary, as long as it is sufficient to understand the accountable manager’s responsibility for ensuring the FSTD is properly supported.

(b) The documentation of the Management System (MS) may be provided in any number of documents, provided there are appropriate cross-references in all documents such that the system is fully traceable in both directions from end to end. For all but small organisations, at least two documents would be expected:

(1) Firstly, an MS manual containing the policy, terminology, organisational charts and responsibilities, an overview of all processes, within the system, including those for maintaining regulatory compliance such as QTG running and fly-outs, CMS including the audit schedule, and audit procedures including reporting and corrective action procedures. In addition, the MS manual may include, either directly or by reference, the identification of skills and experience and associated training.

(2) Secondly, a procedures manual containing, as a minimum, software and hardware control procedures, configuration control procedures including, for example, control of training loads, updates to visual models, navigation and IOS databases, QTG running and checking procedures, fly-out procedures, maintenance procedures including both defect rectification and preventative maintenance processes. Any standard forms and checklists may also be included.

(c) The MS documentation also includes all records such as technical logs, QTG runs, fly-out reports and maintenance job cards, and their retention periods.

(d) The demonstration of the compliance of the organisation MS with the EU regulation may be done through a matrix with cross-references to link the MS documentation to each paragraph of the applicable regulation.

(e) The documentation of the MS may be electronic, provided the necessary controls can be demonstrated. This may include control of any paper copies that may be downloaded for use by individuals. It is recommended that any such copies are automatically designated as uncontrolled as part of the download process. Whilst electronic signatures on master documents may be accepted, with appropriate protections, a hardcopy master of the MS manual should be provided, with wet-ink signatures to be held by the applicant.

(f) For organisations with several certificates (e.g. ATO, CAMO), separate and modular procedures manuals with a single MS manual covering all approvals, may be acceptable.

~~GM1~~ GM2 ORA.FSTD.100 General

~~COMPLIANCE MONITORING~~ COMPLIANCE MANAGEMENT – ORGANISATIONS OPERATING FSTDs – GENERAL

(a) The concept of ~~compliance monitoring (CM)~~ compliance management (operation of the FSTD) is a fundamental requirement ~~for organisations operating FSTDs~~. An effective ~~CM~~ compliance management function in accordance with ORA.GEN.210 (b) (i.e. the FSTD Manager) is vitally important in supporting operation of the devices, in a structured way, to ensure they remain in compliance with the technical standards of CS-FSTD(A) and CS-FSTD(H) and continue to be effective training tools. An effective ~~CM~~ compliance management ~~function~~ is also essential to support any level of extended recurrent evaluation period as permitted by ORA.FSTD.225(b).

(b) The following guidance has been developed to provide additional material to help ~~both~~ organisations operating FSTDs ~~and competent authorities~~ in developing effective ~~CM~~

compliance management that ~~satisfy~~ satisfies the applicable requirements and ensures that the highest standards of training are maintained.

(c) The compliance manager (i.e. the FSTD manager) should have sufficient knowledge and experience of FSTD operations to ensure that the FSTD operation remains in compliance with the applicable requirements. This is likely to require experience of FSTD operation and knowledge of the technical standards with which they should comply (e.g. CS-FSTDs, AC120-40s, AC120-63s, JAR-STDs, JAR-FSTDs, CUP).

(d) For organisations that hold multiple certificates and may cover multiple sites, it is advantageous to have a common function with an overall responsibility. However, it is essential, particularly where sites may be significantly separated geographically, that there is a nominated representative at each site and possibly for each certificate. These representatives should hold the delegated responsibility of the Compliance Manager for the day-to-day operation at their site and in their function and have the necessary direct reporting line to the overall Compliance Manager. In many cases, the local representatives may perform other functions in addition to this role.

~~(c) Additional GM provide a compliance checklist for organisations operating FSTDs (GM2 ORA.FSTD.100) and guidance detailing the preparation for an evaluation by the competent authority (GM3 ORA.FSTD.100). The compliance checklist should be used by the competent authorities as a standardised checklist for the elements that are expected in the CM function of an organisation operating FSTDs. The organisation should complete as a minimum the second column of the checklist by providing appropriate manual or procedure references for each of the identified elements of the CM function. Additional information can be provided in the third column to aid assessment of the checklist as appropriate. This would then be provided to the competent authority. Use of this checklist should assist in ensuring a consistent approach by the competent authorities and also provide organisations operating FSTDs with additional guidance on all the elements of a CM function that the competent authorities will expect. The guidance is provided to help organisations operating FSTDs to prepare for authority visits.~~

~~(d) The documentation of the CM may be electronic, provided the necessary controls can be demonstrated. This should include control of any paper copies that may be downloaded for use by individuals. It is recommended that any such copies are automatically designated as uncontrolled as part of the download process. Whilst electronic signatures on master documents may be accepted, with appropriate protections, a hardcopy master of the CM manual should be provided, with wet-ink signatures to be held by the applicant.~~

(e) It should be recognised that whatever ~~CM~~ process is developed, it ~~will~~ is not ~~be~~ effective unless it becomes an integral part of the way in which the organisation works. It includes ~~both~~ the necessary procedures for maintaining compliance with all the applicable requirements ~~and a compliance monitoring programme (CMP) to monitor the execution of these procedures~~. A successful ~~CM MS~~ compliance management ~~will~~ ensures that the highest training tool is available at all times. If the ~~CM~~ compliance management is viewed as an add-on to existing organisation processes, it ~~will~~ becomes a burden and it will never be wholly effective. ~~It should also be noted that compliance control or inspection is only a small part of a CMMS. If the CM~~

~~MS is working effectively, inspections such as fly-outs should become routine revealing little beyond day-to-day unserviceabilities. Systematic defects should be captured by the CMP~~.

~~(f) The competent authority should be satisfied that the accountable manager is able to adequately provide the required level of resources to properly support the FSTD. Detailed knowledge of FSTD requirement standards are not necessary, only sufficient to understand his/her responsibility for ensuring the FSTD is properly supported. The assessment of the compliance Compliance monitoring Monitoring manager Manager (CMM) should concentrate on establishing that the nominee has sufficient knowledge and experience of both CM MS management and FSTD operations to operate a compliance Compliance monitoring Monitoring system System (CMS) within an organisation operating FSTDs. This is likely to require experience of working in the compliance monitoring field and sufficient knowledge of FSTDs and the technical standards with which they should comply (AC120-40s, AC120-63s, JAR-STDs, JAR-FSTDs, CUP, CS-FSTDs, etc...).~~

(f)~~(g)~~ If an organisation operating FSTDs is certified under any international quality standard, it should assure that it fully covers the applicable organisation requirements of Part-ORA and the qualification basis.

~~(h) For small organisations, it is perfectly acceptable to combine the roles of compliance monitoring managerCMM and accountable manager. For other organisations that hold multiple certificates and may cover multiple sites, it is advantageous to have a common CM compliance monitoring function with an overall compliance monitoring managerCMM. However, it is essential, particularly where sites may be significantly separated geographically, that there is a nominated representative at each site and possibly for each certificate. These representatives should hold the delegated responsibility of the CMM manager for the day-to-day CM compliance monitoring role at their site and in their function and have the necessary direct reporting line to the overall CMM manager. It will also be necessary to ensure that local representatives are also acceptable to the local competent authority. In many cases the local representatives may perform other functions in addition to this role. This is acceptable provided the necessary independence of any compliance monitoring activity is maintained.~~

(g)~~(i) CM~~ Compliance management, as a whole, begins with the requirements with which the system seeks to comply. These include both the technical standards, in this case the relevant parts of CS-FSTD(A)/(H), or other previous FSTD technical standards, plus any other specific standards;~~,~~ for example, health and safety regulations, and the compliance ~~monitoring~~ objectives, such as defect rates and rectification intervals and FSTD reliability targets. These standards should be made available to those who are required to apply them.

(h)~~(j)~~ The next part of ~~CM~~ compliance management is that part which defines the day-to-day procedures or working practices by which the standards will be achieved. These procedures should include as a minimum defect reporting systems, defect rectification processes, tracking mechanisms, preventative maintenance programmes, spares handling, equipment calibration and configuration management of the device. They should include checks to assess the compliance of the performed actions. These procedures and standards should be made readily available to anybody involved in the maintenance and day-to-day operation of the FSTD.

~~(k) The third part of CM is the method by which the organisation operating an FSTD confirms the device is maintained in compliance with the defined standards and is being operated in accordance with the defined procedures. This is the compliance monitoring programme (CMP) and includes the audit methods, reporting and corrective action procedures and feedback, management reviews and schedules for audits of all aspects of the FSTD operation.~~

(i)~~(l)~~ Across all aspects of ~~CM~~ compliance management, and most important to it, are the people. ~~CM~~ Compliance management includes the definition of the responsibilities of all staff and should include a declaration of the minimum levels of resource proposed for the direct support of the FSTD plus the levels of support and managerial staff proposed. The number of full time equivalents (FTEs) specific to the FSTD operation should be provided. The levels of resource can be affected by factors such as local health and safety regulations, existence of weekend and/or night usage of the device(s), etc. ~~CM~~ Compliance management also includes definition of the skills and experience required for staff and leads to definition of any required training programmes. Training needs cover ~~both~~ technical training and ~~audit training including QTG running and checking and~~ fly-out techniques ~~flight crew~~ for pre-flights.

~~(m) The documentation of CM may be provided in any number of documents provided there are appropriate cross-references in all documents such that the system is fully traceable in both directions from end to end. For all but small organisations at least two documents would be expected:~~

~~(1) Firstly, a CM manual containing the policy, terminology, organisational charts and responsibilities, an overview of all processes, within the system, including those for maintaining regulatory compliance such as QTG running and fly-outs (function and subjective testing), CMP including the audit schedule and audit procedures including reporting and corrective action procedures. In addition, the CM manual should include, either directly or by reference, the identification of skills and experience and associated training.~~

~~(2) Secondly, a procedures manual containing, as a minimum, software and hardware control procedures, configuration control procedures including, for example, control of training loads, updates to visual models, navigation and instructor operation station (IOS) databases, QTG running and checking procedures, fly-out procedures, maintenance procedures including both defect rectification and preventative maintenance processes. Any standard forms and checklists should also be included.~~

~~(n) The CM documentation also includes all records such as technical logs, QTG runs, fly-out reports and maintenance job cards.~~

~~(o) For organisations with several certificates, separate and modular procedures manuals with a single CM MS manual covering all approvals, may be acceptable.~~

~~(p) It is important to understand the difference between compliance assuranceCMP and compliance control. An effective CM will contain elements of both. Compliance control is normally done by inspection of the product; it provides confirmation at the time of the inspection that the product conforms to a defined standard.~~

~~(q) The compliance assurance CMP element is essential to ensure the standard is maintained throughout the periods between product (FSTD) inspections. Within a CMP, the processes are~~

~~defined that are necessary to provide confidence that the FSTD(s) is/are being supported and maintained to the highest possible standard and in compliance with the relevant requirements. A programme of internal audits is then set in place to confirm that the processes are being followed and are effective. The competent authority would normally oversee a certified organisation by process and system audit, however, in the case of FSTDs, authority oversight includes an inspection element in the form of the recurrent FSTD evaluation.~~

~~(r) In addition to the normal process and system audits, the compliance assurance CMP audit schedule should include the schedule for each FSTD for fly-outs and QTG running through the audit year.~~

~~(s) The audit procedure should include, at least, the following: statement of scope, planning, initiation of audit, collection of evidence, analysis, reporting of findings, identification and agreement of corrective actions and feedback, including reporting significant findings to the competent authority, where appropriate. The review of published material could include, in addition to the CM and procedures manuals, QTG records, fly-out reports, technical log sheets, maintenance records and configuration control records.~~

~~(t) In addition to basic knowledge of FSTD requirements and operation, it is expected that auditors have received training in CMS and audit techniques.~~

~~(u) The routine fly-outs of the device are a specialised part of the audit programme CMP. It is essential that the pilots tasked with carrying out these fly-outs are adequately experienced. They would be expected to be type rating instructor/examiner (TRI/TRE) qualified on the type, and should have experience of simulator evaluations carried out by the competent authority. The assignment of such pilots can present difficulties, particularly for the independent organisation operating FSTDs not directly associated with an airline. It is vital for the organisation to ensure their users are aware of the importance of the fly-outs as part of the continued qualification of the device and the need to assist in the provision of suitably qualified pilots to carry them out. It is worth noting that simulator users are required to satisfy themselves that the training devices they use are assessed for continued suitability, as part of their own CMP. Involvement in fly-outs assists in meeting this need.~~

~~(v) Whilst it is accepted that the number of audits required in an organisation with a single device will be significantly less than those in larger organisations with multiple devices, the CMP should still meet the same criteria, and cover all aspects of the operation within a 12 month period. The independence of the audit personnel should be maintained at all times. The audit programme, whether by full audit or by using a checklist system should still be sufficiently comprehensive to provide the necessary level of confidence that the device is maintained and operated to the highest possible standard. This includes monitoring and review of corrective actions and feedback processes.~~

(j)~~(w)~~ The successful use of sub-contractors ~~who~~ that play a significant role in the provision of services, such as maintenance or engineering services, to an organisation operating FSTDs is reliant on the sub-contractor operating under the ~~CM~~ compliance management of the organisation. All requirements that an organisation is expected to meet are equally applicable to their ~~his/her~~ sub-contractor. It is the organisation's responsibility to ensure that the sub-contractor observes its ~~CM~~ compliance management.

(~~x~~) ~~It is essential that a proper understanding of the CM and how it applies to each and every staff member is provided by appropriate training to all, not just those directly involved in operating the CM, such as the accountable manager, the CMM manager, representatives and the auditors. The training given to those directly involved in CM compliance monitoring should cover the CM compliance monitoring, audit techniques and applicable technical standards. CM Compliance monitoring familiarisation training should be an integral part of any induction training and recurrent training. Update training on technical standards for audit personnel, is also of particular importance.~~

(k)~~(y)~~ Any effective ~~CM~~ compliance management will include measurement of its effectiveness. The organisation should develop performance measures that can be monitored against objectives. Such measures, often referred to as metrics, should be reviewed by the competent authority as part of its oversight of the ~~CM~~ compliance management within the organisation and during recurrent evaluations. In addition, they should form part of the data reviewed during scheduled management reviews as part of the ~~CM~~ compliance management.

(l)~~(z)~~ AMC2 ORA.FSTD.100 ~~ARINC 433~~ provides the metrics to be recorded ~~good guidance on FSTD compliance masurement~~. Metrics should monitor not only individual FSTD performance but also, for larger organisations, how each FSTD is performing within the fleet. It is also recommended that metrics data be shared, regularly, with the FSTD manufacturers to allow monitoring for generic problems such as design issues, which may be best addressed with a fleet-wide solution.

Rationale:

Changes in AMC have been made to clarify by clearly separating compliance management and compliance monitoring systems, linked to the respective Part-ORA FSTD sections. Additionally, new GM has been developed for the same purpose.

GM3 ORA.FSTD.100 General

COMPLIANCE MONITORING SYSTEM – ORGANISATIONS OPERATING FSTDs – GENERAL

(a) The Compliance Monitoring Manager (CMM) should have sufficient knowledge and experience of both compliance monitoring and FSTD operations to operate a Compliance Monitoring System (CMS) within an organisation operating FSTDs. This is likely to require experience of working in the compliance monitoring field and sufficient knowledge of FSTDs and the technical standards with which they should comply (e.g. CS-FSTDs, AC120-40s, AC120-63s, JAR-STDs, JAR-FSTDs, CUP).

(b) Small organisations may combine the roles of CMM and accountable manager. For other organisations that hold multiple certificates and may cover multiple sites, it is advantageous to have a common compliance monitoring function with an overall CMM. However, it is essential, particularly where sites may be significantly separated geographically, that there is a nominated representative at each site. These representatives should hold the delegated responsibility of the CMM for the day-to-day compliance monitoring role at their site and in their function and have the necessary direct reporting line to the overall CMM. In many cases, the local representatives may perform other functions in addition to this role, provided the necessary independence of any compliance monitoring activity is maintained.

(c) The purpose of the CMS is to monitor the method by which the organisation confirms that the FSTD is maintained in compliance with the EU regulation applicable and is being operated in accordance with the defined procedures. This is ensured by means of a compliance monitoring programme (CMP) that includes the audit methods, reporting and corrective action procedures and feedback, management reviews and schedules for audits of all aspects of the FSTD operation.

(d) The CMP element is essential to ensure that the compliance is maintained. Within a CMP, the processes are defined that are necessary to provide confidence that the FSTD(s) is (are) being supported and maintained in compliance with the relevant requirements. A programme of internal audits should be established to confirm that the processes are being followed and are effective. The competent authority would normally oversee a certified organisation by process and system audit; however, in the case of FSTDs, authority oversight includes an inspection element in the form of the recurrent FSTD evaluation.

(e) Whilst it is accepted that the number of audits required in an organisation with a single device will be significantly less than those in larger organisations with multiple devices, the CMP should still meet the same criteria, and cover all aspects of the operation within a 12-month period. The independence of the audit personnel should be maintained at all times. The audit programme, whether by full audit or by using a checklist system should still be sufficiently comprehensive to provide the necessary level of confidence that the device is maintained and operated to the highest possible standard. This includes monitoring and review of corrective actions and feedback processes. In addition to the normal process and system audits, the CMP audit schedule should include a fly-out per FSTD.

(f) The audit procedure should include, at least, the following: statement of scope, planning, initiation of audit, collection of evidence, analysis, reporting of findings, identification and agreement of corrective actions and feedback, including reporting significant findings to the competent authority, where appropriate. The review of published material could include, in addition to the MS and procedures manuals, QTG records, fly-out reports, technical log sheets, maintenance records and configuration control records.

(g) The routine fly-outs of the device are a specialised part of the CMP. It is essential that the pilots tasked with carrying out these fly-outs are adequately experienced. They would be expected to be type rating instructor (TRI) qualified on the type, and should have experience of simulator evaluations carried out by the competent authority. The assignment of such pilots can present difficulties, particularly for the independent organisation operating FSTDs not directly associated with an airline. It is vital for the organisation to ensure that their users are aware of the importance of the fly-outs as part of the continued qualification of the device and the need to assist in the provision of suitably qualified pilots to carry them out. It is worth noting that simulator users are required to satisfy themselves that the training devices they use are assessed for continued suitability, as part of their own CMP. Involvement in fly-outs assists in meeting this need.

(h) It is essential that a proper understanding of the compliance and how it applies to each and every staff member is provided by appropriate training to all. The training given to those involved in ensuring compliance should also cover the compliance monitoring process in addition to the applicable requirements. Compliance monitoring familiarisation training should be an integral part of any induction training and recurrent training. On the other side, update training on technical standards and FSTD operation for audit personnel, is also of particular importance.

GM2 ORA.FSTD.100 General

~~ED Decision 2012/007/R~~

~~**COMPLIANCE MONITORING – ASSESSMENT FOR ORGANISATIONS OPERATING FSTDs**~~

~~COMPLIANCE MONITORING ASSESSMENT FOR ORGANISATIONS OPERATING FSTDs~~			
~~Organisation:~~			
~~Site Assessed:~~			
~~Date of Assessment:~~			
~~Accountable Manager:~~			
~~Compliance Monitoring Manager:~~			
~~Number and Type of FSTDs:~~			
~~CM Manual Reference:~~			
~~Audit Area~~	~~CM/Proc Ref~~	~~Comments~~	~~Satisfactory Y/N~~
~~**1. ACCOUNTABLE MANAGER**~~			
~~Has an accountable manager (AM) with overall responsibility for compliance monitoring (CM) been nominated?~~			
~~Does the accountable manager have corporate authority to ensure all necessary activities can be financed and carried out to the standard required by the competent authority?~~			
~~Has a formal written compliance policy statement been established, included in the CM manual and signed by the accountable manager?~~			
~~**2. COMPLIANCE MONITORING MANAGER**~~			
~~Has a compliance monitoring manager (CM manager) been nominated?~~			
~~Are the posts of CM manager and AM combined? If so, is the independence of compliance audits assured?~~			

~~Does the CM manager have overall responsibility and authority to:~~ ~~a) verify that standards are met; and~~ ~~b) ensure that the compliance monitoring programme is established, implemented and maintained?~~			
~~Does the CM manager have direct access to the AM?~~			
~~Does the CM manager have access to all parts of the organisation operating an FSTD and as necessary any sub-contractor's organisation?~~			
~~**3. COMPLIANCE MONITORING (CM)**~~			
~~Has CM been established by the operator?~~			
~~Is CM properly documented? (see Section 4)~~			
~~Is the CM structured according to the size and complexity of the operator?~~			
~~Does the CM include the following as a minimum:~~ ~~a) monitoring of compliance with required technical standards;~~ ~~b) identification of corrective actions and person responsible for rectification;~~ ~~c) a feedback system to accountable manager to ensure corrective action are promptly addressed;~~ ~~d) reporting of significant noncompliances to the competent authority;~~ ~~e) a compliance monitoring programme to verify continued compliance with applicable requirements, standards and procedures.~~		~~a)~~ ~~b)~~ ~~c)~~ ~~d)~~ ~~e)~~	
~~Is the CM structured according to the size and complexity of the operator?~~			
~~Are the responsibilities of the CM manager defined to include, as a minimum:~~ ~~a) monitoring of corrective action programme;~~ ~~b) ensuring that the corrective actions contain the necessary elements;~~ ~~c) providing management with an independent assessment of corrective action, implementation and completion;~~ ~~d) evaluation of the effectiveness of the corrective action programme.~~		~~a)~~ ~~b)~~ ~~c)~~ ~~d)~~	
~~Are adequate financial, material and human resources in place to support CM?~~			
~~Are management evaluations/reviews of CM held at least quarterly?~~			
~~Does the management evaluation ensure that the CMS is working effectively and is it comprehensive and well documented?~~			

~~Does the compliance monitoring programme identify the processes necessary and the persons within the organisation who have the training, experience, responsibility and authority to carry out the following:~~ ~~a) schedule and perform quality inspections and audits, including unscheduled audits when required;~~ ~~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 timescales.~~		~~a)~~ ~~b)~~ ~~c)~~ ~~d)~~	
~~Is there sufficient auditor resource available and can~~ ~~their required level of independence be demonstrated?~~			
~~Do the auditors report directly to the compliance monitoring manager?~~			
~~Does the defined audit schedule cover the following areas, within each 12 month period?~~ ~~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) aircraft and simulator configuration management, including Airworthiness Directives~~		~~a)~~ ~~b)~~ ~~c)~~ ~~d)~~ ~~e)~~ ~~f)~~ ~~g)~~ ~~h)~~ ~~i)~~ ~~j)~~	
~~How are audit noncompliances recorded?~~			
~~Are procedures in place to ensure that corrective actions are taken in response to findings?~~			
~~Are records of the compliance monitoring programme:~~ ~~a) accurate~~ ~~b) complete and~~ ~~c) readily accessible?~~		~~a)~~ ~~b)~~ ~~c)~~	
~~Is there an acceptable and effective procedure for providing a briefing on the CM to all personnel?~~			

~~Is there an acceptable and effective procedure for ensuring that all those responsible for managing the CM receive training covering:~~ ~~a) an introduction to the concept of the CM;~~ ~~b) compliance management;~~ ~~c) the concept of compliance assurance;~~ ~~d) CM manuals;~~ ~~e) audit techniques;~~ ~~f) reporting and recording;~~ ~~g) how the CM supports continuous improvement within the organisation.~~		~~a)~~ ~~b)~~ ~~c)~~ ~~d)~~ ~~e)~~ ~~f)~~ ~~g)~~	
~~Are suitable training records maintained?~~			
~~Are activities within the CM sub-contracted out to external agencies?~~			
~~Do written agreements exist between the organisation and the sub-contractor clearly defining the services and standard to be provided?~~			
~~Are the procedures in place to ensure that the necessary authorisations/ approval when required are held by a sub-contractor?~~			
~~Are the procedures in place to establish that the subcontractor has the necessary technical competence?~~			
~~**4. CM MANUAL**~~			
~~What is the current status of the CM manual – amendment and issue date?~~			
~~Is there a procedure in place to control copies and the distribution of the CM manual?~~			
~~Is the CM manual signed by the accountable manager and the compliance monitoring manager?~~			
~~Does the CM manual include, either directly or by reference to other documents, the following:~~ ~~a) a description of the organisation;~~ ~~b) reference to appropriate FSTD technical standards;~~ ~~c) allocation of duties and responsibilities;~~ ~~d) audit procedures;~~ ~~e) reporting procedures;~~ ~~f) follow-up and corrective action procedures;~~ ~~g) document retention policy;~~ ~~h) training records~~		~~a)~~ ~~b)~~ ~~c)~~ ~~d)~~ ~~e)~~ ~~f)~~ ~~g)~~ ~~h)~~	

~~Is there a document retention policy covering:~~ ~~a) audit schedules;~~ ~~b) inspection and audit reports;~~ ~~c) responses to findings;~~ ~~d) corrective action reports;~~ ~~e) follow-up and closure reports;~~ ~~f) management evaluation reports.~~		~~a)~~ ~~b)~~ ~~c)~~ ~~d)~~ ~~e)~~ ~~f)~~	
~~Does the CM manual include, either directly or by reference to other documents, the following procedures for day to day operation of the FSTD:~~ ~~a) defect reporting systems;~~ ~~b) defect rectification processes;~~ ~~c) tracking mechanisms;~~ ~~d) preventative maintenance programmes;~~ ~~e) spares handling;~~ ~~f) equipment calibration;~~ ~~g) configuration management of the device including visual, IOS and navigation databases;~~ ~~h) configuration control system to ensure the continued integrity of the hardware and software qualified;~~ ~~i) QTG running and function and subjective tests.~~		~~a)~~ ~~b)~~ ~~c)~~ ~~d)~~ ~~e)~~ ~~f)~~ ~~g)~~ ~~h)~~ ~~i)~~	
~~Does the CM manual include, either directly or by reference to other documents, procedures for notification of the competent authorities of the following:~~ ~~a) any change in the organisation including company name, location, management;~~ ~~b) major changes to a qualified device;~~ ~~c) deactivation or relocation of a qualified device;~~ ~~d) major failures of a qualified device;~~ ~~e) major safety issue associated with the installation.~~		~~a)~~ ~~b)~~ ~~c)~~ ~~d)~~ ~~e)~~	
~~Does the CM manual define acceptable and effective procedures to ensure compliance with applicable health and safety regulations, including:~~ ~~a) safety briefings;~~ ~~b) fire/smoke detection and suppression;~~ ~~c) protection against electrical, mechanical, hydraulic and pneumatic hazards;~~ ~~d) other items as defined in AMC1 ORA.FSTD.115~~		~~a)~~ ~~b)~~ ~~c)~~ ~~d)~~	

~~Does the CM manual include acceptable and effective procedures for regularly checking FSTD safety features such as emergency stops and emergency lighting, and are such tests recorded?~~			
~~**5. COMPLIANCE MEASURES**~~			
~~Have compliance monitoring objectives been developed from the policy statement, and included either directly or by reference in the CMS manual?~~			
~~Does the CMS include processes to produce and review appropriate metrics data?~~			
~~Do these compliance measures track the following:~~ ~~a) FSTD availability;~~ ~~b) numbers of defects;~~ ~~c) open defects;~~ ~~d) defect closure rates;~~ ~~e) training session interrupt rates;~~ ~~f) training session compliance rating.~~		~~a)~~ ~~b)~~ ~~c)~~ ~~d)~~ ~~e)~~ ~~f)~~	
~~Do the compliance measures support the compliance objectives?~~			
~~**Required actions/Comments**~~ ~~Signature:……………………………………………………~~ ~~Date:…………………………………~~			

Rationale:

The checklist is no longer deemed relevant.

GM3 ORA.FSTD.100 General

~~**COMPLIANCE MONITORING SYSTEM – GUIDANCE FOR ORGANISATIONS OPERATING FSTDs TO PREPARE FOR A COMPETENT AUTHORITY EVALUATION**~~

~~(a) Introduction~~

~~The following material provides guidance on what is expected by the competent authorities to support the discussion during the preliminary briefing, which is a first step of any initial or recurrent evaluation of an FSTD carried out by a competent authority.~~

~~This document has been developed as well to standardise working methods throughout Member States and to develop effective CM spot checks to satisfy the applicable requirements and therefore to ensure the highest standards of training are attained.~~

~~(b) Document form~~

~~Different document forms can be considered. Nevertheless, it appears that the best solution is a dossier, which includes all the information required by the competent authority to perform an evaluation.~~

~~(c) Contents of the dossier for an initial evaluation:~~

~~(1) type of FSTD and qualification level requested;~~

~~(2) evaluation agenda: including date of evaluation, name of people involved for the competent authority, contact details for the FSTD operator, schedules for the subjective flight profile, QTG rerun;~~

~~(3) FSTD identification and detailed technical specification including, type of FSTD, manufacturer, registration number, date of entry into service, host computer, visual system, motion system, type of IOS, simulated version(s), standards of all the aircraft computers, if applicable. Manuals needed for an evaluation (e.g. flight manuals, system manuals, acceptance test manual, IOS user manual etc. – if applicable) could already be provided as part of the dossier in an electronic format;~~

~~(4) planned modifications;~~

~~(5) subjective open defect(s);~~

~~(6) airport visual databases including for each visual scene, name of the airport, IATA and ICAO codes, type of visual scene (specific or generic), additional capabilities (e.g. snow model, WGS 84 compliance, enhanced ground proximity warning system (EGPWS)); and~~

~~(7) QTG status: the list should include for each QTG test available the status of the tests following the FSTD operator and competent authority reviews.~~

~~(d) Contents of the dossier for a recurrent evaluation:~~

~~(1) type of FSTD and qualification level requested;~~

~~(2) evaluation agenda, including date of evaluation, name of people involved for the competent authority, contact details for the operator, schedules for the subjective flight profile, QTG rerun and QTG review;~~

~~(3) FSTD identification, including type of FSTD, manufacturer, registration number, date of entry into service, host computer, visual system, motion system, type of IOS, simulated version(s), standards of all the aircraft computers, if applicable;~~

~~(4) status of items raised during the last evaluation and date of closure;~~

~~(5) reliability data: training hours month by month during the past year, numbers of complaints mentioned in the technical log, training hours lost, availability rate;~~

~~(6) operational data: a list of FSTD users over the previous 12 months should be provided, with number of training hours;~~

~~(7) failure tabulation including categorisation of failures (by ATA chapter and Pareto diagram, ARINC classification);~~

~~(8) details of main failures leading to training interruption or multiple occurrences of some failures;~~

~~(9) hardware and/or software updates or changes since last evaluation and planned hardware and/or software updates or changes;~~

~~(10) subjective open defect(s);~~

~~(11) airport visual databases including for each visual scene, name of the airport, ATA and ICAO codes, type of visual scene (specific or generic), additional capabilities (snow model, WGS 84 compliance, EGPWS);~~

~~(12) QTG status: the list should include for each QTG test available, the date of run during the past year, any comment, and the status of the tests; and~~

~~13) results of scheduled internal audits and additional quality inspections (if any) since last evaluation and a summary of actions taken.~~

Rationale:

The text of the deleted GM has been included in AMC1.

AMC1 ORA.FSTD.105(a)(1) Maintaining the FSTD qualification

RECURRENT EVALUATION

The organisation operating the FSTD should rectify the defects of the FSTD identified during the evaluation and notify the competent authority of the result of such rectifications within 30 days.

Rationale:

The above requirement has been transferred from AMC2 ARA.FSTD.100(a)(1) as it is an organisation and not an authority requirement.

AMC1 ORA.FSTD.105(b) Maintaining the FSTD qualification

QUALIFICATION TEST GUIDE (QTG) RERUNS

(a) The organisation operating FSTDs should run the complete QTG validation tests between each annual evaluation by the competent authority.

(b) The complete QTG should not be run just prior to an evaluation. As a minimum, the validation tests should be run in at least four approximately equal 3-monthly blocks on an annual cycle. Each block of validation tests should be chosen to provide coverage of the different types of validation.

Rationale:

A new AMC has been added regarding QTG reruns to provide clarity to industry based on CA experiences and feedback.

AMC2 ORA.FSTD.105(b) Maintaining the FSTD qualification

RECURRENT EVALUATIONS — VALIDATION TEST DATA PRESENTATION

(a) During the initial evaluation of an FSTD, the master qualification test guide (MQTG) is created. The establishment of the MQTG is an important step in preparation for subsequent recurrent evaluations.

(1) The currently accepted method of presenting recurrent validation test results is to provide FSTD results overplotted with either:

(i) aircraft validation data for type-specific FSTD models or where the aircraft simulation models feature fidelity level is *S*, or,

(ii) the reference data standard established during the initial evaluation for non-type-specific FSTD models or where the aircraft simulation models feature fidelity level is *R* or *G*.

(2) Test results are carefully reviewed to determine if the test is within the specified tolerances. This can be a time-consuming process, particularly when the validation or 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 organisation operating FSTDs and the competent authority are looking for any change in the FSTD performance since initial qualification.

(b) Presentation of recurrent evaluation test results

(1) The method described below to present recurrent validation test results is offered solely to promote greater efficiency for organisations operating FSTDs while conducting recurrent FSTD validation testing. The efficiency gain arises from the ability to immediately identify, regardless of the experience of the individual conducting or assessing the test, any variance between the MQTG and recurrent validation test results. This method may only be practically used when the FSTD uses automatic testing, which is strongly recommended to demonstrate consistent repeatability of validation test results.

(2) The organisation operating FSTDs should have the capability to overplot the recurrent result against the validation data, MQTG results or reference data standard. Plotting capability should be available for both automatic (if applicable) and manual validation test results.

(3) For all FSTD types, as every MQTG test result is essentially a 'footprint' test for the FSTD, any variations between recurrent evaluation test results and MQTG test results or reference data standard will be readily apparent. A variance occurring in an established FSTD, other than minor variations attributable to repeatability issues, are a probable indication of change. Unless there has been a software modification or hardware change, the variance may indicate hardware wear or some other drift or degradation issue. A consistent recurrent validation test result that differs from the

MQTG for a new FSTD may indicate that the MQTG test is at fault and should be updated. This should normally only occur during the first recurrent evaluation(s). Investigation of any variance between the MQTG and recurrent FSTD performance should be conducted, particularly if these variations exceed tolerances explained below and if they cannot easily be explained, but this is left to the discretion of the organisation operating FSTDs and the competent authority.

(4) For type-specific FSTDs (FFSs or FTDs), or where the aircraft simulation models feature fidelity level is *S*, there are no suggested tolerances between the recurrent test results and the MQTG validation test results of the initial evaluation. Investigation of any discrepancy between the MQTG and recurrent FFS/FTD performance is left to the discretion of the organisation operating FSTDs and the competent authority. Where small deviations from the MQTG are seen, the test result should be acceptable if the test is still within the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105 when measured against the validation data.

(5) For non-type-specific FSTDs (FNPTs), or where the aircraft simulation models feature fidelity level is *R* or *G*, the test result will be acceptable if the test is within the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105 when measured against the MQTG or reference data standard.

Rationale:

A new AMC has been developed with the text of CS FSTD(A).QTG.410 (which has now been deleted) to ensure that organisations are aware of an alternative process for recurrent QTG results regardless of the qualification standard.

AMC1 ORA.FSTD.105(c) Maintaining the FSTD qualification

CONFIGURATION CONTROL SYSTEM — HARDWARE AND SOFTWARE

(a) A configuration control system should provide traceability of the changes performed on an FSTD. It should cover as a minimum the following areas:

— simulation software;

— FSTD hardware;

— specific visual scene;

— navigation and avionic databases.

(b) The following phases should be described in the operation procedures:

(1) Development: this phase should be conducted without affecting the configuration software or hardware used in training.

(2) Acceptance: the validation of the modification should be performed by a subject matter expert. A pilot should validate the modification in case it is related to the performance and the flying qualities of the FSTD or a major update of a specific visual scene. The validation should be recorded.

(3) Update of the documentation: the description of the modification should be recorded with the reference of the load in case of software modification, or the revision of the specific visual scene.

(4) Analysis of the impact on the validation tests: the tests that could be impacted by the modification should be rerun. In case the result differs from the one in the MQTG, the master document should be updated with the new test.

(5) Release into training: the dates of the release should be recorded.

(6) Software backup: The software modification should create supplementary exact copies.

Rationale:

This AMC outlines the expectations of the CA in the area of the configuration control system.

AMC2 ORA.FSTD.105(c) Maintaining the FSTD qualification

CONFIGURATION CONTROL SYSTEM — ENVIRONMENT — AERODROME AND TERRAIN — VISUAL DATABASE CURRENCY

(a) All airport models should be representations of real-world, operational airports or representations of fictional airports and should meet the requirements set out in the relevant PRD, as appropriate.

(b) If fictional airports are used, the operator should ensure that navigational aids and all appropriate maps, charts, and other navigational reference material for the fictional airports (and surrounding areas as necessary) are compatible, complete, and accurate with respect to the visual presentation of the airport model of this fictional airport. A statement of compliance (SOC) should be issued that addresses navigation aid installation and performance and other criteria (including obstruction clearance protection) for all instrument approaches to the fictional airports that are available in the simulator. The SOC should reference and account for information in the terminal instrument procedures manual and the construction and availability of the required maps, charts, and other navigational material. This material should be clearly marked 'for training purposes only'.

(c) When an airport model represents a real-world airport and a permanent change is made to that real-world airport (e.g. a new runway, an extended taxiway, a new lighting system, a runway closure), an update to that airport model should be made in accordance with the following suggested time limits:

(1) For a new airport runway, a runway extension, a new airport taxiway, a taxiway extension, or a runway/taxiway closure — within 90 days of the opening for use of the new airport runway, runway extension, new airport taxiway, or taxiway extension; or within 90 days of the closure of the runway or taxiway.

(2) For a new or modified approach light system — within 45 days of the activation of the new or modified approach light system.

(3) For other facility or structural changes on the airport (e.g. new terminal, relocation of Air Traffic Control Tower) — within 180 days of the opening of the new or changed facility or structure.

(d) If an operator desires an extension to the time limit for an update to a visual scene or airport model or has an objection to what should be updated in the specific airport model requirement, the operator should inform the competent authority stating the reason for the update delay and a proposed completion date, or explain why the update is not necessary (i.e. why the identified airport change will not have an impact on flight training, testing, or checking).

Rationale:

This new AMC outlines the expectations of the CA for maintaining the currency of required visual database scenes with respect to training. The test aligns with ICAO Doc 9625 requirements as well as those of the FAA to ensure harmonisation.

AMC1 ORA.FSTD.110 Modifications

GENERAL

(a) The FSTD, where applicable, should be maintained in a configuration that accurately represents the aircraft or class of aircraft being simulated. This may be a specific aircraft tail number or may be a representation of a common standard.

[…]

Rationale:

Minor editorial change.

AMC2 ORA.FSTD.110(e) Modifications

LETTER OF INFORMATION TO THE AUTHORITY

The following letter of compliance should be sent to the competent authority by the organisation operating FSTDs after a major modification, and not more than 3 days after the acceptance tests have been performed .

(Date) ……………………………

The FSTD has been assessed by the following evaluation team:

(Name)…………………………… Qualification……………………………………

(Name)…………………………… Pilot’s Licence No……………………………

(Name)…………………………… Flight Engineer’s Licence No (if applicable)……………………………

This team attests that the modification has been performed according to the applicable rules. The tests performed demonstrate that following the modification, the modified area operates correctly, and that it has not affected other areas of the FSTD.

(Additional comments as required)
……………………………………………………………………
……………………………………………………………………
……………………………………………………………………
Signed
……………………………………………………………………

Print name: …………………..
Position/appointment held: …………………..
Email address: …………………..
Telephone number: …………………..

Rationale:

After a major modification, the organisation operating FSTDs should provide a letter of compliance that the acceptance, regression and non-regression testing, has been conducted. This letter is required even if a special evaluation is required by the CA.

GM1 ORA.FSTD.110 Modifications

EXAMPLES OF MAJOR MODIFICATIONS

The following are examples of modifications that ~~should~~ could be considered as major and thus merit consideration for competent authority special evaluation. This list is not exhaustive and modifications need to be classified on a case-by-case basis:

(a) any change that materially affects the QTG general requirements, statements of compliance and objective validation tests compared to those established at the initial qualification. Typically, this will be due to modifications of the FSTD hardware or aircraft simulation models software (e.g. updated aerodynamic data packages or subjective tuning) that affect flying handling qualities and/or performance. For cueing systems (such as motion, sound and visual display), any major modifications may also affect the original qualification criteria and QTG validation tests for these features.

(b) introduction of new standards of equipment or systems representation such as updated flight management and guidance computer (FMGC) and ~~updated aerodynamic data~~ electronic flight controls or fly-by-wire system packages;

(c) re-hosting of the FSTD software; this may be due to computer equipment obsolescence or replacement of avionics line replaceable units with avionics rehost or retarget solutions;

(d) introduction of features that ~~model new training scenarios~~ enable new training tasks to be completed; e.g. airborne collision avoidance system (ACAS), EGPWS; and

(e) ~~aircraft~~ modifications that could affect the FSTD qualification level and/or FCS.~~; and~~

~~(f) FSTD hardware or software modifications that could affect the handling qualities, performance or system representation.~~

Rationale:

The GM has been modified to clarify what constitutes major modifications to FSTDs that might require special evaluation by the CA. It provides clarity for the industry.

AMC1 ORA.FSTD.120 Equipment and specifications list

GENERAL

(a) The ESL is a document prepared and released by the FSTD qualification certificate holder. There should be an ESL established for each individual FSTD qualification certificate, which should list the applicable technical details of the device. As such, the ESL should form a section in the QTG, supplementing the QTG FSTD information sheet.

(b) The ESL should provide information to the FSTD users to assist in the assessment of the FSTD's suitability for the intended use.

(c) The FSTD qualification certificate holder should be able to demonstrate the reasoning for each entry in the ESL. Equipment and specifications included in the ESL should be validated as part of the organisation operating FSTDs's functional, subjective and objective QTG testing. The associated documentation should:

(1) be part of the configuration control process;

(2) refer to the applicable reference documents, such as technical criteria documents, acceptance test manuals or procedures, malfunction description documents, visual database currency lists, FSTD technical specifications, aeroplane flight manual (AFM), operations manual, or equivalent; and

(3) indicate details on how, when and by whom the element was checked, tested and found acceptable.

(d) The ESL declaration should be signed by the person of the organisation operating FSTDs who is allocated with the organisational responsibility to submit this declaration in accordance with ORA.GEN.210(b).

Rationale:

These AMC and GM cover the ESL general requirements, provide an ESL template that organisations operating FSTDs can use, plus guidance material for completing the ESL. The ESL is now a declaration of the FSTD capability belonging to the organisation operating FSTDs. The ESL is additional to the authority-issued FSTD qualification certificate and will assist other FSTD users in meeting their obligation to check that selected FSTDs are suitable for use in their training programmes.

AMC2 ORA.FSTD.120 Equipment and specifications list

ESL TEMPLATE

Equipment and specifications list (ESL) — Declaration
Pursuant to Commission Regulation (EU) No 1178/2011

The following information is guidance only for training providers (ATOs, AOC holders and others) which will use the FSTD. When developing the training programme in accordance with Annex I (Part-FCL) to Commission Regulation (EU) No 1178/2011 or Annex III (Part-ORO) to Commission Regulation (EU) 965/2012, the training provider is responsible for determining overall usability of the FSTD in accordance with ORA.ATO.135 and ORO.FC.145 in achieving the training objectives. The below-mentioned FSTD equipment and specifications are therefore of indicative nature only and do not constitute an indication of FSTD capability, nor should the specifications be used to limit the scope of training as determined by the training provider's suitability for use evaluation.

ESL-[FSTD identification]: [ESL document date], [ESL document revision number]:			
Section 1.0: Organisation operating FSTDs information			
Operator name:		FSTD Location:	

Address:		Address:	
City:		City:	
Country:		Country:	
Post code / ZIP:		Post Code / ZIP:	
Section 2.0: FSTD information			
Operator's FSTD ID:		EASA FSTD ID:	
FSTD manufacturer:		FSTD manufacturer serial number:	
Date of manufacture:		Qualification PRD:	
FSTD type:		FSTD Level:	
Validation/Reference data Document reference / revision:		Qualification test guide Document reference / revision:	
Section 2.1: Flight deck layout and structure		**(N,G,R,S):**	
Aircraft type /make/model/class:		Number of seats:	
Other:			
Section 2.2: Flight model		**(N,G,R,S):**	
Primary engine type/Thrust:		Primary engine FADEC:	
Alternate engine type/thrust:		Alternate engine FADEC:	
Aero model/data revision:		Icing effects:	
UPRT:		Stall modelling:	
Other:			
Section 2.3: Ground reaction and handling characteristics		**(N,G,R,S):**	
Runway contaminations:		Pushback:	
Section 2.4.a: Aeroplane systems *(fixed wing)*		**(N,G,R,S):**	
AFM reference:			
Avionics type/suite:		Avionics Std/Rev:	
Autopilot:		Flight Director:	
Auto-coupled approach:		Autoland / Rollout:	
Auto go-around:		Auto throttle:	
FMS:		HUD/HGS/EVS:	
WX radar / PWS:		LPV/GPS/WAAS:	
NVG:		ACAS:	
TAWS:		EFB Class:	
CPDLC:		ADS A/B/C:	
RAAS:		AWO minima:	
RNP AR:		Other:	
Other:			
Section 2.4.b: Helicopter systems *(rotary wing)*		**(N,G,R,S):**	
AFM reference:			
Avionics type/suite:		Avionics Std/Rev:	
Autopilot:		Flight Director:	
Auto-coupled approach:		FMS:	
WX radar / PWS:		NVG/NVIS:	
AWO minima:		ARA:	
Other:			
Section 2.5:Flight controls and forces		**(N,G,R,S):**	
Flight controls data revision:		Flight controls type:	
Other:			
Section 2.6: Sound cues		**(N,G,R,S):**	
Sound system:			
Section 2.7: Visual display cue		**(N,G,R,S):**	
Image generator:		Projector type:	
System display:		Field of View:	
Other:			
Section 2.8.a: Motion cue		**(N,G,R,S):**	
Manufacturer:		Type:	
Model & payload:		Stroke:	
Other:			
Section 2.8.b: Vibration cue *(rotary wing)*		**(N,G,R,S):**	
Manufacturer:		Type:	

Model & payload:		Stroke:	
Other:			
Section 2.9: Environment ATC		**(N,G,R,S):**	
SATCE-enabled airports		SATCE regions:	
Section 2.10: Environment — Navigation		**(N,G,R,S):**	
FSTD navigation aids database:		Nav aids available:	
Section 2.11: Atmosphere and weather		**(N,G,R,S):**	
Weather presets:		Volcanic ash:	
T-storms:		Precipitations:	
Windshear:		Microburst:	
Turbulence types:		Predictive W/S scenarios	
Other:			
Section 2.12.a: Aerodromes and terrain *(fixed wing)*		**(N,G,R,S):**	
Visual databases reference document:			
RNP AR scenes:		SMGCS:	
VGS:		Other:	
Other:			
Section 2.12.b: Landing areas and terrain *(rotary wing)*		**(N,G,R,S):**	
Visual databases reference document:			
VGS:		Other:	
Other:			
Section 2.13: Miscellaneous			
Malfunctions reference document:			
Computer system:		Smoke:	
Lesson plan:		Snapshot:	
Other:		Other:	
Other:			

[The FSTD qualification certificate holder] declares that the information contained in this declaration complies with the configuration of the FSTD.
We confirm that all information in this declaration is complete and correct.
Name, date and signature of the person of the FSTD qualification certificate holder who has the organisational responsibility to submit this declaration:

ESL-[FSTD identification]: [ESL document date], [ESL document revision number]:			
Section 3: Approval			
Operator signature:		Date:	

GM1 ORA.FSTD.120 Equipment and specifications list

ESL COMPLETION GUIDANCE

(a) The ESL has been designed to provide all relevant information about all the FSTD's key features, which might be of use to all parties needing to conduct own assessment prior to considering use of the device. The information in this list should therefore only show the installed equipment, specifications and declared capabilities. The ESL is independent of whether the FSTD has a declared FCS or not.

(b) As the ESL template is designed to suit both type-specific and non-type-specific FSTDs, not all of the information proposed may be applicable and this should be taken into consideration when developing the ESL for an given FSTD. Where items are not applicable, they may be marked as such or, preferably, omitted from the ESL completely.

(c) The organisation operating FSTDs should decide themselves the appropriate level of detail depending upon the type and level of FSTD or its FCS where applicable. However, the layout and level of detail should be such that the information can fit to not more than three pages unless not practical for the FSTD concerned.

(d) The information provided in Section 2.0. should be consistent with that contained in the application for FSTD evaluation and in the submitted QTG. This includes all administrative information, as well as the qualification level or FCS fidelity levels (depending on the applicable PRD) which are determined by the operator and for which the evaluation is requested.

(e) Sections 2.1 to 2.12 each correspond to one of the 12 FSTD features in the FCS, furthermore, Section 2.13 should be used for miscellaneous.

(f) Where an FCS applies to the FSTD, the operator should record the declared FCS level of fidelity in the right hand column box adjacent to the FSTD feature name. If the feature fidelity level is ‘N’, meaning that feature is not simulated or applicable, then ‘*N*’ should be entered and the rows below that are relevant to that FSTD feature heading may be removed from the ESL.

(g) Where an FCS does not apply to the FSTD, because the applicable PRD does not specify requirements in terms of features and fidelities, then the feature fidelity level is not applicable and the box should be marked ‘N/A’. The information in the boxes below however that indicates installed systems, functionality or capabilities should still be completed as appropriate for the FSTD type and qualification level.

(h) The following subparagraphs provide additional guidance on completing each of these subsections taking into account whether the FSTD is type-specific or class representative and the level of fidelity of the feature where relevant.

(1) Section 2.1: Flight deck layout and structure

(i) *Aircraft type/make/model/class*

For fidelity level ‘S’, or type-specific FSTDs, the aircraft type and model should be entered (e.g. Airbus A320-200).

For fidelity level ‘G’ and ‘R’, or class representative FSTDs, information that identifies the aircraft class or category should be entered (e.g. light business jet, twin turboprop, etc.).

(ii) *Number of seats*

In addition to crew and instructor seating, the number of observer seats available for FSTDs with motion cueing or enclosed aft structures.

(2) Section 2.2: Flight model

(i) *Primary engine type/thrust; Primary engine FADEC*

The engine make, model, thrust rating (e.g. IAE V2527-A5) and FADEC version if applicable.

(ii) *Alternate engine type/thrust; Primary engine FADEC*

Where an additional engine type or thrust rating / FADEC combination is available, then they should be indicated here. If more than one alternate engine type or thrust rating is available, then additional row should be added to the ESL.

(iii) *Aero model / data revision*

Identify the reference of the aero model and data tables either as supplied from the aircraft manufacturer or as developed by the FSTD manufacturer or third party.

(iv) *Icing effects*

Indicate (Y/N) if the flight model includes performance effects due to icing where appropriate, on the airframe, aerodynamics and the engine(s) as required in the relevant PRD.

(v) *UPRT*

Indicate (Y/N) if the flight model and data tables will support UPRT as required in the relevant PRD.

(vi) *Stall modelling*

Indicate (Y/N) if the flight model and data tables will support full stall recovery training or just approach to stall recognition, as required in the relevant PRD.

(3) Section 2.3: Ground reaction and handling characteristics

(i) *Runway contaminations*

Indicate runway surface contaminations available, e.g. dry, wet, ice, patchy snow, etc.

(ii) *Pushback*

Indicate if the pushback functionality is available (Y/N).

(4) Section 2.4.a: Aeroplane systems *(fixed wing)*

(i) *Aeroplane flight manual (AFM) reference*

For fidelity level 'S', or type-specific FSTDs, aircraft systems and equipment, it is acceptable to reference the aircraft flight manual supplement name and number as appropriate to the aircraft type or standard where this fully details the aircraft systems capability and functionality. This may then not require some of the other fields within Section 2.4 to be completed if the operator believes the referenced flight manual is sufficient.

(ii) *Avionics type / suite*

For fidelity level 'R', or non-type specific FSTDs particularly, it is helpful to mention the type of avionics display / navigation equipment installed (e.g. manufacturer, class). For example:

(1) For single-engine piston aircraft FSTDs:

Analogue, HSI, RMI, etc.

(2) For multi-engine turbine aircraft FSTDs:

PFD/ND, EFIS 2 x EADI, 2 x EHSI (representative of model XYZ), etc.

(iii) *Avionics STD/Rev*

For example, aircraft type standard 1.2.3, etc.

(iv) *Autopilot*

For fidelity level 'R', or non-type specific FSTDs, identifying the available basic modes as applicable and number of axes of the autopilot may be useful.

(v) *Flight director*

Where a flight director is fitted, if it is dual, single, etc.

(vi) *Auto-coupled approach*

Specify if the auto-coupled approach function is available (Y/N) and note any limitations.

(vii) *Autoland/rollout*

Specify if autoland and rollout modes are available (Y/N) and note any limitations (e.g. autoland fail passive).

(viii) *Auto go-around*

Specify if auto go-around mode is available (Y/N) and note any limitations (e.g. single/dual engine).

(ix) *Auto throttle*

Specify if the auto throttle function is available (Y/N) and note any limitations.

(x) *Flight management system (FMS)*

Specify the FMS make and model (e.g. Honeywell dual FMS standard ABC123, etc.).

(xi) *Head-up display (HUD)/Head-up Guidance System (HGS)/Enhanced Vision System(EVS):*

Specify the HUD/HGS/EVS make and model (e.g. single/dual standard ABC123, etc.).

(xii) *Weather radar (WXR) / Predictive windshear system (PWS)*

Specify the weather radar / PWS and/or make and model.

(xiii) *Night vision goggles (NVG)/Night vision imaging system (NVIS)*

Specify make and model.

(xiv) *Localiser performance with vertical guidance (LPV)/global positioning system (GPS)/ wide area augmentation system (WAAS)*

Specify which systems are available if any.

(xv) *Terrain awareness and warning system (TAWS)*

Specify the type of TAWS available (e.g. EGPWS).

(xvi) *Airborne collision avoidance system (ACAS)*

Specify the type of ACAS system available (e.g. TCAS 7.1).

(xvii) *Controller pilot datalink communications (CPDLC)*

Specify if CPDLC is available (Y/N) and type as applicable.

(xviii) *Electronic flight bag class*

Specify the class of the EFB installed (e.g. Class I, II or II).

(xix) *RAAS*

Specify if RAAS is available (Y/N) and any other pertinent information.

(xx) *Automatic dependent surveillance (ADS-A/B/C)*

Specify type of ADS and level of service simulated e.g. ADS B [in/out] as applicable.

(xxi) *Required navigation performance (RNP)*

Specify the RNP minimum value or limitation as applicable for RNP.

(xxii) *All-weather operations minima*

Applicable weather minima (e.g. CAT I/II/III and associated RVR and DH and RVR for LVTO as applicable) should be presented for which the FSTD has been satisfactorily assessed.

(xxiii) *Other*

Specify any other additional information thought to be relevant with regard to aircraft systems and navigational performance. If the FSTD qualification does not require all the aircraft systems to be simulated, the ESL should at least provide the list of the simulated systems.

(5) Section 2.4.b: Helicopter systems *(rotary wing)*

(i) See guidance above in (4) as applicable for rotorcraft FSTDs.

(ii) *Airborne radar approach (ARA)*

Specify capabilities and limitations of ARA system if fitted.

(iii) *Other*

Specify any other additional information thought to be relevant with regard to rotorcraft systems and navigational performance. If the FSTD qualification does not require all the rotorcraft systems to be simulated, the ESL should at least provide the list of the simulated systems.

(6) Section 2.5: Flight controls and forces

(i) *Flight controls data revision*

Identify the reference of the flight controls model and data tables either as supplied from the aircraft manufacturer or as developed by the FSTD manufacturer or third party.

(ii) *Flight controls type*

Identify characteristics relevant to the type of flight controls simulation such as reversible/non-reversible, hydraulic or electric, active force feedback or passive, spring-loaded, etc.

(iii) *Other*

Identify any other significant features of the flight controls and forces simulation that are considered relevant. For example, some types of FSTD may not have all the secondary flight controls fitted (such as a tiller), or may use non-type-specific controls such as joystick controllers.

(7) Section 2.6: Sound cue

(i) *Sound system*

Identify the type of sound and speaker system for the FSTD (e.g. digital sound system with multi-directional speakers, single front unidirectional speaker, etc.).

(8) Section 2.7: Visual display cue

(i) *Image generator*

Manufacturer, image generator model and version.

(ii) *Projector type*

Type of projectors (e.g. CRT, LCD, LCoS, LCoS-laser, DLP-LED, etc.).

(iii) *System display*

Projection method (e.g. collimated, direct projection, dome, etc.).

(iv) *Field of view*

Horizontal and field of view in degrees.

(v) *Other*

Examples might include additional equipment such as chin windows for helicopter FSTDs.

(9) Section 2.8.a: Motion cue

(i) *Manufacturer*

Motion system manufacturer name

(ii) *Type*

Motion system technology (e.g. hydraulic, electrical pneumatic, electro-hydraulic, vibration platform, etc.).

(iii) *Model & payload*

Motion system manufacturer model and payload in kg.

(iv) *Stroke*

Motion system actuator stroke length.

(10) Section 2.8.b: Vibration cue *(rotary wing)*

(i) *Manufacturer*

Motion system manufacturer name

(ii) *Type*

Motion system technology (e.g. hydraulic, electrical pneumatic, electro-hydraulic, vibration platform, etc.)

(iii) *Model & payload*

Motion system manufacturer model and payload in kg.

(iv) *Stroke*

Motion system actuator stroke length.

(11) Section 2.9: Environment — ATC

(i) *SATCE-enabled scenes*

List here any airports that have SATCE functionality enabled (e.g. EGLL, EGCC, etc.)

(ii) *Stroke*

List here any SATCE-enabled regions (e.g. London TMA, etc.)

(12) Section 2.10: Environment — Navigation

(i) *FSTD navigation aids database*

List here the regions covered (if not worldwide) in the FSTD for the provision of ground-based navigation aids.

(ii) *Navigation aids available*

List here the different types of navigation aids available if all types are not automatically included (e.g. VOR / DME / TACAN / NDB / GBAS/ ILS /MLS).

(13) Section 2.11: Environment — Atmosphere and weather

(i) *Weather pre-sets*

List here the weather pre-sets available if there is any limitation (e.g. CAT I, etc.)

(ii) *Volcanic ash*

Indicate if a volcanic ash scenario is available (Y/N).

(iii) *T-Storms*

Indicate number and/or type of thunderstorm scenarios available.

(iv) *Precipitations*

Indicate the different precipitation types and/or associated special effects available (e.g. snow, rain, hail, blowing snow, etc.).

(v) *Windshear*

Indicate type of windshear scenarios available (e.g. FAA WTA profiles, etc.).

(vi) *Microburst*

Indicate type of microburst scenarios available (e.g. Rae Bedford model, etc.).

(vii) *Turbulence types*

Indicate type of turbulence models available (e.g. rough air, wake, etc.).

(viii) *Predictive W/S scenarios;*

Indicate type of PWS scenarios available (e.g. take off, approach, etc.).

(14) Section 2.12.a: Environment — Aerodromes and terrain *(fixed wing)*

(i) *Visual databases reference document*

Reference the document containing the list of airport visual databases available to the FSTD users, including for each visual scene, name of the airport, IATA and ICAO codes, type of visual scene (specific or generic), additional capabilities (e.g. snow model, RNP APCH AR).

(ii) *VGS*

List airport and runway used for the visual ground segment (e.g. EGLL 09R).

(iii) *RNP AR scenes*

Indicate visual scenes available that support RNP AR approaches which have been assessed as suitable by the operator.

(iv) *SMGCS*

For low-visibility operations, at least one taxi route should be simulated. The taxi route(s) and/or whether SMGCS is available (e.g. EGCC, etc.) should be clearly indicated.

(v) *Other*

Other may be used to indicate any other specific PBN approaches and/or steep approaches that the system supports.

(15) Section 2.12.b: Environment — Landing areas and terrain *(Rotary wing)*

(i) *Visual databases reference document*

Reference the document containing the list of visual databases available to the FSTD users, including for each visual scene, name of the airport, IATA and ICAO codes, type of visual scene (specific or generic), additional capabilities (e.g. heli deck, ditching, ship landing, rig landing, elevated platform landing, etc.).

(ii) *VGS*

List airport and runway used for the visual ground segment (e.g. EGLL 09R).

(iii) _Other_

Other may be used to indicate any other specific PBN approaches and/or steep approaches that the system supports.

(16) Section 2.13: Miscellaneous

(i) _Malfunctions reference document_

Reference the document containing the list of available malfunctions and malfunction descriptions that are available and that have been validated by the operator.

(ii) _Computer system_

Identify the host computer system type or make.

(iii) _Smoke_

Indicate if the FSTD supports smoke generation.

(iv) _Lesson plan_

Indicate if the FSTD has lesson plan capability.

(v) _Snapshot_

Indicate if the FSTD has snapshot capability.

(vi) _Other_

List here any additional information with regard to FSTD operations (e.g. brief / debrief tools, etc.).

AMC1 ORA.FSTD.200 Application for FSTD qualification

APPLICATION FORM FOR INITIAL QUALIFICATION OF AN FSTD~~; EXCEPT BASIC INSTRUMENT TRAINING DEVICE (BITD)~~

~~A sample of letter of application is provided overleaf.~~

Part A

~~To be~~ The form should completed and submitted not less than 3 months prior to the requested qualification date.

(Date)
(Office – ~~C~~competent ~~A~~authority)
(Address) ……………………………………………………
(City) …………………………………………………………
(Post code) ………………………………………………
(Country) ……………………………………………………

FSTD TYPE AND QUALIFICATION LEVEL SOUGHT:

FSTD Type ~~of FSTD~~	PRD	Aircraft type/class	FSTD ~~Q~~qualification ~~L~~level ~~Sought~~

Full flight simulator	CS-FSTD(A)		~~A~~	~~B~~	~~C~~	D	~~Sp./Cat~~
FFS	CS-FSTD (H)		A	B	C	D	
Flight training device	CS-FSTD(A)		~~1~~ A	~~2~~ B	~~3~~ C		
FTD	CS-FSTD (H)		1	2	3		
Flight and navigation procedures	CS-FSTD(A)		A ~~I~~	B ~~II~~	C ~~III~~	D ~~II~~ ~~MCC~~	E ~~III~~ ~~MCC~~
trainer FNPT	CS-FSTD (H)		I	II	III	II MCC	III MCC

FSTD CAPABILITY SIGNATURE (FCS)* SOUGHT:
(* if applicable to PRD)

	FSTD FEATURE	**FIDELITY LEVEL**
1.	Flight deck layout and structure	N G R S
2.	Flight model	N G R S
3.	Ground reaction and handling characteristics	N G R S
4.a	Aeroplane systems _(fixed wing)_	N G R S
4.b	Helicopter systems _(rotary wing)_	N G R S
5.	Flight controls and forces	N G R S
6.	Sound cue	N G R S
7.	Visual display cue	N G R S
8.a	Motion cue	N G R S
8.b.	Vibration cue _(rotary wing)_	N G R S
9.	Environment — ATC	N G R S
10.	Environment — Navigation	N G R S
11.	Environment — Atmosphere and weather	N G R S
12.a	Environment — Aerodromes and terrain _(fixed wing)_	N G R S
12.b	Environment — Landing areas and terrain _(rotary wing)_	N G R S

Interim Qualification Level requested: YES/NO

Dear,

<*Name of Applicant*> requests the evaluation of its flight simulation training device <*operator's identification of the FSTD*> for qualification. ~~The <*FSTD manufacturer's name*> FSTD with its <*visual system and manufacturer's name, if applicable*> visual system.~~

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: <*date(s)*> and the FSTD will be located at <*place*>.

The objective tests of the QTG will be submitted by <*date*> and in any event not less than ~~30 days~~ 1 month before the requested evaluation date unless otherwise agreed with the competent authority.

Comments:
……
……

Signed
…………………………………………………………………….

Print name: …………………..
Position/appointment held: …………………..
Email address: …………………..
Telephone number: …………………..

Part B
~~To be~~ The form should be completed and submitted not less than 1 month prior to the requested qualification date with attached QTG results.

(Date) ……………………….

We have completed objective testing~~s~~ of the FSTD and declare that it meets all applicable requirements except as noted below.
~~The following QTG tests still have to be provided:~~

Tests	Comments

(Add boxes as required)

It is expected that ~~they~~ these tests will be completed and submitted no later than 2 weeks ~~3 weeks~~ prior to the evaluation date.

Signed
…………………………………………………………………….

Print name: …………………..

Position/appointment held: …………………..
E-mail address: …………………..
Telephone number: …………………..

Part C

To be completed and submitted not less than 1 week ~~7 days~~ prior to the initial evaluation.

(Date) ....

The required contents of the dossier for an initial evaluation are, or have been, submitted to the competent authority. 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) ....~~

☐ FFS/FTD: This team attests that the <*type of FSTD*> conforms to the aeroplane flight deck/helicopter cockpit configuration of <*name of aircraft operator (if applicable), type of aeroplane/helicopter*> aeroplane/helicopter within the requirements for <*type of FSTD and level*> and that the simulated systems and subsystems function equivalently to those in that aeroplane/helicopter. The pilot of this evaluation team has also assessed the performance and the flying qualities of the FSTD and finds that it represents the designated aeroplane/helicopter.

☐ FNPT: This team attest(s) that the <*type of FSTD*> represents the flight deck or cockpit environment of a <*aeroplane/helicopter or class of aeroplane/type of helicopter*> within the requirements for <*type of FSTD and level*> and that the simulated systems appear to function as in the class of aeroplane/type of helicopter. The pilot of this evaluation team has also assessed the performance and the flying qualities of the FSTD and finds that it represents the designated class of aeroplane/type of helicopter.

☐ This team attests that the attached copy of the ESL has been assessed and corresponds to the FSTD features and capabilities that will be presented at the initial evaluation.

(Additional comments as required)
....
....
....

Signed
....

Print name: ....
Position/appointment held: ....
E-mail address: ....
Telephone number: ....

Rationale:

The FSTD initial evaluation application form has been updated. It now requests an FCS to be evaluated as well as a type and qualification level where relevant. The ESL also now forms part of the declaration by the organisation operating FSTDs's attestation that the simulator has been assessed as ready for initial evaluation.

GM1 ORA.FSTD.200 Application for FSTD qualification

SUBMISSION OF QTG

(a) A copy of the organisation operating FSTDs's QTG, marked with test results, should accompany Part B of the request for initial qualification in order for the competent authority to start the review of the validation tests prior to the initial qualification. Any QTG deficiencies raised by the competent authority should be addressed prior to the start of the on-site evaluation.

(b) The organisation operating FSTDs may decide 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 organisation operating FSTDs should then validate FSTD performance at the final location by repeating at least one third of the validation tests in the QTG and submitting those tests to the competent authority. The QTG should be clearly annotated to indicate when and where each test was accomplished.

Rationale:

This new GM includes text from CS-FSTD(A) regarding the possibility to run validation tests in factory and then validate the FSTD performance by repeating at least one third of the validation tests on site.

GM~~1~~ 2 ORA.FSTD.200 Application for FSTD qualification

USE OF FOOTPRINT TESTS IN QUALIFICATION TEST SUBMISSION

(a) Introduction

(1) Recent experience during initial qualification of some ~~FFSs~~ FSTDs has required acceptance of increasing numbers of footprint tests. This is particularly true for ~~FFSs~~ FSTDs of smaller or older aircraft types, where there may be a lack of aircraft flight test data. However, the large number of footprint tests offered in some QTGs has given rise to concern.

(2) This guidance is applicable to type-specific FSTDs (FFS aeroplane, FTD aeroplane, FFS helicopter and FTD helicopter) qualifications.

(b) Terminology

Footprint test – A test conducted and recorded on the same FSTD, during its initial evaluation, should be used as the reference data standard for recurrent evaluations. In the event of an approved change to the FSTD to the flight model, or flight control system that may alter its characteristic, the competent authority may require that the footprint test result be re-generated under the new conditions to form a new reference data standard. ~~footprint test data are derived from a subjective assessment carried out on the actual FSTD requiring qualification. The assessment and validation of these data are carried out by a pilot appointed by the competent authority. The resulting data are the footprint validation data for the FSTD concerned.~~

(c) Recommendation

(1) ~~It is permitted to use footprint data where flight test data is not available~~. Only when all other alternative possible sources of data have been thoroughly reviewed without success may a footprint test be acceptable, subject to a case-by-case review with the competent authorities concerned, and taking into consideration the level of qualification or FCS sought for the FSTD.

(2) Footprint test data should be:

(i) constructed with initial conditions and FFS set up in the appropriate configuration (e.g. correct engine rating) for the required validation data;

(ii) a manoeuvre representative of the particular aircraft being simulated;

(iii) manually flown out by a type rated pilot who has current experience on the type* and is deemed acceptable by the competent authority**;

(iv) constructed from validation data obtained from the footprint test manoeuvre and transformed into an automatic test;

(v) an automatic test run as a fully integrated test with pilot control inputs; and

(vi) automatically run for the initial qualification and recurrent evaluations supplemented, wherever possible, with flight test data which will further substantiate the intended purpose and key aspects of the test being presented.

* In this context, 'current' refers to the pilot experience on the aircraft and not to the Part-FCL standards.

** The same pilot should sign off the complete test as being fully representative.

[...]

Rationale:

The text was originally GM in CS-FSTD(A). It has been transferred here and updated to ensure currency with ICAO Doc 9625 edition 4.

AMC2 ORA.FSTD.200 Application for FSTD qualification

PERSONNEL IN SUPPORT OF AN INITIAL QUALIFICATION

The following persons from the applicant should be present to support the initial evaluation:

(a) A type or class rated instructor depending of the level of qualification of the FSTD and the aircraft simulated;

(b) Sufficient FSTD support staff to assist with the running of tests and operation of the instructor's station.

GM1 ORA.FSTD.210(a) Qualification basis

DETERMINATION PROCESS FOR FSTD QUALIFICATION CRITERIA

Background

In the development of ICAO Doc 9625 'Manual of criteria for the qualification of FSTDs' (upon which CS-FSTD PRDs may be based), a process was used to define FSTD requirements for the training, testing and checking tasks applicable to the various licence or training types.

The process outcome defined levels of required fidelity of FSTD features that are expressed in a FSTD capability signature (FCS) to support either individual or combinations of training types and tasks. The FCS comprises 12 individual simulation features and 4 simulation feature fidelity levels (none or not required (N), generic (G), representative (R), and specific (S)).

However, not all training tasks or types may be described in terms of a suitable FCS in the relevant Part-FCL or Part-ORO documentation. Some training types and tasks may still refer to a specific FSTD type and qualification level rather than to an FCS or both. The following section therefore outlines the process to be used to determine the relevant qualification criteria and QTG in either case.

(a) Process

Figure 1 provides a step-by-step process map to determine the FSTD qualification criteria for the required FCS, or FSTD type and level, according to training task considerations. This enables the construction of an FSTD qualification test guide (QTG).

(b) The process is outlined as follows:

(1) *Step 1 — Determine the list of training tasks for licence or training type*.

Confirm that the training tasks listed in the relevant part of the Regulation (e.g. Part FCL) for the licence or training type chosen fulfil the FSTD user's and competent authority requirements. Proceed to *Decision 1*.

(2) *Decision 1 — Training tasks in FSTD type and level or expressed in terms of an FCS?*

In the relevant part of the Regulation check whether the training tasks are to be completed in a specific type and level of FSTD, or, whether the training tasks are mapped against an FCS describing the FSTD features and fidelity levels required to achieve them.

(i) If *FCS*, proceed to *Step 2(a).*

(ii) If *FSTD type and level*, proceed to *Step 2(b)*.

(3) *Step 2(a) — Determine the appropriate FCS required for licence or training type*. Confirm the FCS features and fidelity levels for the desired training type and tasks. Disregard *Step 2(b)* and proceed to *Decision 3.*

(4) *Step 2(b) — Determine the FSTD type and level of qualification required for licence or training type*. Confirm the FSTD type and qualification level required for the desired training type and tasks. Disregard *Step 2(a)* and proceed to *Decision 2*.

(5) *Decision 2 — FSTD type and level defined as an FCS in PRD?*

In the relevant FSTD certification specification check whether the required FSTD type and level is also mapped to a specific FCS.

(i) If *yes*, proceed to *Decision 3*.

(ii) If *no*, proceed to *Step 4(b).*

(6) *Decision 3 — Does the FCS meet the general requirements in the PRD?*

Determine if the FSTD features and fidelity levels will meet the general requirements specified for the features and fidelity levels in the FSTD certification specifications.

(i) If *yes*, proceed to *Step 4(a).*

(ii) If *no*, proceed to *Step 3.*

(7) *Step 3 — Determine the required changes to the FCS or training tasks to be accomplished in the FSTD*.

If the FSTD features and fidelity levels will not meet the general requirements specified in the FSTD certification specifications, then either the training tasks able to be performed will be limited or the FSTD will need to be modified to meet the required FCS for training. Proceed to *Step 4(a).*

(8) *Step 4(a) — Determine FSTD SoCs and testing requirements for FCS.*

Use the FSTD certification specifications to determine the FSTD general requirements, associated SoCs, objective and functional and subjective testing for the relevant FCS features and fidelity levels. Proceed to *Step 5.*

(9) *Step 4(b) — Determine FSTD SoCs and testing requirements for FSTD type and level.*

Use the FSTD certification specifications to determine the FSTD general requirements, associated SoCs, objective and functional and subjective testing for the relevant FSTD type and level of qualification. Proceed to *Step 5.*

(10) *Step 5 — Construct the qualification test guide (QTG).*

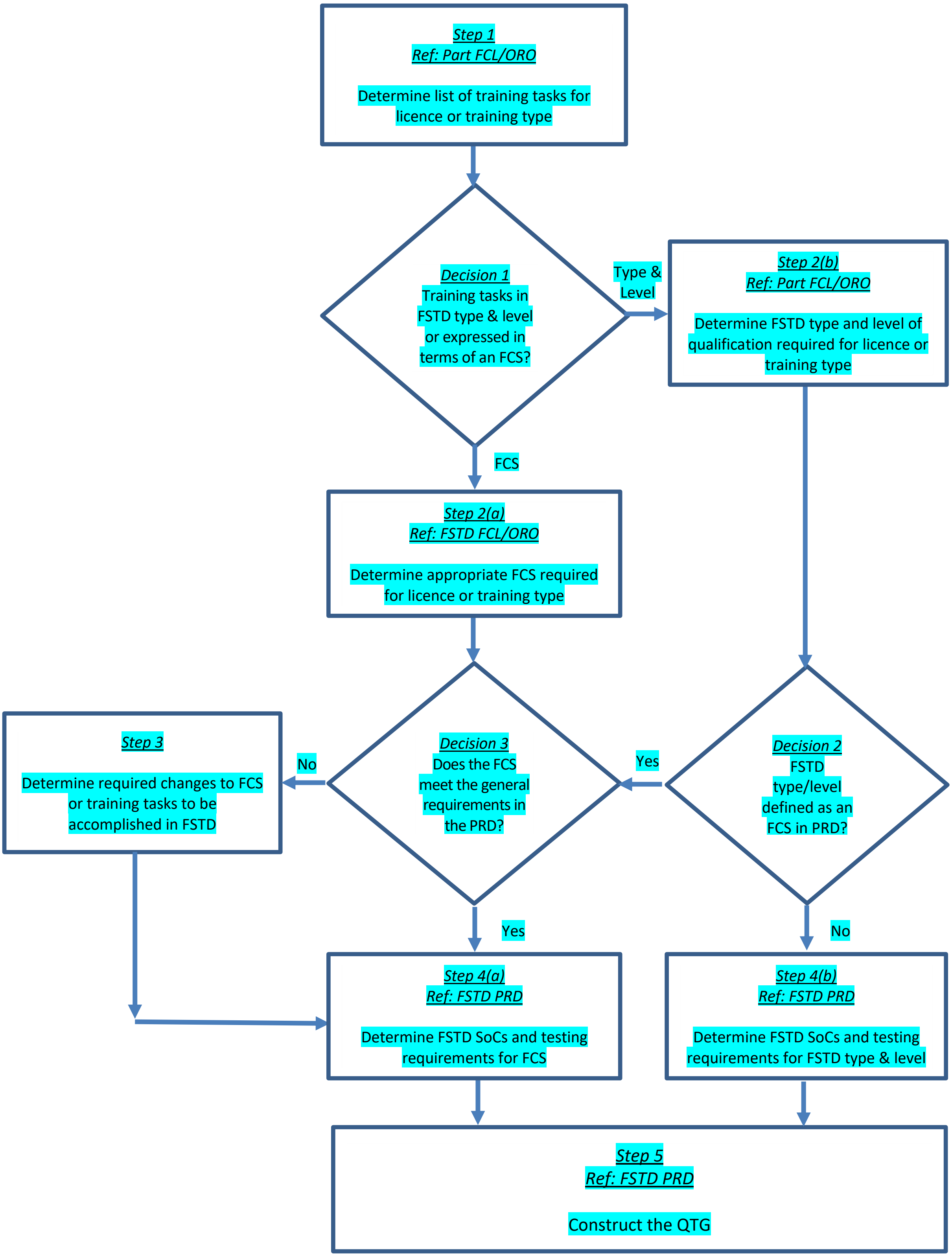
Step 1
Ref: Part FCL/ORO
Determine list of training tasks for licence or training type
Decision 1
Training tasks in FSTD type & level or expressed in terms of an FCS?
Type & Level
Step 2(b)
Ref: Part FCL/ORO
Determine FSTD type and level of qualification required for licence or training type
FCS
Step 2(a)
Ref: FSTD FCL/ORO
Determine appropriate FCS required for licence or training type
Step 3
Determine required changes to FCS or training tasks to be accomplished in FSTD
No
Decision 3
Does the FCS meet the general requirements in the PRD?
Yes
Decision 2
FSTD type/level defined as an FCS in PRD?
Yes
No
Step 4(a)
Ref: FSTD PRD
Determine FSTD SoCs and testing requirements for FCS
Step 4(b)
Ref: FSTD PRD
Determine FSTD SoCs and testing requirements for FSTD type & level
Step 5
Ref: FSTD PRD
Construct the QTG

Figure 1

Rationale:

New GM to explain the FCS approach and how to determine general and objective testing requirements for QTGs depending upon the training tasks desired to be achieved. Thus, this links in with the relevant changes made in Appendix 9 to Part-FCL that specify an FCS for specific training types, such as type rating training.

GM1 ORA.FSTD.210(a)(3) Qualification basis

GUIDANCE ON OLD VISUAL SYSTEMS AND NEW VISUAL SCENES

(a) Background

FCS feature 'Environment – Aerodromes and terrain' at fidelity level 'S' specifications for visual systems call for three fully simulated airport scenes (so-called 'real' scenes). Due to the advances in computer and display techniques, modern visual systems can simulate complex real airports in full detail. All available runways and lighting systems can be simulated including environmental lights in the airport vicinity. Older visual systems are beginning to experience limitations, as they cannot simulate the number of polygons and lightpoints necessary to fully simulate the current large airports expanding to sometimes five or more runways, complex taxi routings, etc. Since these large airports do have real training value to airlines, airlines request that these large airports be modelled, so that the models can be used for flight training.

At the time of initial qualification certificates issued in the 1980s and 1990s these systems were compliant with the specifications of that time. The 'real' scenes of those days were less complexly modelled due to system capabilities. These older, grandfathered, visual systems are not able to simulate the modern large airport scenes of today.

Users, however, still want to use those simulators to perform their flight training and want to use these complex visual scenes because it happens to be their home base or a major destination and request simulator operators to simulate these scenes. Therefore, these scenes are modelled up to the limitations of the system but are unable to fully comply with the current CS-FSTD specifications for visual scenes to qualify them as 'real'.

(b) Practical solution

(1) The typical limitation of these previously described older systems is the number of runways that can be simulated and the level of detail. Alternatively, smaller airports can be fully simulated but are sometimes less valuable for training purposes. The ATO can then decide to simulate:

(i) all airport content (runways) but in less detail, by (drastically) reducing the number of light points, textures and polygons used. This can result in a lower number of taxiways, no environmental lights, etc.;

(ii) only part of the airport, but in full detail. This could result in simulating fewer runways with their associated taxiways and light points;

(iii) only less complex visual scenes that fulfil the CS-FSTD specifications, but are hardly ever used by the FFS users, because they do not simulate their operational destinations.

(2) Whatever decision is made, either the resulting requested simulated visual scene will not be fully matching reality and so the requirement for three fully simulated airports will not be met according to the modern standards, or these complex scenes will not be modelled at all.

(3) In order to prevent the organisation operating FSTDs from designing and maintaining airports it does not need for the FFS users, but only to satisfy the competent authorities when they (re-)qualify the FFS, it should be allowed to use models which satisfy the requirements in parts of their model and lack them in other areas.

(4) For example, when an airport has five runways, it may be acceptable to simulate only four of them. The organisation operating FSTDs should, when agreed by the competent authority, state this limitation in a rationale, which will form part of the approved MQTG of the FFS. The FFS user should also be aware of this limitation and agree to this in writing and it should also be stated in the ATO certificate or operations manual (OM).

(5) Previously mentioned older visual systems or other visual systems manufactured before 1994 should therefore be allowed to display only part of the CS-FSTD specified visual details for the scenes offered for evaluation by the competent authority. The detail to be provided should be correct within reasonable limits, up to the decision of the competent authority.

(6) For these specific scenes, the specifications to have at least one dedicated taxi route from the gate to a specific runway (single designated route) that can be followed using the appropriate airfield charts, taxi lights and taxi signs (also under-low visibility conditions) remain valid. Also, the prevention of runway incursions (safety) is paramount. Therefore, stop bars should be correctly modelled and switchable on/off. If no switchable feature exists, then they should be modelled ‘on’ where the instructor will grant clearance to cross.

Rationale: The text of this GM has been transferred from AMC6 FSTD(A).300) in CS-FSTD(A) Issue 2.

GM2 ORA.FSTD.210(a)(3) Qualification basis

GUIDANCE ON MEANS OF QUALIFICATION FOR NEW FSTD TECHNOLOGIES

(a) Background

Simulation technology and training research will continue to advance. It is likely that at some stage, before further revisions of the applicable CS-FSTD are published, other technical requirements or solutions to meet the criteria specified for training may be proposed. This guidance material proposes a process that may be undertaken to assist the operator, in conjunction with the competent authority (see ARA.FSTD.100(c)), to be able to achieve qualification of the device and recognise its potential credits in training, testing and checking as appropriate.

(b) Figure 1 illustrates the process for proposing means of qualification for new FSTD technologies assuming that the operator has established that the current FSTD certification specification does not cater for the new FSTD technology in terms of requirements, objective or functional and subjective testing.

(c) Prior to considering the inclusion of alternate requirements or solutions, the related proposal should include, as a minimum, the items listed below to the satisfaction of the competent authority concerned:

(1) a detailed description of the technical proposal including differences and advantages compared with existing means of compliance for the criteria or requirement in question;

(2) demonstration by the applicant that the proposed new requirement or solution achieves a level of training capability at least equivalent to that provided by existing means. This should include evidence that existing training and training-to-proficiency outcomes have been achieved;

(3) revised or additional validation testing criteria to be used in FSTD evaluation and qualification;

(4) revised or additional functional and subjective testing criteria to be used in FSTD evaluation and qualification; and

(5) publication of supporting guidance documentation based on the technical proposal, the demonstration by the applicant, and the revised or additional criteria described above.

(d) The competent authority may accept the proposal on a trial basis for validation. If successful, then the competent authority should publish related guidance material for future use and potential updates to the relevant CS-FSTD regulatory documentation in accordance with established EASA rulemaking processes.

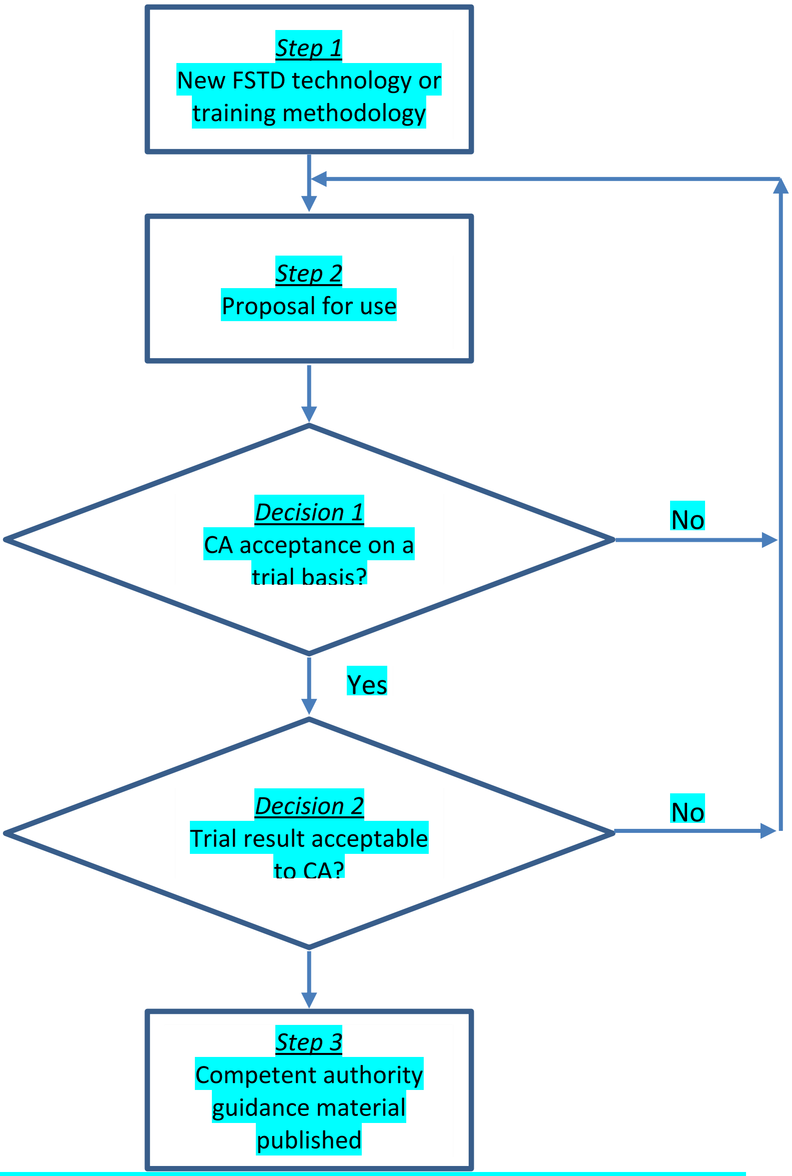

Figure 1: Alternate qualification process for new FSTD technologies

Rationale:

New GM based on ICAO Doc 9625 Part II Appendix D that outlines a process for evaluating new FSTD technologies that are not yet specified in the certification specification. Benefit is that this opens up the possibilities of starting to use increasingly varied types of technologies, such as virtual reality, in training.

AMC1 ORA.FSTD.225(a)(2) Duration and continued validity

ACCESS TO THE ORGANISATION FOR RECURRENT EVALUATION

(a) The same persons present for an initial qualification should be present for a recurrent evaluation (see AMC2 ORA.FSTD.200).

(b) A dossier should be provided to support the recurrent evaluation preparation (see AMC4 ORA.FSTD.100).

Rationale:

The above requirement for the persons available has been transferred from AMC4 ARA.FSTD.100(a)(1) as it is not an authority requirement but an organisation requirement. In addition, the need to produce a dossier to support a recurrent evaluation has been introduced, since this was only indicated in the initial evaluation section for both initial and recurrent evaluations.

AMC1 ORA.FSTD.225(b)~~(4)~~ Duration and continued validity

ASSIGNED PERSON

(a) The assigned person should have experience in FSTDs and training. The person may have FSTD experience or training experience with an education in FSTD evaluation procedures only, provided the other element of expertise is available within the organisation and a procedure for undertaking the annual review and reporting to the competent authority is documented within the compliance monitoring function.

(b) The assigned person should inform the authority of the schedule of the evaluations and QTG checks.

(c) The organisation should maintain the list of persons qualified to perform the task.

Rationale:

Clarifications for the assigned person with regard to FSTDs based on feedback from industry.

AMC1 ORA.FSTD.230(b) Changes to the qualified FSTD

UPDATING AND UPGRADING EXISTING FSTDs

(a) An update is a result of a change to the existing device where it retains its existing qualification level and/or its existing FCS. In any event, the operator should also consider whether the previously declared ESL would also need to be updated. The change may be certified through a recurrent inspection or an extra inspection if deemed necessary by the competent authority according to the applicable requirements in effect at the time of initial qualification.

(b) If such a change to an existing device would imply that the performance of the device could no longer meet the requirements at the time of initial qualification, but that the result of the change would, in the opinion of the competent authority, clearly mean an improvement to the performance and training capabilities of the device altogether, then the competent authority might accept the proposed change as an update while allowing the device to retain its original qualification level and/or FCS.

(c) An upgrade is defined as the raising of the FSTD qualification level or the fidelity level of one or more of the FSTD features in the previously qualified FCS of the ~~a~~ device, or an increase in training credits, which can only be achieved by undergoing an initial qualification according to the latest applicable requirements.

(d) As long as the qualification level or FCS of the device does not change, all changes made to the device should be considered to be updates pending approval by the competent authority.

(e) An upgrade, and consequent initial qualification according to the latest applicable requirements, is only applicable when the organisation requests another qualification level (recategorisation) or amended FCS for the FSTD.

Rationale:

References to FCS changes have been added.

AMC2 ORA.FSTD.230(b) Changes to the qualified FSTD

ASSESSMENT OF FCS FOR FSTDs QUALIFED AGAINST PRIOR CERTIFICATION SPECIFICATIONS

(a) When it is desired by an operator to determine the FCS for an existing FSTD qualified to a previous PRD (e.g. CS-FSTD(A) Initial issue FTD Level 2) that did not specify an FCS, then the operator has two possible options as follows:

(1) Update the device to comply with current certification specifications that describes FCS requirements and request a new initial evaluation from the competent authority.

(2) Maintain the device as currently qualified to its existing certification specifications and request the competent authority to determine the FCS at the next evaluation by means of a documentation review of the FSTD's current MQTG and other related documentation (e.g. technical specifications, ESL and other documents) against the technical requirements in the current certification specifications for features and fidelity levels, without needing to conduct an actual evaluation on the FSTD. See GM1 ARA.FSTD.100(c) Initial evaluation procedure which describes the process in more detail. It is quite probable that the resulting FCS from this document review may well mean restricted credits compared to those currently desired and consequently the organisation operating FSTDs may need to consider update or upgrade of the device and request an initial evaluation against the current FSTD certification standard to achieve qualification of the FCS required to maximise the credits and training available for the device.

Rationale:

This new AMC provides clarification as regards the assessment of the FCS of an FSTD already qualified to a previous non-FCS-related certification standard. This process benefits the organisation operating FSTDs by potentially maximising the training credits capability of the FSTD by determining its FCS.

AMC1 ORA.FSTD.240 Record-keeping

FSTD RECORDS

~~(a)~~FSTD records to be kept should include all of the following:

(~~1~~a) for the lifetime of the device:

(~~i~~1) the master QTG (MQTG) of the initial evaluation;

(~~ii~~2) the qualification certificate of the initial evaluation;

(~~iii~~3) the initial evaluation report;

(4) the initial ESL;

(~~2~~b) for a period of at least 5 years (in paper or electronic format):

(~~i~~1) recurrent QTG runs;

(~~ii~~2) recurrent evaluation reports;

(~~iii~~3) reports of internal function~~s~~ and subjective testing;

(~~iv~~4) technical log;

(~~v~~5) CMS report;

(~~vi~~6) audit schedule;

(~~vii~~7) evaluation programme;

(~~viii~~8) management evaluation reports;

(~~ix~~9) obsolete procedures and forms~~.~~;

(10) ESL revisions.

Rationale

Minor edits to include references to ESL.

3.6. Draft certification specifications (draft EASA decision)

CS –FSTD(A) Issue 3

SUBPART A — GENERAL

CS FSTD(A).GEN.001 Applicability

(a) These certification specifications (CS-FSTD(A)) are intended to be applicable for the initial qualification of aeroplane flight simulation training devices.

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

CS FSTD(A).GEN.005 Terminology

This CS contains the definitions and terminology used in CS-FSTD(A):

'Flight simulation training device (FSTD)' means a training device used to support training, testing and checking in accordance with its FSTD capability signature (FCS) or its level of qualification such as a full flight simulator (FFS), a flight training device (FTD) or a flight and navigation procedures trainer (FNPT).

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

'Flight training device (FTD)' means a full-size replica of a specific aircraft type's instruments, equipment, panels and controls in an open flight deck or cockpit area or an enclosed aircraft flight deck or cockpit, including the assemblage of equipment and computer software programmes necessary to represent the aircraft in ground and flight conditions to the extent of the systems installed in the device. It does not require a force cueing motion and may require a visual system, depending upon its FCS. It is in compliance with the minimum standards for a specific FTD level of qualification.

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

'FSTD capability signature (FCS)' means the levels of fidelity of the applicable FSTD simulation features required to support the training tasks associated with the intended pilot licensing, qualification, rating or training types as defined in the applicable regulations.

'Flight simulation training device user (FSTD user)' means the organisation or person requesting training, checking or testing through the use of an FSTD.

'Flight simulation training device qualification (FSTD qualification)' means the process of evaluating a FSTD to determine its FCS.

'Qualification test guide (QTG)' means a document designed to demonstrate that the performance and handling qualities of an FSTD are within the prescribed limits of the aircraft or class of aeroplane and that all applicable requirements have been met. The QTG includes both the data of the aircraft or class of aeroplane and FSTD data used to support the validation.

'FSTD simulation features' means the domain of simulation which when used together, associated with the fidelity levels, create an FCS. The features can be grouped into four categories and are defined as follows:

(a) ***Aircraft simulation*** comprising the following simulation features:

(1) *Flight deck layout and structure*. Defines the physical structure and layout of the cockpit environment, instrument layout and presentation, controls, and pilot, instructor and observer seating.

(2) *Flight model.* Defines the mathematical models and associated data to be used to describe the aerodynamic and propulsion characteristics.

(3) *Ground reaction and handling characteristics.* Defines the mathematical models and associated data to be used to describe the ground handling characteristics and runway conditions.

(4) Aeroplane systems. Defines the types of aircraft systems simulation. These should allow normal, abnormal and emergency procedures to be accomplished. The Air Transport Association (ATA) chapters are generally used to describe these in more detail (e.g. hydraulic power, fuel, electrical power).

(5) *Flight controls and forces.* Defines the mathematical models and associated data to be used to describe the flight controls and flight control force and dynamic characteristics.

(b) ***Cueing simulation*** comprising the following simulation features:

(1) *Sound cues.* Defines the type of sound cue and associated data. Such sound cues are those related to sounds generated externally to the cockpit environment such as sounds of aerodynamics, propulsion, runway rumble and weather effects, and those internal to the cockpit.

(2) *Visual display cues.* Defines the type of out-of-cockpit window image display (e.g. collimated or non-collimated) and field of view (horizontal and vertical) that is required to be seen by the pilots using the FSTD from their reference eyepoint. Technical requirements such as contrast ratio and light point details are also described. Head-up display (HUD) and enhanced flight visibility system (EFVS) options are also addressed.

(3) *Motion cues.* Defines the type of motion cueing and associated data that may be generated by the aircraft dynamics and from other such effects as airframe buffet, control surface buffet, weather and ground operations.

(c) ***Environment simulation:*** comprising the following simulation features:

(1) *Environment — Air traffic control (ATC)*. Defines the level of complexity of a fully automated simulated ATC environment and how simulated ATC services and other traffic entities interact with the ownship and flight crew during training. Technical requirements include information and controls over the simulated ATC environment available to the instructor.

(2) *Environment — Navigation*. Defines the level of complexity of the simulated navigation aids, systems and networks, such as:

(i) distance measuring equipment (DME),

(ii) ground-based augmentation system (GBAS),

(iii) global positioning system (GPS),

(iv) instrument landing system (ILS),

(v) non-directional beacon (NDB),

(vi) satellite-based augmentation system (SBAS),

(vii) VHF omni-directional range (VOR),

(3) *Environment — Atmosphere and weather*. Defines the level of complexity of the simulated weather conditions, from ambient temperature and pressure to full thunderstorm modelling, etc.

(4) *Environment — Aerodromes and terrain*. Defines the complexity and level of detail of the simulated aerodrome and terrain modelling. This includes such items as generic versus customised aerodromes, visual scenes, terrain elevation and enhanced ground proximity warning system (EGPWS) databases.

(d) ***Miscellaneous***. Defines criteria for technical requirements for the following FSTD miscellaneous features (not-fidelity-level-dependent but applicable to all FSTDs in principle):

(1) instructor operating station;

(2) self-diagnostic testing;

(3) computer capacity;

(4) automatic testing facilities; and

(5) system integration (transport delay).

'FSTD simulation feature fidelity levels' means the level of realism assigned to each of the defined FSTD features. The fidelity levels are as follows:-

(a) *Specific (S).* The highest level of required fidelity for a given FSTD feature.

(b) *Representative (R).* The intermediate level of required fidelity for a given FSTD feature.

(c) *Generic (G).* The lowest level of required fidelity for a given FSTD feature.

(d) *None (N).* Where the fidelity level is (N), the FSTD feature is not installed, functional or available for use in training.

Fidelity levels (other than (N)) for each feature category are described at a high level in Table 1 below.

Level	**Aircraft simulation**	**Cueing simulation**	**Environment simulation**
Generic	Not specific to aeroplane model, type or variant.	<u>For *sound cueing* only:</u> Germane to an aeroplane of its class. Simple modelling of key basic cueing features. <u>For *visual cueing* only:</u> Generic visual environment with perspective sufficient to support basic instrument flying and transition to visual from straight-in instrument approaches.	Simple modelling of key basic environment features.
Representative	Representative of an aeroplane of its class, e.g. four-engine turbo-fan aeroplane. It does not have to be type-specific.	<u>For *sound* and *motion cueing* only:</u> Replicates an aeroplane of its class to the maximum extent possible within current physical limitations. <u>For *visual cueing* only:</u> Representative of the real-world visual environment and perspective.	Representative of the real-world environment.
Specific	Replicates the specific aeroplane.	<u>For *sound* and *motion cueing* only:</u> Replicates the specific aeroplane to the maximum extent possible within current physical limitations. <u>For *visual cueing* only:</u> Replicates the real-world visual environment and (infinity) perspective.	Replicates the real-world environment, as far as required to meet the training objectives, for any specific location.

Table 1: Fidelity levels for each feature category other than None (N)

'Validation data' means data used to prove that the FSTD handling qualities and performance correspond to those of the aeroplane or class of aeroplane as appropriate.

'Validation data roadmap (VDR)' means a document from the aeroplane validation data provider that should clearly identify (in matrix format) the best possible sources of data for all required qualification tests in the QTG. It should also provide validity with respect to engine type and thrust rating and the revision levels of all avionics that affect aeroplane handling qualities and performance. For further information, please refer to CS FSTD(A).QTG.400.

'Validation flight test data' means performance, stability and control, and other necessary test parameters, electrically or electronically recorded in an aeroplane using a calibrated data acquisition system of sufficient resolution and verified as accurate to establish a reference set of relevant parameters to which FSTD parameters can be compared.

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

'Active force feedback', in the context of a flight controls system, means a dynamic system that produces FSTD control forces accurately reflecting those of the aeroplane in all phases of flight in normal, abnormal and emergency operations.

'Aircraft performance data' means performance data published by the aircraft manufacturer in documents such as the aeroplane flight manual (AFM), operations manual, performance engineering manual, or equivalent. The data is generally for a normalised representation of the aeroplane fleet with a margin to ensure that the values represent the least performing case.

'Airspeed' means calibrated airspeed unless otherwise specified (knots).

'Airport' means a defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft. Synonymous with 'aerodrome' in this document.

'Airport clutter' is the set of ground-based entities added to a visual airport scene to create a sense of activity. Airport clutter may include both static and dynamic models such as gate infrastructure, baggage carts, ground personnel, ground service vehicles and aircraft parked or undertaking ground movements.

'Alpha/beta envelope plot' is a two-dimensional plot of FSTD envelopes with the alpha (α) axis representing the angle of attack and the beta (β) axis representing the angle of sideslip. The type of envelope being plotted varies. For example, a plot may be used to depict the 'FSTD validation envelope'.

'Alternate engines/avionics' means an FSTD which has simulation of a replacement engine/avionics fit.

'Alternate FSTD platform' means alternate combination(s) of flight deck and platform (i.e. inserting cockpit module into other platform than the baseline).

'Altitude' means pressure altitude (m or ft) unless specified otherwise.

'Approved subjective development' is the use of a documented process prior to the initial evaluation, acceptable to the competent authority, to resolve issues with validation data by use of specific measurements on the aeroplane or documentation for aeroplane operation or judgement by qualified personnel.

'Audited engineering simulation' means an aircraft manufacturer's engineering simulation that has undergone a review by the appropriate competent authorities and been found to be an acceptable source of supplemental validation data.

'Automatic testing' means FSTD testing wherein all stimuli are under computer control.

'Background radio communications' means radiotelephony messages between air traffic control and other traffic that are heard on the active frequency by the flight crew. The word 'background' refers to the fact that these messages are not intended for the ownship. Background radio communications are also known as 'party line' or 'background chatter'.

'Bank' means bank/roll angle (degrees).

'Baseline' means a fully flight-test-validated production aircraft simulation. It may represent a new aircraft type or a major derivative.

'Baseline FSTD platform' means the primary combination of flight deck and platform.

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

'Class of aeroplane' in relation to the classification of aeroplanes, means aeroplanes having similar operating characteristics.

'Closed loop testing' is a test method for which the input stimuli are generated by controllers which drive the FSTD to follow a predefined target response.

'Computer controlled aircraft' means an aircraft where the pilot inputs to the control surfaces are transferred and augmented via computers.

'Configuration' means that set of components necessary to ensure the device has the capability to provide the necessary training, testing, or checking capability for the level of qualification or FCS being sought.

'Control sweep' means 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.

'Convertible FSTD' means 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 of 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.

'Correct trend and magnitude (CT&M)' means a tolerance representing the appropriate general direction of movement of the aeroplane, or part thereof, with appropriate corresponding scale of forces, rates, accelerations, etc.

'Critical engine parameter' means the engine parameter that is the most appropriate measure of propulsive force.

'Damping (critical)': critical damping means 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.

'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.

'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.

'Daylight visual' means a visual system capable of meeting, as a minimum, system brightness, contrast ratio requirements and performance criteria appropriate for the level of qualification or FCS sought.

'Deadband' means 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.

'Driven' means 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.

'Engineering simulation' means 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. It is also used to generate data for checkout, proof-of-match/validation and other training FSTD data documents.

'Engineering simulator' means the aircraft manufacturer's or data provider'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 for FSTDs, which are also released by the aircraft manufacturer to the industry. The engineering simulator may or may not include actual on-board system hardware in lieu of software models.

'Engineering simulator data' means data generated by an engineering simulation or engineering simulator, depending on the aircraft manufacturer's processes.

'Engineering simulator validation data' means validation data generated by an engineering simulation or engineering simulator.

'Entity', in the context of the simulated environment, means an aeroplane, ground vehicle, or other dynamic object.

'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.

'Equipment and specifications list' (ESL) means the document as described in ORA.FSTD listing the equipment and specifications of the FSTD that is declared by the organisation operating FSTDs at the time of the initial evaluation.

'Essential match' means 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.

'Footprint test' means a test conducted and recorded on the same FSTD, during its initial evaluation, to be used as the reference data standard for recurrent evaluations of this FSTD or initial qualification of subsequent FSTDs. In the event of an approved change to the FSTD to the flight model, or flight control system that may alter its characteristic, the competent authority may require that the footprint test result be re-generated under the new conditions to form a new reference data standard.

'FSTD capability signature (FCS)' means the set of FSTD features and their associated fidelity levels that together describe the technical capability of the FSTD and that may be used to determine the FSTD suitability for the defined training, testing and checking tasks.

'FSTD data' means the various types of data used by the FSTD manufacturer and the applicant to design, manufacture, test and maintain the FSTD.

'FSTD evaluation' means a detailed appraisal of an FSTD by the competent authority to ascertain whether or not the standard required for a specified qualification level or FCS is met.

'FSTD training envelope' means high and moderate confidence regions of the FSTD validation envelope.

'Flight deck' means the shell of the cockpit and all associated panels, seats, controls, etc. 'Aft of the flight deck' refers to the area behind the pilots' seats or rear bulkhead that normally contains instructor and observer seating and other non-aircraft-related features.

'Flight test data' means actual aircraft data obtained by the aircraft manufacturer (or other supplier of acceptable data) during an aircraft flight test programme.

'Free response' means the hands-off response of the aircraft after completion of a control input or disturbance.

'Frozen/locked' is a state where a variable is held constant with time.

'Fuel used' means the mass of fuel used (kilos or pounds).

'Full stall' means the same as 'post-stall' as referred to in Commission Implementing Regulation (EU) 2018/1974.

'Full sweep' means the 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.

'Functional performance' means an operation or performance that can be verified by objective data or other suitable reference material that may not necessarily be flight test data.

'Functions test' means a quantitative 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.

'Grandfather rights' means the right of an organisation operating FSTDs to retain the qualification level granted under a previous regulation of an EASA Member State. It also means the right of an FSTD user to retain the training and testing/checking credits that were gained under a previous regulation of an EASA Member State.

'Ground effect' means the change in aerodynamic characteristics due to modification of the air flow past the aircraft caused by the presence of the ground.

'Ground reaction' means forces acting on the aeroplane due to contact with the ground. These forces include the effects of strut deflections, tyre friction, side forces, structural contact and other appropriate aspects. These forces change appropriately, for example, with weight and speed.

'Hands-off manoeuvre' means a test manoeuvre conducted or completed without pilot control inputs.

'Hands-on manoeuvre' means a test manoeuvre conducted or completed with pilot control inputs as required.

'Heavy' means with operational mass at or near maximum for the specified flight condition.

'Height' means the height above ground/AGL (m or ft).

'High angle of attack' means flying at an angle of attack higher than in normal operation beyond the first indication of stall or stall protection systems, whichever occurs first.

'Highlight brightness' means the maximum displayed brightness that satisfies the appropriate brightness test.

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

'Integrated testing' means 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.

'Irreversible control system' means a control system in which movement of the control surface will not backdrive the pilot's control on the flight deck.

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

'Light' means with operational mass at or near minimum for the specified flight condition.

'Line-oriented flight training (LOFT)' refers to flight crew training which involves full-mission simulation of situations which are representative of line operations, with special emphasis on situations which involve communications, management and leadership. It means 'real-time', full-mission training.

'Manual testing' means FSTD testing where the pilot conducts the test without computer inputs except for initial set-up. All modules of the simulation should be active.

'Master qualification test guide (MQTG)' means the competent-authority-approved QTG which incorporates the results of tests witnessed by the competent authority. The MQTG serves as the reference for future evaluations.

'Medium' means the normal operational weight for flight segment.

'Near performance-limited condition' (when related to approach to stall or stall) means a stall event occurring close to the lowest limit of the following:

— maximum certified altitude (structural);

— thrust-limited altitude; and

— buffet- or manoeuvre-limited altitude.

Stall data above flight level (FL) 250 should generally be acceptable.

'Night visual' means 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 ownship lights (e.g. landing lights).

'Nominal' means the normal operational weight, configuration, speed, etc. for the flight segment specified.

'Non-normal control' is 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.

'Normal control' is 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.

'Objective test (objective testing)' means a quantitative assessment based on comparison with data.

'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 that support the primary change (e.g. weight, thrust rating and control system gain changes accompanying a body length change) are considered part of the 'one step'.

'Organisation operating FSTDs' means that organisation directly responsible to the competent authority for requesting and maintaining the qualification of a particular FSTD.

'Other traffic' means entities other than the ownship in the simulated environment. This traffic will include other aircraft, both airborne and on the ground, and may also include ground vehicles as part of an airport scene.

'Ownship' means the visual aeroplane model or entity associated with the FSTD.

'Platform' means, for example:

— motion system; or

— visual system; or

— computers; or

— necessary additional equipment; or

— any combination of the above that can be used in more than one configuration

'Power lever angle' means 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.

'Predicted data' means data derived from sources other than type-specific aircraft flight tests.

'Primary reference document' means any regulatory document which has been used by a competent authority to support the initial evaluation of an FSTD.

'Proof-of-match (POM)' means a document that shows agreement within defined tolerances between model responses and flight test cases at identical test and atmospheric conditions.

'Protection functions' means systems functions designed to protect an aircraft from exceeding its flight and manoeuvre limitations.

'Pulse input' means an abrupt input to a control followed by an immediate return to the initial position.

'Reference data report' means a document from the FSTD manufacturer or validation data provider to substantiate the set of proposed validation data for aircraft simulation feature fidelity levels G and R.

'Reference data standard' means the set of agreed tests and data for use during recurrent evaluations.

'Reversible control system' means a partially powered or unpowered control system in which movement of the control surface will backdrive the pilot's control on the flight deck or affect its feel characteristics.

'Robotic test' means 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.

'Snapshot' means a presentation of one or more variables at a given instant of time.

'Simulated ATC environment' means the simulation of other traffic entities within an airspace or ground environment, along with the associated ATC radio and data communications to other traffic and the ownship within this wider context.

'Statement of compliance (SoC)' means a declaration that specific requirements have been met.

'Step input' means an abrupt input held at a constant value.

'Subjective test (subjective testing)' means a qualitative assessment based on established standards as interpreted by a suitably qualified person.

'Swap' means changing another flight deck into the platform.

'Throttle lever angle (TLA)' means the angle of the pilot's primary engine control lever(s) on the flight deck.

'Time history' means a presentation of the change of a variable with respect to time.

'Transport delay' means 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.

'Twilight (dusk/dawn) visual' means 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).

'Update' means the improvement or enhancement of an FSTD.

'Upgrade' means the improvement or enhancement of an FSTD for the purpose of achieving a higher qualification.

'Validation data' means data used to prove that the FSTD performance corresponds to that of the aircraft or class of aeroplane.

'Validation flight test data' means performance, stability and control, and other necessary test parameters, which are 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 with which like FSTD parameters can be compared.

'Validation test' means a test by which FSTD parameters can be compared with the relevant validation data.

'Visual ground segment test' means a test designed to assess items impacting the accuracy of the visual scene presented to the pilot at a decision height (DH) on an instrument landing system (ILS) approach.

'Visual system response time' means 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.

'Well-understood effect' means an incremental change to a configuration or system that can be accurately modelled using proven predictive methods based on known characteristics of the change.

CS FSTD(A).GEN.010 Abbreviations

This CS contains the abbreviations used in CS-FSTD(A):

A	=	aeroplane
AC	=	Advisory Circular
ACJ	=	Advisory Circular Joint
A/C	=	aircraft

Ad	=	total initial displacement of pilot controller (initial displacement to final resting amplitude)
ADF	=	automatic direction finder
ADS-B	=	automatic dependent surveillance — broadcast
ADS-C	=	automatic dependent surveillance — contract
ADS-R	=	automatic dependant surveillance — rebroadcast
AFM	=	aeroplane flight manual
AFCS	=	automatic flight control system
AGL	=	above ground level (m or ft)
A_n	=	sequential amplitude of overshoot after initial x-axis crossing, e.g. A1 = 1st overshoot.
AEO	=	all engines operating
AIRAC	=	aeronautical information regulation and control
AOA	=	angle of attack (degrees)
AOC	=	aeronautical operational communications
APCH	=	approach
APU	=	auxiliary power unit
APV	=	approach procedures with vertical guidance
ATC	=	air traffic control
ATIS	=	automatic terminal information service
ATO	=	approved training organisation
Baro	=	barometric
BC	=	ILS localiser back course
CAT I/II/III	=	landing category operations
CCA	=	computer-controlled aeroplane
cd/m2	=	candela/metre2, 3.4263 candela/m2 = 1 ft-Lambert
CDFA	=	continuous descent final approach
CFIT	=	controlled flight into terrain
CoG	=	centre of gravity
CPDLC	=	controller pilot data link communications
cm(s)	=	centimetre, centimetres
CS	=	certification specifications
CT&M	=	correct trend and magnitude

D-ATIS	=	data link ATIS
daN	=	decaNewtons
dB	=	decibel
deg(s)	=	degree (°), degrees
DGPS	=	differential global positioning system
DH	=	decision height
DLIC	=	data link initiation capability
DME	=	distance measuring equipment
DOF	=	degrees of freedom
DPBL	=	defined point before landing
DSP	=	data service provider
EFB	=	electronic flight bag
EFVS	=	enhanced flight vision system
EGPWS	=	enhanced ground proximity warning system
EPR	=	engine pressure ratio
EVS	=	enhanced vision system
EW	=	empty weight
FAA	=	Federal Aviation Administration (of the United States of America)
FCS	=	FSTD capability signature
FD	=	flight director
FMS	=	flight management system
FOV	=	field of view
FPM	=	feet per minute
ft	=	feet, 1 foot = 0.304801 metres
ft-Lambert	=	foot-Lambert, 1 ft-Lambert = 3.4263 candela/m2
g	=	acceleration due to gravity (m or ft/s2), 1g = 9.81 m/s2 or 32.2 ft/s2
G	=	generic (as related to fidelity level)
G/S	=	glideslope
GBAS	=	ground-based augmentation system
GNSS	=	global navigation satellite system
GPS	=	global positioning system
GPWS	=	ground proximity warning system

H	=	helicopter
HGS	=	head-up guidance system
HUD	=	head-up display
HUGS	=	head-up guidance system
Hz	=	unit of frequency, 1 Hz = one cycle per second
IAS	=	indicated airspeed
IATA	=	International Air Transport Association
ICAO	=	International Civil Aviation Organization
ILS	=	instrument landing system
IMC	=	instrument meteorological conditions
in	=	inches, 1 in = 2.54 cm
IOS	=	instructor operating station
JAA	=	Joint Aviation Authorities
JAWS	=	Joint Airport Weather Studies
JOEB	=	Joint Operations Evaluation Board (JAA)
km	=	kilometres, 1 km = 0.62137 statute miles
kPa	=	kiloPascal (kilo Newton/metres2). 1 psi = 6.89476 kPa
kt	=	knots, calibrated airspeed unless otherwise specified, 1 knot = 0.5148 m/s or 1.689 ft/s
lb	=	pounds
lbf	=	pound-force, 1 lbf = 4.448 2 newton
LDP	=	landing decision point
LED	=	light emitting diode
LNAV	=	lateral navigation
LOC	=	localiser
LOC-BC	=	localiser back course
LOFT	=	line-oriented flight training
LOS	=	line-oriented simulation
LP	=	localiser performance
LPV	=	localiser performance with vertical guidance
m	=	metres, 1 metre = 3.28083 ft
MCC	=	multi-crew cooperation
MCTM	=	maximum certified take-off mass (kilos/pounds)

MDA	=	motion drive algorithm
MEH	=	multi-engine helicopter
min	=	minutes
MLG	=	main landing gear
MLS	=	microwave landing system
mm	=	millimetres
MMO	=	maximum operating limit speed (Mach)
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	=	None (as related to fidelity level) or Normal control state referring to computer-controlled aircraft (depending on context)
N/A	=	not applicable
N1	=	engine low pressure rotor revolutions per minute expressed in per cent of maximum
N1/Ng	=	gas generator speed
N2	=	engine high pressure rotor revolutions per minute expressed in per cent of maximum
N2/Nf	=	free turbine speed
NDB	=	non-directional beacon
NM	=	nautical mile, 1 nautical mile = 6 080 ft = 1 852 m
NN	=	non-normal control, a state referring to computer-controlled aircraft
NR	=	main rotor speed
Nx	=	load factor in the aeroplane x-axis direction
Ny	=	load factor in the aeroplane y-axis direction
Nz	=	load factor in the aeroplane z-axis direction
NWA	=	nosewheel angle (degrees)
OEB	=	Operations Evaluation Board
OEI	=	one engine inoperative
OEM	=	original equipment manufacturer
OGE	=	out-of-ground effect

OMCT	=	objective motion cueing test
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
PBN	=	performance-based navigation
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
QC	=	qualification certificate
QFE	=	altimeter setting related to a specific feature reference datum point (e.g. airport)
QNH	=	altimeter setting related to sea level
QTG	=	qualification test guide
R	=	representative (as related to fidelity level)
R/C	=	rate of climb (m/s or ft/min)
R/D	=	rate of descent (m/s or ft/min)
Rad	=	radian
RAE	=	Royal Aerospace Establishment
RAeS	=	Royal Aeronautical Society
RAT	=	ram air turbine
REIL	=	runway end identifier lights
RMS	=	root mean square
RNAV	=	radio navigation

RNP	=	required navigation performance
RPM	=	revolutions per minute
RTO	=	rejected take-off
RVR	=	runway visual range (m or ft)
s	=	second(s)
S	=	specific (as related to fidelity level)
SBAS	=	satellite-based augmentation system
sec(s)	=	second, seconds
sm	=	statute mile, 1 statute mile = 5 280 ft = 1 609 m
SME	=	subject matter expert
SoC	=	statement of compliance
SPL	=	sound pressure level
T(A)	=	tolerance applied to amplitude
T(Ad)	=	tolerance applied to residual amplitude
T(p)	=	tolerance applied to period
T/O	=	take-off
TACAN	=	tactical air navigation
TAWS	=	terrain awareness warning system
TCAS	=	traffic alert and collision avoidance system
Tf	=	total time of the flare manoeuvre duration
Ti	=	total time from initial throttle movement until a 10 % response of a critical engine parameter
TIS-B	=	traffic information service — broadcast
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
UPRT	=	upset prevention and recovery training
VASI	=	visual approach slope indicator system
VDR	=	validation data roadmap
VFR	=	visual flight rules
VHF	=	very-high frequency

VGS	=	visual ground segment
Vmca	=	minimum control speed (air)
Vmcg	=	minimum control speed (ground)
Vmcl	=	minimum control speed (landing)
Vmu	=	minimum unstick speed
VMO	=	maximum operating limit speed (airspeed)
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 (also referenced as V2)
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 (CS-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 (CS-25)
3rd segment	=	that portion of the take-off profile after flap/slat retraction is complete (CS-25)

SUBPART B — QUALIFICATION BASIS

CS FSTD(A).QB.100 Qualification standards

(a) Any FSTD submitted for initial evaluation should be evaluated against applicable CS-FSTD(A) criteria for the qualification level and declared FCS.

(b) The FSTD should be subjected to:

(1) validation tests; and

(2) function and subjective tests.

(c) The QTG and the equipment and specifications list (ESL) including all data, supporting material and information should be submitted in a format to allow efficient review and evaluation before the FSTD can be assigned a qualification level or FCS. Where applicable, the QTG should be based on the aircraft validation data as defined by the operational suitability data (OSD) established in accordance with Annex I (Part 21) to Commission Regulation (EU) No 748/2012.

CS FSTD(A).QB.101 FSTD levels and FCS

The FCS for each FSTD type and level against the FSTD features has to be defined. The general technical requirements for these FSTD types and levels with the defined FCS are summarised in CS FSTD(A).QB.115 General technical requirements for FSTD qualification levels.

Table 1 below describes the minimum full flight simulator (FFS), flight training device (FTD), flight and navigation procedures trainer (FNPT) capability signature (FCS) requirements for qualifying devices to the proposed qualification levels.

			FSTD features											
			Aircraft					**Cueing**			**Environment**			
FSTD type	**FSTD level**	**ICAO equivalent type**	**Flight deck layout and structure**	**Flight model (aero and engine)**	**Ground handling**	**Aeroplane systems**	**Flight controls and forces**	**Sound cues**	**Visual cues**	**Motion cues**	**Environment — ATC (*)**	**Environment — Navigation**	**Environment — Atmosphere and weather**	**Environment — Aerodromes and terrain**
FFS	**D**	*VII*	*S*	*S*	*S*	*S*	*S*	*S*	*S*	*S*	*S*	*S*	*R*	*R*
FTD	**B**	*V*	*S*	*S*	*S*	*S*	*S*	*R*	*R*	*N*	*G*	*S*	*R*	*R*
	A	*N/A*	*G*	*R*	*G*	*S*	*G*	*G*	*N*	*N*	*N*	*S*	*G*	*N*
FNPT	**E**	*VI*	*R*	*R*	*R*	*R*	*R*	*R*	*S*	*R*	*S*	*S*	*R*	*R*
	D	*IV*	*R*	*G*	*G*	*R*	*G*	*G*	*G*	*N*	*G*	*S*	*G*	*R*
	C	*III*	*R*	*R*	*R*	*R*	*R*	*G*	*R*	*N*	*N*	*S*	*G*	*G*
	B	*II*	*G*	*G*	*G*	*R*	*G*	*G*	*G*	*N*	*G*	*S*	*G*	*G*
	A	*I*	*R*	*R*	*R*	*R*	*R*	*G*	*R*	*N*	*N*	*S*	*G*	*R*
			FSTD feature fidelity levels											

Table 1: FSTD capability signature (FCS) summary matrix

(*) The 'Environment — ATC' feature is optional unless otherwise specified in Part-FCL (Annex I) of Commission Regulation (EU) No 1178/2011 for any given training task or type. Therefore, the fidelity level (N,G,R or S) of the 'Environment — ATC' feature does not affect the FSTD qualification level granted when evaluated. However, for FSTDs that have this feature, the fidelity levels indicated in the table above are those recommended for each qualification level shown.

CS FSTD(A).QB.110 FSTD general requirements for feature fidelity levels

This CS provides a description of the general requirements for each FSTD feature and applicable feature fidelity levels as shown in Table 1 below.

This table is divided in sections; each section corresponds to an FSTD feature.

In order to identify all the FSTD general requirements applicable to the considered FSTD, the organisation operating FSTDs should select in Table 1 below, for all FSTD features, all the requirements corresponding to the fidelity level of the considered FSTD feature.

Each feature has a high-level requirement expressed for each applicable fidelity level. For example, *1 – 'Flight deck layout and structure'* has high-level requirements expressed for 1.S, 1.R and 1.G.

The feature is further broken down into sub-feature requirements which also have requirements expressed for the applicable fidelity levels. For example, 1.1 '*Flight deck structure*' is a sub-feature of '*Flight deck layout and structure*' and has the requirement fidelity levels expressed for 1.1.S, 1.1.R and 1.1.G.

It is important when assessing compliance with the high-level requirement at a given fidelity level (for example, 1.S) that the relevant sub-feature requirements for that fidelity level are also fully complied with (for example, 1.1.S.a, 1.1.S.b, 1.1.S.c) unless otherwise noted where options may apply.

Certain requirements included in this CS should be supported with a statement of compliance (SoC) and, in some designated cases, an objective test. The SoC should provide a high-level description on how the requirement was met. In the following tabular listing of FSTD criteria, requirements for SoCs are indicated in the comments column.

The validation tests listed in CS FSTD(A).QTG.105 and the function and subjective tests listed in CS FSTD(A).FST.105 should also be consulted when determining the requirements for qualification.

Table 1: Flight simulation training device (FSTD) general requirements for feature fidelity levels

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
1.	**FLIGHT DECK LAYOUT AND STRUCTURE**				
1.S	An enclosed full-scale replica of the aeroplane flight deck, which will have fully functional controls, instruments and switches to support the intended use. Anything not required to be accessed by the flight crew during normal, abnormal, emergency and, where applicable, non-normal operations, does not need to be functional.			✓	
1.R	An enclosed or perceived to be enclosed flight deck, excluding distraction, which will represent that of the aeroplane derived from, and appropriate to class, to support the intended use.		✓		
1.G	An open, enclosed or perceived to be enclosed, flight deck, excluding distraction, which will represent that of the aeroplane derived from, and appropriate to class, to support the intended use.	✓			
1.1	FLIGHT DECK STRUCTURE				
1.1.S.a	An enclosed, full-scale replica of the flight deck of the aeroplane being simulated.			✓	Applies to devices with motion cueing feature fidelity level specific (S).
1.1.S.b	An enclosed, full-scale replica of the flight deck of the aeroplane being simulated except the enclosure need only extend to the aft end of the flight deck area.			✓	
1.1.S.c	An enclosed, full-scale replica of the flight deck of the aeroplane being simulated including all: structure and panels; primary and secondary flight controls; engine and propeller controls, as applicable; equipment and systems with associated controls and observable indicators; circuit breakers; flight instruments; navigation, communications and similar-use equipment; caution and warning systems and emergency equipment. The tactile feel, technique, effort, travel and direction required to manipulate the preceding, as applicable, should replicate those in the aeroplane.			✓	Fitted systems or functions not required as part of the training programme are not required to be supported in the simulation software, but any visible hardware and associated controls and switches should be fitted. Such systems, when part of any normal, abnormal or emergency flight deck procedure(s), should function to the extent required to replicate the aeroplane during that procedure(s). Such systems or functions that are not supported in the simulation software should be identified on the FSTD information page. Bulkheads containing only items such as landing gear pin storage

FEATURE GENERAL REQUIREMENTS		**FEATURE FIDELITY LEVEL**			**COMMENTS**
		G	**R**	**S**	
	As applicable, equipment for operation of the flight deck windows should be included but the actual windows need not to be operable. Additional required flight crew member duty stations and those bulkheads aft of the pilots' seats 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 flight deck preparation is complete, are also considered part of the flight deck and should replicate the aeroplane. Note. The flight deck, for flight simulation purposes, consists of all space forward of a cross section of the fuselage at the most extreme aft setting of the flight crew members' seats or if applicable, to that cross section immediately aft of additional flight crew member seats or required bulkheads.				compartments, fire axes or extinguishers, spare light bulb, aeroplane document pouches, etc. may be omitted. Any items required by the training programme, including those required to complete the pre-flight checklist, should be available but may be relocated to a suitable location as near as possible to the original position. An accurate facsimile of emergency equipment items, such as a three-dimensional model or a photograph, is acceptable provided the facsimile is modelled or is operational to the extent required by the training programme. Fire axes and any similar-purpose instruments should be only represented by a photograph or silhouette. Exceptions to this policy may be accepted on a case-by-case basis following coordination with the respective competent authority. Coordination should be concluded during the FSTD design phase. Aeroplane observer seats are not considered to be additional flight crew member duty stations and may be omitted. The use of electronically displayed images with physical overlay or masking for FSTD instruments or instrument panels is acceptable provided that: — all instruments and instrument panel layouts are dimensionally correct with differences, if any, being imperceptible to the pilot; — instruments replicate those of the aeroplane including full instrument functionality and embedded logic; — the instruments displayed are free of quantisation (stepping); — the instrument display characteristics replicate those of the aeroplane including: resolution, colours, luminance, brightness, fonts, fill patterns, line styles and symbology; — overlay or masking, including bezels and bugs, as applicable, replicates the aeroplane panel(s); — instrument controls and switches replicate and operate with the same technique, effort, travel and in the same direction as those in the aeroplane;

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
					— the instrument lighting replicates that of the aeroplane and is operated from the FSTD control for that lighting and, if applicable, is at a level commensurate with other lighting operated by that same control; — as applicable, instruments should have faceplates that replicate those in the aeroplane; and — the display image of any three-dimensional instrument, such as an electro-mechanical instrument, should appear to have the same three-dimensional depth as the replicated instrument. The appearance of the simulated instrument, when viewed from any angle, should replicate that of the actual aeroplane instrument. Any instrument reading inaccuracy due to viewing angle and parallax present in the actual aeroplane instrument should be duplicated in the simulated instrument display image.
1.1.R	An enclosed, or perceived to be enclosed, spatially representative flight deck of the aeroplane or class of aeroplanes being simulated including representative: primary and secondary flight controls; engine and propeller controls as applicable; systems and controls; circuit breakers; flight instruments; navigation and communications equipment; and caution and warning systems. The technique, effort, travel and direction required to manipulate the preceding, as applicable, should be representative of those in the aeroplane or class of aeroplane. Note 1. The flight deck enclosure need only be representative of that in the aeroplane or those in the class of aeroplane being simulated and should include windows. Note 2. The enclosure need only extend to the aft end of the flight deck.		✓		FSTD instruments or instrument panels using electronically displayed images with physical overlay or masking and operable controls representative of those in the aeroplane are acceptable. The instruments displayed should be free of quantisation (stepping). A representative circuit breaker panel(s) should be presented (photographic reproductions are acceptable) and located in a spatially representative location(s). Only those circuit breakers used in a normal, abnormal or emergency procedure need to be simulated, in a class representative form, and be functionally accurate. With the requirement for only a spatially representative cockpit/flight deck, the physical dimensions of the enclosure may be acceptable to simulate more than one aeroplane or class of aeroplane in a convertible FSTD. Each FSTD conversion should be representative of the aeroplane or class of aeroplane being simulated which may require some controls, instruments, panels, masking, etc. to be changed for some conversions. For Multi-Crew Cooperation (MCC) training usage, additional instrumentation and indicators may be required. See 4.4.R
1.1.G	An open, enclosed or perceived to be enclosed flight deck area with aeroplane-like primary and secondary flight controls; engine and propeller controls as applicable; equipment; systems; instruments;	✓			The assembled components should be compatible and function in a cohesive manner. FSTD instruments or instrument panels using electronically displayed

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	and associated controls, assembled in a spatial manner to resemble that of the aeroplane or class of aeroplane being simulated. The flight instrument panel(s) position and crew member seats should provide the crew member(s) with a representative posture at the controls and design eye position.				images with or without physical overlay or masking are acceptable. Operable controls should be incorporated if pilot input is required during training events. The instruments displayed should be free of quantisation (stepping). Only those circuit breakers used in a normal, abnormal or emergency procedure need to be presented, simulated in an aeroplane-like form, and be functionally accurate. Note. Aeroplane-like controls, instruments and equipment means as for the aeroplane or class of aeroplane being simulated. If the FSTD is convertible, some controls, instruments and equipment may have to be changed for some conversions.
1.2	SEATING				
1.2.1.S 1.2.1.R	Flight crew member seats should replicate those in the aeroplane being simulated.		✓	✓	
1.2.1.G	Crew member seats should provide the crew member(s) with a representative design eye position and have sufficient adjustment to allow the occupant to achieve proper posture at the controls as appropriate for the aeroplane or class of aeroplane.	✓			
1.2.2.S.a	In addition to the flight crew member seats, there should be one instructor station seat and two suitable observer seats for an observer and an authority inspector. The location of at least one of these observer seats should provide an adequate view of the pilots' panels and forward windows.			✓	Applies to full motion-based devices. The authority may consider options to this requirement based on unique cockpit/flight deck configurations. The seats need not represent those found in the aeroplane but should be adequately secured and fitted with positive restraint devices of sufficient integrity to safely restrain the occupant during any known or predicted motion system excursion. Both observer seats should have adequate lighting to permit note taking and a system to permit selective monitoring of all flight crew member and instructor communications. Both seats should be of adequate comfort for the occupant to remain seated for a 2-hour training session.
1.2.2.S.b	In addition to the flight crew member seats, there should be one			✓	Applies to non-full motion-based devices

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	instructor station seat and two suitable observer seats for an observer and an authority inspector.				At least one observer seat should have a system to permit selective monitoring of all flight crew member and instructor communications.
1.2.2.R 1.2.2.G	In addition to the flight crew member seats, there should be an instructor station seat and two suitable seats for an observer and an authority inspector.	✓	✓		
1.3	COCKPIT/FLIGHT DECK LIGHTING				
1.3.S	Cockpit/flight deck lighting should replicate that in the aeroplane.			✓	
1.3.R 1.3.G	Lighting environment for panels and instruments should be sufficient for the operation being conducted.	✓	✓		
2.	**FLIGHT MODEL**				
2.S	Aerodynamic and engine modelling for all combinations of drag and thrust, including the effects of change in aeroplane attitude, sideslip, altitude, temperature, gross mass, CoG location and configuration to support the intended use. Should address ground effect, Mach effect, aeroelastic representations, non-linearities due to sideslip, effects of airframe icing, forward and reverse dynamic thrust effect on control surfaces. Realistic aeroplane mass properties, including mass, CoG and moments of inertia as a function of payload and fuel loading should be implemented.			✓	
2.R	Aerodynamic, engine and ground effect modelling, aeroplane-like, derived from and appropriate to class to support the intended use. 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.		✓		
2.G	Aerodynamic and engine modelling, aeroplane-like, not specific to class, model, type or variant to support the intended use. 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	✓			

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	attitude, sideslip, thrust, drag, altitude, temperature.				
2.1	FLIGHT DYNAMICS MODEL				
2.1.S.a	Flight dynamics model that accounts for various combinations of drag and thrust normally encountered in flight supported by type-specific flight test data, including the effect of change in aeroplane attitude, sideslip, thrust, drag, altitude, temperature, gross mass, moments of inertia, CoG location and configuration to support the intended use.			✓	
2.1.S.b	Aerodynamic modelling, that includes Mach effect, normal and reverse dynamic thrust effect on control surfaces, aeroelastic effect and representations of non-linearities due to sideslip based on aeroplane flight test data provided by the data provider.			✓	Statement of compliance (SoC) required. Mach effect, aeroelastic representations and non-linearities due to sideslip are normally included in the flight simulator aerodynamic model. The SoC should address each of these items. Separate tests for thrust effects and an SoC are required. Please refer to CS FSTD(A).UPRT.001(a)(2).
2.1.S.c	Aerodynamic modelling to include ground effect derived from type-specific flight test data; for example, round-out, flare and touchdown. This requires data on lift, drag, pitching moment, trim and power in ground effect.			✓	SoC required. See CS FSTD(A).QTG.220. and test 2.f for further information on ground effect.
2.1.S.d	Aerodynamic modelling for the effects of reverse thrust on directional control.			✓	Tests required. See CS FSTD(A).QTG.105 tests 2.e.8 and 2.e.9 (directional control).
2.1.S.e	Modelling that includes the effects of icing, where appropriate, on the airframe, aerodynamics and the engine(s). Icing-effects simulation models are only required for aeroplanes authorised for operations in icing conditions.			✓	Icing models simulate the aerodynamic degradation effects of ice accretion on the aeroplane lifting surfaces, including (if present on the simulated aeroplane) loss of lift, decrease in stall angle of attack, change in pitching moment, decrease in control effectiveness, and changes in control forces in addition to any overall increase in drag. Aeroplane systems (such as the stall protection system and auto flight system) must respond properly to ice accretion, consistent with the simulated aeroplane. Aeroplane original equipment manufacturer (OEM) data or other acceptable analytical methods must be used to develop ice accretion models. Acceptable methods may include wind tunnel analysis or engineering analysis of the aerodynamic effects of icing on the aeroplane

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
					lifting surfaces coupled with tuning and supplemental subjective assessment by a subject-matter expert (SME) pilot knowledgeable of the effect of ice accretion on the handling qualities of the simulated aeroplane. An SoC is required describing the effects that provide training in the specific skills for recognition of icing phenomena and execution of recovery. The SoC must describe the source data and any analytical methods used to develop ice accretion models, including a verification that these effects have been tested. Please refer to CS FSTD(A).UPRT.040.
2.1.S.f	The aerodynamic modelling has to support stall-recovery training tasks in the following flight conditions: (1) stall entry at wing level (1g); (2) stall entry into turning flight of at least 25° bank angle (accelerated stall); (3) stall entry into a power-on condition (required only for propeller-driven aeroplanes); and (4) aeroplane configurations of second-segment climb, high-altitude cruise (‘near performance-limited condition’), and approach or landing.			✓	This requirement applies only to FSTDs that are to be qualified to conduct full-stall training tasks. An SoC is required which describes the aerodynamic-modelling methods, validation, and check of the stall characteristics of the FSTD. An additional SoC has also to include a verification that the FSTD has been evaluated by an SME pilot acceptable to the competent authority. Please refer to CS FSTD(A).UPRT.005(e) for clarification on the definition of a ‘subject-matter expert pilot’. Please refer to CS FSTD(A).UPRT.001(a)(4) for clarification on the stall modelling. Please refer to CS FSTD(A).GEN.005 Terminology for clarification on the ‘near performance-limited condition’.
2.1.S.g	The aerodynamic model has to incorporate data representing the aeroplane’s characteristics covering an angle of attack and sideslip range to support the training tasks.			✓	An SoC is required. Please refer to CS FSTD(A).UPRT.001(a)(3).
2.1.R.a	Flight dynamics model that accounts for various combinations of drag and thrust normally encountered in flight, including the effect of change in aeroplane attitude, sideslip, thrust, drag, altitude, temperature, gross weight, moments of inertia, CoG location and configuration.		✓		
2.1.R.b	Modelling that includes the effects of icing, where appropriate, on the airframe, aerodynamics and the engine(s).		✓		

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	Icing-effects simulation models are only required for those aeroplanes authorised for operations in icing conditions.				
2.1.G	Modelling, aeroplane-like, not specific to class, model, type or variant. Flight dynamics model that accounts for various combinations of drag and thrust normally encountered in flight and supported by aeroplane generic data, including the effect of change in aeroplane attitude, sideslip, thrust, drag, altitude, temperature, gross weight, moments of inertia, CoG location, and configuration.	✓			
2.2	MASS PROPERTIES				
2.2.S	Type-specific implementation of aeroplane mass properties, including mass, CoG and moments of inertia as a function of payload and fuel loading. The effects of pitch attitude and of fuel slosh on the aircraft CoG should be simulated.			✓	SoC required. The SoC should include a range of tabulated target values to enable a demonstration of the mass properties model to be conducted from the instructor's station. The SoC should include a mention pertaining to the effects of fuel slosh on the CoG.
3.	**GROUND REACTION AND HANDLING CHARACTERISTICS**				
3.S	Represents ground reaction and handling characteristics of the aeroplane during surface operations to support the intended use. Brake and tyre failure dynamics (including anti-skid) and decreased brake efficiency should be specific to the aeroplane simulated. Stopping and directional control forces should be representative for all environmental runway conditions.			✓	
3.R	Represents ground reaction and handling, aeroplane-like, derived from and appropriate to class.		✓		
3.G	Represents ground reaction, aeroplane-like, derived from and appropriate to class. Simple aeroplane-like ground reactions, appropriate to the aeroplane geometry and mass.	✓			
3.1	GROUND REACTION AND HANDLING CHARACTERISTICS				
3.1.S	Aeroplane type-specific ground handling simulation to include: (1) Ground reaction. Reaction of the aeroplane upon contact with the runway during take-off, landing and ground operations to			✓	SoC required. Tests required. See CS FSTD(A).QTG.105, tests 1.a.1,1.a.2,1.b.1 through 1.b.7.

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	include strut deflections, tyre friction, side forces and other appropriate data, such as weight and speed, necessary to identify the flight condition and configuration; and (2) Ground handling characteristics. Steering inputs to include crosswind, braking, thrust reversing, deceleration and turning radius.				
3.1.R	Representative aeroplane ground handling simulation to include: (1) Ground reaction. Reaction of the aeroplane upon contact with the runway during take-off, landing and ground operations 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; and (2) Ground handling characteristics. Steering inputs to include crosswind, braking, thrust reversing, deceleration and turning radius.		✓		SoC required. Tests required. See CS FSTD(A).QTG.105, tests 1.b.1, 1.b.7.
3.1.G	Generic ground reaction and ground handling models to enable touchdown effects to be reflected by the sound and visual systems.	✓			
3.2	RUNWAY CONDITIONS				
3.2.S	Stopping and directional control forces for at least the following runway conditions based on aeroplane-related data: (1) dry; (2) wet; (3) icy; (4) patchy wet; (5) patchy icy; and (6) wet on rubber residue in touchdown zone.			✓	SoC required. Objective tests required for (1), (2) and (3). See CS FSTD(A).QTG.105, tests 1.e (stopping). Subjective tests for (4), (5) and (6). See CS FSTD(A).FST.105, test 10.a.6.
3.2.R	Stopping and directional control forces should be representative for at least the following runway conditions based on aeroplane-related data: (1) dry; and (2) wet.		✓		

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
3.2.G	Stopping and directional control forces for dry runway conditions.	✓			
3.3	BRAKE AND TYRE FAILURES				
3.3.S	Brake and tyre failure dynamics (including anti-skid) and decreased braking efficiency due to brake temperatures.			✓	SoC required. Subjective tests required for decreased braking efficiency due to brake temperature, if applicable.
4.	**AEROPLANE SYSTEMS**				
4.S	Aeroplane systems should be replicated with sufficient functionality for flight crew operation to support the intended use. System functionality should enable all normal, abnormal, and emergency operating procedures to be accomplished. To include communications, navigation, caution and warning equipment corresponding to the aeroplane. Circuit breakers required for operations should be functional.			✓	
4.R	Aeroplane systems should be replicated with sufficient functionality for flight crew operation to support the intended use. System functionality should enable sufficient normal and appropriate abnormal and emergency operating procedures to be accomplished.		✓		For non-type-specific FSTDs, additional guidance is contained in CS FSTD(A).MISC.020.
4.G	*Reserved for future use — N/A*				
4.1	NORMAL, ABNORMAL AND EMERGENCY SYSTEMS OPERATION				
4.1.S	All aeroplane systems represented in the FSTD should simulate the specific aeroplane type system operation including system interdependencies, both on the ground and in flight. Systems should be operative to the extent that all normal, abnormal and emergency operating procedures can be accomplished.			✓	Aeroplane system operation should be predicated on, and traceable to, the system data supplied by either the aeroplane manufacturer, original equipment manufacturer or alternative validation data for the aeroplane system or component. Once activated, proper systems operation should result from system management by the crew member and not require any further input from the instructor's controls.
4.1.R	Aeroplane systems represented in the FSTD should simulate representative aeroplane system operation including system interdependencies, both on the ground and in flight. Systems should be operative to the extent that appropriate normal, abnormal and		✓		Aeroplane system operation should be predicated on, and traceable to, the system data supplied by either the aeroplane manufacturer, original equipment manufacturer or alternative validation data for the aeroplane system or component.

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	emergency operating procedures can be accomplished.				Once activated, proper systems operation should result from system management by the crew member and not require any further input from the instructor's controls.
4.2	CIRCUIT BREAKERS				
4.2.S 4.2.R	Circuit breakers that affect procedures or result in observable cockpit/flight deck indications should be functionally accurate.		✓	✓	Applicable if circuit breakers fitted.
4.3	INSTRUMENT INDICATIONS				
4.3.S 4.3.R	All relevant instrument indications involved in the simulation of the aeroplane should automatically respond to control movement by a flight crew member or to atmospheric disturbance and also respond to effects resulting from icing.		✓	✓	Numerical values should be presented in the appropriate units.
4.4	COMMUNICATIONS, NAVIGATION AND CAUTION AND WARNING SYSTEMS				
4.4.S	Communications, navigation, and caution and warning equipment corresponding to that installed in a specific aeroplane type should operate within the tolerances prescribed for the applicable airborne equipment.			✓	Applies where the appropriate systems are simulated.
4.4.R	Communications, navigation, and caution and warning equipment corresponding to that typically installed in a representative aeroplane simulation should operate within the tolerances prescribed for the applicable airborne equipment.		✓		For non-type-specific FSTDs, to support Multi-Crew Cooperation (MCC) training tasks, additional instrumentation and indicators as required for MCC training and operations are as follows: 1. Turbo-jet or turbo-prop engine;. 2. Performance reserves, in the case of an engine failure, to be in accordance with CS-25. These may be simulated by a reduction in the aeroplane gross mass; 3. Retractable landing gear; 4. Pressurisation system; 5. De-icing systems; 6. Fire detection / suppression system; 7. Dual controls; 8. Autopilot with automatic approach mode; 9. Two VHF transceivers including oxygen masks intercom system; 10. Two VHF NAV receivers (VOR, ILS, DME);

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
					11. One ADF receiver; 12. One Marker receiver; 13. One transponder; The following indicators should 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).
4.5	ANTI-ICING SYSTEMS				
4.5.S	Anti-icing systems corresponding to those installed in the specific aeroplane type should operate with appropriate effects upon ice formation on airframe, engines and instrument sensors.			✓	
4.5.R	Anti-icing systems corresponding to those typically installed in that class of aeroplane should be operative.		✓		Simplified airframe and engine, including engine induction and pitot-static system, icing models with corresponding performance degradations due to icing should be provided. Effects of anti-icing/de-icing systems activation should also be present.
5.	**FLIGHT CONTROLS AND FORCES**				
5.S	Control forces and control travel should correspond to those of the aeroplane to support the intended use. Control displacement should generate the same effect as the aeroplane under the same flight conditions. Control feel dynamics should replicate the aeroplane simulated.			✓	
5.R	Aeroplane-like, derived from class, appropriate to the aeroplane mass to support the intended use. Active force feedback required.		✓		

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	**R**	**S**	
5.G	Aeroplane-like to support the intended use. Active force feedback not required.	✓			
5.1	CONTROL FORCES AND TRAVEL				
5.1.S.a	Control forces, control travel and surface position should correspond to those of the type-specific aeroplane being replicated. Control travel, forces and surfaces should react in the same manner as in the aeroplane under the same flight and system conditions.			✓	Active force feedback required if appropriate to the aeroplane installation.
5.1.S.b	For aeroplanes equipped with stick pusher system (e.g. longitudinal control feel system, or equivalent) control forces, displacement, and surface position of the aeroplane correspond to those of the aeroplane being simulated.			✓	This requirement applies only to FSTDs that are to be qualified to conduct full-stall training tasks. An SoC is required verifying that the stick pusher system has been modelled, programmed, and validated using the aeroplane manufacturer's design data or other acceptable data source. The SoC must address, at a minimum, the stick pusher activation and cancellation logic as well as system dynamics, control displacement and forces as a result of the stick pusher activation. Test required.
5.1.R	Control forces, control travel and surface position should correspond to those of the aeroplane or class of aeroplane being simulated. Control travel, forces and surfaces should react in the same manner as in the aeroplane or class of aeroplane under the same flight and system conditions.		✓		Active force feedback required if appropriate to the aeroplane installation.
5.1.G	Control forces, control travel and surface position should broadly correspond to the aeroplane or class of aeroplane simulated.	✓			Active force feedback not required. Control forces produced by a passive arrangement are acceptable.
5.2	CONTROL FEEL DYNAMICS				
5.2.S	Control feel dynamics should replicate the aeroplane simulated.			✓	See CS FSTD(A).QTG.210 for a discussion of acceptable methods of validating control dynamics. Tests required. See CS FSTD(A).QTG.105 to this Part, tests 2.b.1 through 2.b.3 (dynamic control checks).
5.3	CONTROL SYSTEM OPERATION				

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
5.3.S	Control systems should replicate aeroplane operation for the normal and any non-normal modes including back-up systems and should reflect failures of associated systems. Appropriate cockpit indications and messages should be replicated.			✓	See CS FSTD(A).FST.105 for applicable testing.
5.3.R	Control systems should replicate the class of aeroplane operation for the normal and any non-normal modes including back-up systems and should reflect failures of associated systems. Appropriate cockpit indications and messages should be replicated.		✓		See CS FSTD(A).FST.105 for applicable testing.
5.3.G	Control systems should allow basic aeroplane operation with appropriate cockpit indications.	✓			See CS FSTD(A).FST.105 for applicable testing.
6.	**SOUND CUES**				
6.S	Significant sounds perceptible to the flight crew during flight operations to support the intended use. Comparable engine, airframe and environmental sounds of correct frequencies and amplitudes for a specific aeroplane type. The volume control should have an indication of sound level setting.			✓	
6.R	Significant sounds perceptible to the flight crew during flight operations to support the intended use. Comparable engine, airframe and environmental sounds representative for the aeroplane type or of an aeroplane of its class. The volume control should have an indication of sound level setting.		✓		
6.G	Significant sounds perceptible to the flight crew during flight operations to support the intended use. Comparable engine and airframe sounds. The volume control should have an indication of sound level setting.	✓			
6.1	SOUND SYSTEM				
6.1.S	Significant cockpit/flight deck sounds during normal and abnormal operations corresponding to those of the aeroplane, including engine and airframe sounds as well as those which result from pilot or instructor-induced actions.			✓	For FSTDs that are to be qualified for full-stall training tasks, sounds associated with stall buffet have to be replicated, if significant in the aeroplane. SoC required.

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
					Tests required. See CS FSTD(A).QTG.105.
6.1.R	Significant cockpit/flight deck sounds during normal and abnormal operations corresponding to those of the class of aeroplane, including engine and airframe sounds as well as those which result from pilot or instructor-induced actions.		✓		SoC required. Tests required. See CS FSTD(A).QTG.105.
6.1.G	Significant cockpit/flight deck sounds during normal and abnormal operations, including engine and airframe sounds as well as those which result from pilot or instructor-induced actions.	✓			SoC required. Tests required. See CS FSTD(A).QTG.105.
6.2	CRASH SOUNDS				
6.2.S 6.2.R 6.2.G	The sound of a crash when the simulated aeroplane exceeds limitations.	✓	✓	✓	
6.3	ENVIRONMENTAL SOUNDS				
6.3.S 6.3.R	Significant environmental sounds should be coordinated with the simulated weather.		✓	✓	
6.3.G	Environmental sounds are not required. However, if present, they should be coordinated with the simulated weather.	✓			
6.4	SOUND VOLUME				
6.4.S	The volume control should have an indication of sound level setting which meets all qualification requirements. Full volume should correspond to actual volume levels in the validation data. When full volume is not selected, an indication of abnormal setting should be provided to the instructor.			✓	The abnormal setting should consist of an annunciation on a main instructor operating station (IOS) page which is always visible to the instructor.
6.4.G 6.4.R	The volume control should have an indication of sound level setting which meets all qualification requirements. Full volume should correspond to the actual volume level agreed at	✓	✓		

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	the initial evaluation. When full volume is not selected, an indication of abnormal setting should be provided to the instructor.				
6.5	SOUND DIRECTIONALITY				
6.5.S 6.5.R	Sound should be directionally representative.		✓	✓	SoC required.
6.5.G	Sound is not required to be directional.	✓			
7.	**VISUAL DISPLAY CUES**				
7.S	Continuous field of view with infinity perspective and textured representation of all ambient conditions for each pilot, to support the intended use. Horizontal and vertical field of view to support the most demanding manoeuvres requiring a continuous view of the runway.			✓	
7.R	Continuous field of view with textured representation of all ambient conditions for each pilot, to support the intended use. Horizontal and vertical field of view to support the most demanding manoeuvres requiring a continuous view of the runway.		✓		
7.G	A textured representation of appropriate ambient conditions, to support the intended use. Horizontal and vertical field of view to support basic instrument flying and transition to visual from straight-in instrument approaches.	✓			
7.1	DISPLAY Where a visual display system is fitted even though not attracting specific credits, it will be assessed to ensure that it do es not adversely affect the qualification of the FSTD.				
7.1.1	DISPLAY GEOMETRY AND FIELD OF VIEW				
7.1.1.S	Continuous, cross-cockpit, collimated visual display providing each pilot with a minimum 200 degrees horizontal and 40 degrees vertical field of view. The system should be free from optical discontinuities and artefacts that create non-realistic cues.			✓	See CS FSTD(A).QTG.105 – Test 4.a.1. An SoC is acceptable in place of this test. Consideration should be given to optimising the vertical field of view for the respective aeroplane cut-off angle.

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
					Note. Where the training task includes circling approaches with the landing on the reciprocal runway, a visual field of view in excess of 200 degrees horizontal and 40 degrees vertical would probably be required. Until such time as this becomes feasible, the current arrangements in place with individual competent authorities regarding approval for conducting specific circling approaches on a particular FSTD remain in place. For additional information regarding collimated displays, see CS FSTD(A).QTG.245 Visual display systems.
7.1.1.R	Continuous visual field of view providing each pilot with 200 degrees horizontal and 40 degrees vertical field of view.		✓		See CS FSTD(A).QTG.105 – Test 4.a.1. An SoC is acceptable in place of this test. Collimation is not required but parallax effects should be minimised (not greater than 10 degrees for each pilot when aligned for the point midway between the left and right seat eyepoints). The system should have the capability to align the view to the pilot flying. Installed alignment should be confirmed in an SOC (this would generally be results from acceptance testing).
7.1.1.G	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 minimum distance from the pilot's eye position to the surface of a direct view display may not be less than the distance to any front panel instrument.	✓			See CS FSTD(A).QTG.105 – Test 4.a.1. An SoC is acceptable in place of this test. Collimation is not required.
7.1.2	DISPLAY RESOLUTION				
7.1.2.S	Display resolution demonstrated by a test pattern of objects shown to occupy a visual angle of not greater than 2 arc minutes in the visual display used on a scene from the pilot's eye point.			✓	SoC required containing calculations confirming resolution. See CS FSTD(A).QTG.105 – Test 4.a.3.
7.1.2.R	Display resolution demonstrated by a test pattern of objects shown to occupy a visual angle of not greater than 4 arc minutes in the visual display used on a scene from the pilot's eye point.		✓		SoC required containing calculations confirming resolution. See CS FSTD(A).QTG.105 – Test 4.a.3.

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
7.1.2.G	Adequate resolution to support the intended use.	✓			
7.1.3	LIGHT-POINT SIZE				
7.1.3.S	Light-point size — Not greater than 5 arc minutes.			✓	SoC required confirming test pattern represents lights used for airport lighting. See CS FSTD(A).QTG.105 – Test 4.a.4.
7.1.3.R	Light-point size — not greater than 8 arc minutes.		✓		SoC required confirming test pattern represents lights used for airport lighting. See CS FSTD(A).QTG.105 – Test 4.a.4.
7.1.3.G	Suitable to support the intended use.	✓			
7.1.4	DISPLAY CONTRAST RATIO				
7.1.4.S 7.1.4.R	Display contrast ratio — not less than 5:1.		✓	✓	See CS FSTD(A).QTG.105 – Test 4.a.5.
7.1.4.G	Suitable to support the intended use.	✓			
7.1.5	LIGHT-POINT CONTRAST RATIO				
7.1.5.S	Light-point contrast ratio — not less than 25:1.			✓	See CS FSTD(A).QTG.105 – Test 4.a.6.
7.1.5.R	Light-point contrast ratio — not less than 10:1.		✓		See CS FSTD(A).QTG.105 – Test 4.a.6.
7.1.5.G	Suitable to support the intended use.	✓			
7.1.6	LIGHT-POINT BRIGHTNESS				
7.1.6.S 7.1.6.R	Light-point brightness — not less than 20 cd/m2 (5.8 foot-lamberts).		✓	✓	See CS FSTD(A).QTG.105 – Test 4.a.7.
7.1.6.G	Suitable to support the intended use.	✓			
7.1.7	DISPLAY BRIGHTNESS				
7.1.7.S	Display brightness should be demonstrated using a raster-drawn test pattern. The surface brightness should not be less than 20 cd/m2			✓	See CS FSTD(A).QTG.105 – Test 4.a.8.

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	(5.8. foot-lamberts).				
7.1.7.R	Display brightness should be demonstrated using a raster-drawn test pattern. The surface brightness should not be less than 14 cd/m2 (4.1 foot-lamberts).		✓		See CS FSTD(A).QTG.105 – Test 4.a.8.
7.1.7.G	Suitable to support the intended use.	✓			
7.1.8	BLACK LEVEL AND SEQUENTIAL CONTRAST (Light valve systems only)				
7.1.8.S	The black level and sequential contrast need to be measured to determine it is sufficient for training in all times of day.			✓	A test is generally only required for projection systems. An SoC should be provided if the test is not run, stating why. See CS FSTD(A).QTG.105 – Test 4.a.9.
7.1.8.R 7.1.8.G	The system should not generate unwanted artefacts or adversely affect the use of the FSTD.	✓	✓		
7.1.9	MOTION BLUR (Light valve systems only)				
7.1.9.S	Tests are required to determine the amount of motion blur that is typical of certain types of display equipment. A test should be provided that demonstrates the amount of blurring at a predefined rate of movement across the image.			✓	A test is generally only required for projection systems. An SoC should be provided if the test is not run, stating why. See CS FSTD(A).QTG.105 – Test 4.a.10.
7.1.9.R 7.1.9.G	Suitable to support the intended use.	✓	✓		
7.1.10	SPECKLE TEST (Laser systems only)				
7.1.10.S	A test is required to determine that the speckle typical of laser-based displays is below a distracting level.			✓	A test is generally only required for laser projectors. An SoC should be provided if the test is not run, stating why. See CS FSTD(A).QTG.105 – Test 4.a.11.
7.1.10.R 7.1.10.G	Suitable to support the intended use.	✓	✓		
7.2	ADDITIONAL DISPLAY SYSTEMS				
7.2.1	HEAD-UP DISPLAY (where fitted)				
7.2.1.S	The system should be shown to perform its intended function for			✓	SoC required. See CS FSTD(A).QTG.105 Tests from section 4.b and CS

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	each operation and phase of flight. An active display (repeater) of all parameters displayed on the pilot's combiner should be located on the IOS, or other location approved by the competent authority. Display format of the repeater should represent that of the combiner.				FSTD(A).MISC.030
7.2.1.R	The system should be shown to perform its intended function for each operation and phase of flight. An active display (repeater) of all parameters displayed on the pilot's combiner should be located on the IOS, or other location approved by the competent authority. Display format of the repeater should represent that of the combiner.		✓		SOC required. See CS FSTD(A).QTG.105 – Tests from section 4.b and CS FSTD(A).MISC.030. Only the one Head-Up Display (HUD) can be used by the pilot flying due to alignment display issues. Alternatively, the HUD may be presented as part of the visual scene.
7.2.1.G	N/A				
7.2.2	ENHANCED FLIGHT VISION SYSTEM (EFVS) (Where fitted)				
7.2.2.S	The EFVS simulator hardware/software, including associated cockpit displays and annunciation, should function the same as, or in an equivalent manner to, the EFVS system installed in the aeroplane. A minimum of one airport should be modelled for EFVS operation. The model should include an ILS and a non-precision approach (with VNAV if required for that aeroplane type). The image should be repeated on the IOS as for HUD requirement in 7.2.1.S herein. IOS weather pre-sets should be provided for EFVS minimums.			✓	See CS FSTD(A).QTG.105 – Tests from section 4.c and CS FSTD(A).MISC.040.
7.2.2.R	The EFVS simulator hardware/software, including associated cockpit displays and annunciation, should function the same as, or in an equivalent manner to, the EFVS system installed in the aeroplane. A minimum of one airport should be modelled for EFVS operation. The model should include an ILS and a non-precision approach (with VNAV if required for that aeroplane type).		✓		See CS FSTD(A).QTG.105 – Tests from section 4.c and CS FSTD(A).MISC.040. Only the one HUD can be used by the pilot flying due to alignment display issues. Alternatively, the EFVS may be presented as part of the visual scene.
7.3	VISUAL GROUND SEGMENT				

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
7.3.S 7.3.R	A test is required to demonstrate that the visibility is correct on final approach in CAT II conditions and the positioning of the aeroplane is correct relative to the runway.		✓	✓	See CS FSTD(A).QTG.105 – Test 4.d.
7.3.G	A demonstration of suitable visibility.	✓			
8.	**MOTION CUES**				
8.S	The pilot receives an effective and representative motion cue and stimulus, which provides the appropriate sensations of acceleration of the aeroplane’s 6 degrees of freedom (DOF). Motion cues should always provide a correct sensation, for the intended use.			✓	Replicates a specific aeroplane to the maximum extent possible within current physical limitations
8.R	The pilot receives an effective and representative motion cue and stimulus, which provides the appropriate sensations of acceleration of the aeroplane’s 6 DOF. Motion cues should always provide a correct sensation, to support the intended use. These sensations may be generated by a variety of methods which are specifically not prescribed. The sensation of motion can be less for simplified non-type specific training, the magnitude of the cues being reduced.		✓		Replicates an aeroplane of its class to the maximum extent possible within current physical limitations
8.G	*Reserved for future use- N/A*	✓			
8.1	MOTION CUES GENERAL When motion systems have been added by the organisation operating FSTDs even though not required for that type of device or for attracting specific credits, they will be assessed to ensure that they do not adversely affect the qualification of the FSTD. For motion feature fidelity level S devices, special consideration is given to the motion system response during upset prevention and recovery and approach-to-stall or stall recovery manoeuvres. Notwithstanding the limitations of simulator motion, the operator should place specific emphasis on tuning out objectionable motion system responses, where possible.				
8.1.S.a 8.1.R.a	Motion cues (force) in 6 DOF, as perceived by the pilot, should be representative of the simulated aeroplane’s motion (e.g. touchdown cues should be a function of the rate of descent (R/D) of the simulated aeroplane).		✓	✓	SoC required.

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
8.1.S.b	Motion cues (vestibular) in 6 DOF. The onset cues in the critical axes, as perceived by the pilot, should be representative of the simulated aeroplane's motion for upset recovery and stall training tasks.			✓	Reproduction of the aircraft sustained load factor associated with these manoeuvres is not required. SoC required.
8.1.R.b	Motion cues (vestibular) in 6 DOF. The onset cues in the critical axes, as perceived by the pilot, should be representative of the simulated aeroplane's motion for upset recovery tasks.		✓		SoC required.
8.2	MOTION FORCE CUEING				
8.2.S	A motion system (force cueing) should produce cues at least equivalent to those of a 6-DOF platform motion system (i.e. pitch, roll, yaw, heave, sway, and surge).			✓	SoC required. See above.
8.2.R	A motion system (force cueing) should produce cues at least equivalent to those of a 6 DOF platform motion system (i.e. pitch, roll, yaw, heave, sway, and surge). The magnitude of the cues can be partially reduced and the perception of motion can be less.		✓		SoC required. See above.
8.3	MOTION EFFECTS				
8.3.S 8.3.R	Motion effects should include characteristic motion vibrations, buffets and bumps that result from operation of the aeroplane, in so far as these mark an event or aeroplane state that can be sensed at the cockpit/flight deck. Such effects should be in at least 3 axes, x, y and z, to represent the effects as experienced in the aeroplane:		✓	✓	See CS FSTD(A).FST.105.
	(1) Taxiing effects such as lateral and directional cues resulting from steering and braking inputs.		✓	✓	
	(2) Effects of runway and taxiway rumble, oleo deflections, uneven runway, runway contamination with associated anti-skid characteristics, centre line lights characteristics (such effects should be a function of groundspeed).		✓	✓	
	(3) Buffets on the ground due to spoiler/speed brake extension and thrust reversal.		✓	✓	
	(4) Bumps associated with the landing gear.		✓	✓	
	(5) Buffet during extension and retraction of landing gear.		✓	✓	

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	(6) Buffet in the air due to flap and spoiler/speed brake extension.		✓	✓	
	(7) Buffet due to atmospheric disturbances, e.g. turbulence in three linear axes (isotropic).		✓	✓	
	(8) Approach-to-stall buffet and stall buffet (where applicable).		✓	✓	If there are known flight conditions where buffet is the first indication of the stall, or where no stall buffet occurs, this characteristic should be included in the model.
	(9) Touchdown cues for main and nose gear.		✓	✓	Touchdown bumps should reflect the effects of lateral and directional cues resulting from crab or crosswind landings.
	(10) Nosewheel scuffing (if applicable).		✓	✓	
	(11) Thrust effect with brakes set.		✓	✓	
	(12) Mach and manoeuvre buffet.		✓	✓	
	(13) Tyre failure dynamics.		✓	✓	
	(14) Engine failures, malfunctions and engine damage.		✓	✓	Appropriate cues to aid recognition of failures for flight critical cases (e.g. directional and lateral cues for asymmetric engine failure).
	(15) Tail and pod strike.		✓	✓	
	(16) Other significant vibrations, buffets and bumps that are not mentioned above (e.g. RAT), or checklist items such as motion effects due to pre-flight flight control inputs.		✓	✓	
8.4	MOTION VIBRATIONS				
8.4.S	Motion vibrations tests are required and should include recorded results that allow the comparison of relative amplitudes versus frequency (relevant frequencies up to at least 20 Hz). Characteristic motion vibrations that result from operation of the aeroplane should be present, in so far as vibration marks an event or aeroplane state that can be sensed at the cockpit/flight deck. The FSTD should be programmed and instrumented in such a manner that the characteristic vibration modes can be measured and compared to the aeroplane data.			✓	See CS FSTD(A).QTG.105 – Tests in section 3.f. An SoC is required.
	(1) Thrust effects with brakes set.			✓	
	(2) Landing gear extended buffet.			✓	

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	(3) Flaps extended buffet.			✓	
	(4) Speed brake deployed buffet.			✓	
	(5) Stall buffet			✓	Test required only for FSTDs that are to be qualified for full-stall training tasks or for those aeroplanes which exhibit stall buffet before the activation of the stall warning system.
	(6) High speed or Mach buffet.			✓	Test required only in cases where high speed or Mach buffets can be distinguished from stall buffets
	(7) In-flight vibrations.			✓	Propeller-driven aeroplanes only.
8.4.R	Motion vibrations tests are required and should include recorded results that allow the comparison of relative amplitudes versus frequency (relevant frequencies up to at least 20 Hz). Characteristic motion vibrations that result from operation of the aeroplane should be present, in so far as the vibration marks an event or aeroplane state that can be sensed at the cockpit/flight deck. The FSTD should be programmed and instrumented in such a manner that the characteristic vibration modes can be measured.		✓		See CS FSTD(A).QTG.105 – Tests in section 3.f. An SoC is required.
	(1) Thrust effects with brakes set.		✓		
	(2) Landing gear extended buffet.		✓		
	(3) Flaps extended buffet.		✓		
	(4) Speed brake deployed buffet.		✓		
	(5) Approach to stall buffet.		✓		Test required only for FSTDs of those aeroplanes which exhibit stall buffet before the activation of the stall warning system.
	(6) High speed or Mach buffet.		✓		Test required only in cases where high speed or Mach buffets can be distinguished from stall buffets
	(7) In-flight vibrations.		✓		Propeller-driven aeroplanes only.
9	**ENVIRONMENT – ATC** Simulated air traffic control environment (SATCE) is an automated flight training technology, in which air traffic control (ATC) services and other traffic entities are simulated as part of the synthetic environment provided by the FSTD. Instructor role-play of ATC services or other functions, such as ground or cabin crew, is considered outside the scope of a SATCE system, since this approach is not a feature of the FSTD.				

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
9.S	ATC services should be automatically provided for at least two airports featuring multiple connected runways, taxiways and parking locations, with terminal and en-route controlled airspace, that are characteristic of the location supporting standard and regional ATC procedures and associated radio communications during ownship normal, non-normal and emergency conditions. Automated weather reporting and data link communications should be supported. Multiple distinct voices should be used for both ATC and other traffic radio transmissions. Other traffic should undertake airborne or ground manoeuvres correlated with ATC radio communications, and exhibit characteristic performance, follow appropriate routes and be visible in the scene and on cockpit and instructor displays, including ADS-B traffic information. The instructor should be able to configure traffic flow, have access to all radio communications, as well as the capability to mute and restore background radio communications.			✓	The 'Environment — ATC' feature is optional unless otherwise specified in Part-FCL for any given training task or type. Therefore, the fidelity level (N,G,R or S) of the environment – ATC feature does not affect the FSTD qualification level granted when evaluated. However, for FSTDs that have this feature, then the fidelity levels indicated in Table 1 'FSTD capability signature (FCS) summary matrix' are those recommended for each qualification level shown.
9.R	*Reserved for future use- N/A*				
9.G	ATC services should be automatically provided for at least one airport featuring at least one connected runway, taxiway and parking location, with terminal and en-route controlled airspace, supporting standard ATC procedures and associated radio communications during ownship normal operations. Automated weather reporting should be supported. Distinct voices should be used for both ATC and other traffic radio transmissions. Other traffic should undertake airborne or ground manoeuvres correlated with ATC radio communications, and be visible in the scene and on cockpit and instructor displays, including ADS-B traffic information. The instructor should be able to configure traffic flow, have access	✓			The 'Environment — ATC' feature is optional unless otherwise specified in Part-FCL for any given training task or type. Therefore, the fidelity level (N,G,R or S) of the environment – ATC feature does not affect the FSTD qualification level granted when evaluated. However, for FSTDs that have this feature, then the fidelity levels indicated in Table 1 'FSTD capability signature (FCS) summary matrix' are those recommended for each qualification level shown.

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	to all radio communications, as well as the capability to mute/restore background radio communications.				
9.1	AUTOMATED WEATHER REPORTING Automated weather reporting describes the simulation of fully automatic pre-programmed ATC services delivering reported weather information via radio and data communications. Automated Terminal Information Service (ATIS) is the most common automated weather reporting system. Other reported weather broadcast systems need only be simulated where required to support the intended use.				
9.1.S	More than one automated reported weather message adhering to standard ICAO specifications should be available to the flight crew. Messages should include, at a minimum, airport, reference runway, temperature, wind, altimeter setting, clouds, visibility, runway conditions, as well as predefined other conditions (such as transition level) where required to support the intended use. The instructor should have the ability to override message content, and may associate messages with one or more airports. Any weather-related ATC communication should reflect these messages.			✓	
9.1.G	A single automated reported weather message adhering to standard ICAO specifications should be available to the flight crew. The message should include, at a minimum, airport, reference runway, temperature, wind, altimeter setting, clouds, visibility, runway conditions, as well as predefined other conditions (such as transition level) where required to support the intended use. The instructor should have the ability to override message content. Any weather-related ATC communication should reflect this message.	✓			
9.2	OTHER TRAFFIC Other traffic describes the simulation of entities other than the ownship, where this supports the intended use. Other traffic may be generated and controlled by systems other than SATCE, such as simulator applications for Traffic Collision Avoidance System (TCAS) training, and the visual display system.				
9.2.S	Fully automated other aircraft traffic should be present undertaking manoeuvres under air traffic control. Other aircraft should exhibit characteristic performance for the aircraft type. Other aircraft should land and depart from runways, follow airborne			✓	

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	and taxi routes, and park at locations appropriate to their category and weight class. Other traffic routing should match information available to the flight crew, and behaviours should correlate with ATC radio communications. Other aircraft minimum separation should be typical of ATC procedures during normal conditions. Other aircraft traffic transponder states should be simulated and support modes A, C/S and OFF, with the mode of operation appropriate for the phase of flight and aircraft position. Other aircraft traffic call signs should match their liveries, with aircraft types and liveries that are characteristic of operations at the airport location. Other aircraft traffic visual effects that provide important cues to the flight crew should be simulated.				
9.2.G	Fully automated other aircraft traffic should be present undertaking manoeuvres under air traffic control. Other aircraft should exhibit characteristic performance for the aircraft type. Other traffic routing should match information available to the flight crew, and behaviours should correlate with ATC radio communications. Other aircraft minimum separation should be typical of ATC procedures during normal conditions. Other aircraft traffic call signs should match their liveries.	✓			
9.3	BACKGROUND RADIO TRAFFIC Background radio traffic (also known as party line or 'background chatter') describes the simulation of radio communications between ATC and other traffic, not intended for the ownship.				
9.3.S 9.3.G	Where other traffic is present, background radio communications should be available to the flight crew, correct and complete during normal conditions, and correlate with the ATC services offered and other traffic phase of flight, positions and manoeuvres.	✓		✓	

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	**R**	**S**	
	In general, the number of background radio communications should reflect the amount of other traffic manoeuvring in the simulated environment. Simulated radio transmissions should not step over transmissions from the flight crew or other simulated entities during normal conditions. The SATCE system should detect when the flight crew step over simulated radio transmissions from either other traffic or ATC, and support concurrent radio communications on all radios available to the flight crew, where required to support the intended use.				
9.4	ATC SERVICES Air traffic control services describes the simulation of various distinct air traffic management roles, often allocated to different frequencies, accessible by the flight crew via simulated radio and data communications.				
9.4.S	ATC services should be simulated, managing the ownship and other traffic within controlled ground and airspace. ATC service roles and allocated frequencies should correlate with each other and with the information available to the flight crew. Standard ATC procedures and associated radio communications should be simulated and apply to the ownship and other traffic. ATC procedures should be used as published by ICAO or the Air Navigation Service Provider (ANSP) or the national CAA. In addition, regional or location-specific ATC published procedures and associated radio communications should be simulated and apply to the ownship and other traffic. ATC procedures should correlate with the information available to the flight crew. Radio transmissions should be received by the ownship within realistic and typical reception distances. ATC service provision to other traffic should maintain continuity across ATC sector boundaries within controlled airspace.			✓	
9.4.G	ATC services should be simulated, managing the ownship and other traffic within controlled ground and airspace.	✓			

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	ATC service roles and allocated frequencies should correlate with each other and with the information available to the flight crew. Standard ATC procedures and associated radio communications should be simulated and apply to the ownship and other traffic. ATC procedures should be used as published by ICAO or the ANSP or the national CAA. ATC procedures should correlate with the information available to the flight crew. ATC service provision to other traffic should maintain continuity across ATC sector boundaries within controlled airspace.				
9.5	LANGUAGE AND PHRASEOLOGY Language and phraseology describes the method of simulated ATC communications and the particular set of fixed expressions used.				
9.5.S	Background radio communications, and those from ATC to the ownship should be in English as per ICAO Doc 4444 and comply, where possible, with the phraseologies detailed in ICAO Doc 4444 and ICAO Annex 10, including those with PANS status, supported by ICAO Doc 9432. Background radio communications, and those from ATC to the ownship should include published regional or location-specific phraseology.			✓	
9.5.G	Background radio communications, and those from ATC to the ownship should be in English as per ICAO Doc 4444 and comply, where possible, with the phraseologies detailed in ICAO Doc 4444 and ICAO Annex 10, including those with PANS status, supported by ICAO Doc 9432.	✓			
9.6	VOICE CHARACTERISTICS Voice characteristics describes the features and qualities of simulated speech used for radio communications. Where this is achieved automatically using synthetic speech generation technologies, the focus should be on achieving realistic voice audio from ATC services over that from other traffic.				
9.6.S	Radio transmissions to the ownship should occur using the same ATC voice or voices used to simulate ATC transmissions to other traffic. ATC voices should be dedicated to the ATC function for the duration of a training scenario. Distinct voices should be assigned to both the			✓	

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	ATC function and other traffic that are diverse enough to distinguish between ATC services and other traffic. Where more than one frequency or ATC service is simulated, multiple distinct voices should be assigned to the ATC function, as would be experienced in real-world operations. The number of voices should allow differentiation between ATC services, to the extent required to support the intended use. Where more than one other traffic is simulated, multiple distinct voices should be assigned to other traffic. The number of voices should allow differentiation between other traffic, to the extent required to support the intended use.				
9.6.G	Radio transmissions to the ownship should occur using the same ATC voice or voices used to simulate ATC transmissions to other traffic. ATC voices should be dedicated to the ATC function for the duration of a training scenario. Distinct voices should be assigned to both the ATC function and other traffic that are diverse enough to distinguish between ATC services and other traffic.	✓			
9.7	AIRPORT AND AIRSPACE MODELLING Airport and airspace modelling describes the scope of data and functionality required for the simulation of ATC services and other traffic on airfield ground surfaces and in controlled airspace. Modelling requires data that may include ATC-related airspace data, ATC procedures and airfield data. Not all areas of an airport or airspace need to be modeled or have the same level of fidelity, provided that ATC services and other traffic are simulated to the extent and exactness required to support the intended use.				
9.7.S	A simulated ATC environment should be available at more than one airport, supporting the simulation of ATC services for terminal and en-route controlled airspace that are characteristic of the location. ATC services should be modelled on real-world data, where available, from the location or the ANSP or the national CAA. Multiple ground movement areas, including runways, taxiways and parking locations should be simulated, where this reflects real-world operations at the airport location. Ownship and other traffic movements should be simulated in either direction on a single physical runway surface, where this reflects real-world operations at the airport location and where required to			✓	

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	support the intended use. Ownship and other traffic movements on more than one physical runway surface should be simulated, where the real-world airport has multiple runways and where required to support the intended use. Location-specific operational limitations may be reflected in traffic movements. Runway operation modes should include take-off only, landing only, or both take-off and landing (mixed mode use), where this reflects real-world operations at the airport location, and where required to support the intended use. The lighting state for all open runways, including runway lighting configuration and intensity, should correlate with routine ATC traffic movement procedures for airport operations, time of day, and reported weather. The lighting state of taxiways, taxiway center lights, lead-on / lead-off lights, holding point stop bars, including holding point stop bars associated with runway entry points, should correlate with ATC clearances to the ownship and other traffic.				
9.7.G	A simulated ATC environment should be available at a minimum of one airport, supporting the simulation of ATC services for terminal and en-route controlled airspace. Ground movement areas should include, at a minimum, one runway, taxiway and parking location that are connected. Ownship and other traffic movements should be simulated in at least one direction on a single physical runway surface. The lighting state for all open runways, including runway lighting configuration and intensity, should correlate with routine ATC traffic movement procedures for airport operations, time of day, and reported weather. The lighting state of taxiways, taxiway center lights, lead-on / lead-off lights, holding point stop bars, including holding point stop bars associated with runway entry points, should correlate with ATC	✓			

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	clearances to the ownship and other traffic.				
9.8	WEATHER Weather describes the simulation of ATC procedures and other traffic routing and behaviours influenced by meteorological conditions.				
9.8.S 9.8.G	ATC services should implement appropriate procedures for the reported weather for the location, during the simulation of normal conditions. Similarly, traffic departure and arrival routing, active runways and the direction of take-off and landing should be consistent and congruent with the reported weather for the airport location.	✓		✓	
9.9	VOICE COMMUNICATIONS Voice communications describes air traffic control service provision and radio communications between ATC and the ownship.				
9.9.S	The SATCE system should support both ATC- and flight crew-initiated radio communications. ATC radio communications should be correlated with the time in use in the cockpit. ATC radio communications to the ownship should use the same voices used to simulate radio communications from ATC to other traffic, and correlate with the ATC services offered and the ownship operational context. ATC services should support radio communications to and from the ownship using standard phraseology (where defined) during ownship non-normal and emergency conditions. ATC service provision to the ownship should maintain continuity across ATC sector boundaries within controlled airspace ensuring there is no loss or interruption of services during normal conditions. Standby responses and requests for repeated information from either ATC or the flight crew should be supported. ATC should be capable of responding to or correcting content errors and omissions in flight crew radio transmissions and responding to a radio transmission on an incorrect or inappropriate frequency. Similarly, ATC should be capable of responding to the ownship not following an ATC clearance or instruction. ATC should clear the ownship to follow routing according to the ownship flight plan that follows published routes, where available. During normal conditions, ATC should clear the ownship to land and			✓	

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	depart from runways designated for the ownship aircraft category and weight class. ATC should clear the ownship to follow taxi routes and park at locations appropriate to the ownship aircraft category and weight class.				
9.9.G	The SATCE system should support both ATC- and flight crew-initiated radio communications. ATC radio communications should be correlated with the time in use in the cockpit. ATC radio communications to the ownship should use the same voices used to simulate radio communications from ATC to other traffic, and correlate with the ATC services offered and the ownship operational context. ATC service provision to the ownship should maintain continuity across ATC sector boundaries within controlled airspace ensuring there is no loss or interruption of services during normal conditions. Standby responses and requests for repeated information from either ATC or the flight crew should be supported. ATC should be capable of responding to or correcting content errors and omissions in flight crew radio transmissions and responding to a radio transmission on an incorrect or inappropriate frequency. Similarly, ATC should be capable of responding to the ownship not following an ATC clearance or instruction. ATC should clear the ownship to follow routing according to the ownship flight plan that follows published routes, where available. During normal conditions, ATC should clear the ownship to land and depart from runways designated for the ownship aircraft category and weight class.	✓			
9.10	DATALINK COMMUNICATIONS Data link communications describes the simulation of certain non-voice messages between ATC services and the ownship. Data link communications features and messages need only be simulated where required to support the intended use. Due to the specific nature of data link communications, it may not be practical to simulate generic communications. Datalink communications that are unrelated to ATC (such as company communications, email services) are not required.				
9.10.S	Data link messages should follow a correct and coherent sequence of transmissions, with delays in message timing that are			✓	

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	characteristic of real-world operations. Data link messages, contracts and connections should result in correct cockpit visual or audio indications. ATS clearance messages should be consistent with published routes, waypoints, flight information regions (FIRs), and real-world ATC centres. Data link weather messages should correlate with reported weather conditions. The simulation of data link initialisation capability (DLIC) should allow the flight crew to establish a connection with a controller pilot data link communications (CPDLC) service provider that corresponds to a real-world facility. Flight crews should be transferred between active data authorities at the appropriate time or distance from a control boundary. CPDLC simulation should support the flight crew in sending and receiving messages that are consistent with regional protocols and in the use of the message set available for the corresponding active data authority. Automatic dependent surveillance-contract (ADS-C) messages should be available through simulated real-world data authorities that support ADS-C messaging. Flight information services broadcast (FIS-B) messages should be supported and correlated with other reporting systems available to the flight crew. Data link service failures and recovery, including CPDLC service failures, should be supported. Message timing delays should be characteristic of real-world operations.				
9.11	SYSTEM CORRELATION System correlation describes the features necessary for a SATCE system to be consistent and congruent with various FSTD systems, so that all information concerning the simulated ATC environment available to the flight crew and instructor, including navigation data, visual and audio cues, are in harmony.				
9.11.S	Where weather conditions or range permit, other aircraft traffic within visual range of the ownship should be apparent to the flight crew. Other aircraft positions and routing should be aligned with the visual display system airport model. Clutter generated and			✓	

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	controlled by the visual display system should avoid causing a conflict with the ownship or with other traffic. Airspace volumes and sectorisation and other aircraft traffic positions and routing should be aligned with navigation data available to the flight crew. Other traffic within range should be shown on cockpit displays. Where the aircraft simulated is equipped with ADS-B IN capability, and where other traffic is equipped with ADS-B OUT capability, other traffic ADS-B information should be available to the flight crew. Where the aircraft simulated is equipped with TCAS capability, appropriate TCAS traffic advisories and resolutions should be triggered by other traffic. Standard procedures and associated pilot and ATC radio communications to an ownship TCAS event should be supported in accordance with ICAO Doc 4444.				
9.11.G	Where weather conditions or range permit, other aircraft traffic within visual range of the ownship should be apparent to the flight crew. Other aircraft positions and routing should be aligned with the visual display system airport model. Clutter generated and controlled by the visual display system should avoid causing a conflict with the ownship or with other traffic. Airspace volumes and sectorisation and other aircraft traffic positions and routing should be aligned with navigation data available to the flight crew. Other traffic within range should be shown on cockpit displays. Where the aircraft simulated is equipped with ADS-B IN capability, and where other traffic is equipped with ADS-B OUT capability, other traffic ADS-B information should be available to the flight crew. Where the aircraft simulated is equipped with TCAS capability, appropriate TCAS traffic advisories and resolutions should be triggered by other traffic.	✓			
9.12	INSTRUCTOR INTERFACES AND CONTROLS Instructor interfaces and controls describes the functions and capabilities necessary for the instructor to obtain information and manage the SATCE system, usually from the IOS. SATCE should reduce instructor workload for certain tasks, such as the need to provide ATC services to the ownship.				
9.12.S	Visibility of the wider traffic context and other traffic information			✓	

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	should be available to the instructor during training. The instructor should have access to flight crew and ATC radio communications, and where required to support the intended use, access to data link communications. The SATCE system should support the most commonly used simulation control and scenario set-up functions with minimal training disruption and instructor management, including total / flight freeze, resets and repositions. The instructor should be able to disable all SATCE functionalities during training and return to ATC simulation by manual role play. The instructor should be able to mute background radio communications and then restore the audio with minimal impact on training. The instructor should have the ability to select whether other aircraft traffic is present prior to or during training. The amount of other traffic manoeuvring in the simulated environment should be configurable prior to training.				
9.12.G	Visibility of the wider traffic context and other traffic information should be available to the instructor during training. The instructor should have access to flight crew and ATC radio communications. The SATCE system should support the most commonly used simulation control and scenario set-up functions with minimal training disruption and instructor management, including total / flight freeze, resets and repositions. The instructor should be able to disable all SATCE functionalities during training and return to ATC simulation by manual role play. The instructor should be able to mute background radio communications and then restore the audio with minimal impact on training. The instructor should have the ability to select whether other aircraft traffic is present prior to or during training. The amount of other traffic manoeuvring in the simulated environment should be configurable prior to training.	✓			
10	**ENVIRONMENT – NAVIGATION**				
10.S	Navigational data with the corresponding approach facilities to support the intended use.			✓	

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	Navigation aids should be usable within range or line of sight without restriction, as applicable to the geographic area.				
10.R	*Reserved for future use- N/A*		✓		
10.G	*Reserved for future use- N/A*	✓			
10.1	NAVIGATION DATABASE				
10.1.S	Navigation database sufficient to support simulated aeroplane systems for real-world operations.			✓	For type-specific devices, the navigation database should be according to the Aeronautical Information Regulation And Control (AIRAC) cycle (ICAO Doc 8126, the Aeronautical Information Services Manual, Table 2-1. Schedule of AIRAC effective dates) unless otherwise agreed with the competent authority. For non-type-specific devices, the navigation database should be current within a period not exceeding 3 months where navigation equipment is replicated.
10.2	MINIMUM AIRPORT REQUIREMENT				
10.2.S	Complete navigation database for at least five airports with corresponding 3D precision and 2D/3D non-precision approach procedures.			✓	When global navigation satellite system (GNSS) is installed, the navigation database update cycle should be synchronised with the GNSS update cycle.
10.3	INSTRUCTOR CONTROLS				
10.3.S	Instructor controls of internal and external navigational aids.			✓	E.g. aeroplane ILS glideslope receiver failure compared to ground facility glideslope failure.
10.4	ARRIVAL/DEPARTURE FEATURES				
10.4.S	Navigational data with all the corresponding standard arrival and departure procedures.			✓	
10.5	NAVIGATION AIDS RANGE				
10.5.S	Navigation aids should be usable within range or line of sight without restriction, as applicable to the geographic area.			✓	Replication of the geographic environment with its specific limitations.
11	**ENVIRONMENT – ATMOSPHERE AND WEATHER**				
11.S	*Reserved for future use- N/A*			✓	

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
11.R	Fully integrated dynamic environment simulation including a representative atmosphere with weather effects to support the intended use. The environment should be synchronised with appropriate aeroplane and simulation features to provide integrity. Environment simulation should include thunderstorms, wind shear, turbulence, microbursts and appropriate types of precipitation.		✓		
11.G	Basic atmospheric model, pressure, temperature, visibility, cloud base and winds to support the intended use. The environment should be synchronised with appropriate aeroplane and simulation features to provide integrity.	✓			Environment modelling sufficient to permit accurate systems operation and indication.
11.1	STANDARD ATMOSPHERE				
11.1.R 11.1.G	Simulation of the standard atmosphere including instructor control over key parameters.	✓	✓		
11.2	WIND SHEAR				
11.2.R	The FSTD should employ wind shear models that provide training for recognition and necessary corrective pilot actions for the following critical phases of flight: (1) prior to take-off rotation; (2) at lift-off; (3) during initial climb; and (4) on final approach, below 150 m (500 ft) AGL.		✓		Refer to CS FSTD(A).QTG.105 – Test 2.g.1. The QTG should reference the FAA wind shear training aid or present alternate aeroplane-related data, including the implementation method(s) used. If the alternate method is selected, wind models from the RAE wind shear training, the JAWS Project and other recognised sources may be implemented, but should be supported and properly referenced in the QTG.
11.2.G	The FSTD should employ wind shear models that provide training (if required) for recognition of wind shear phenomena.	✓			A subjective test is required. See CS FSTD(A).FST.105.
11.3	WEATHER EFFECTS				
11.3.R	The following weather effects as observed on the visual system should be simulated and respective instructor controls should be provided. (1) Multiple cloud layers with adjustable bases, tops, sky		✓ ✓		A subjective test is required. See CS FSTD(A).FST.105.

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	coverage and scud effect.				
	(2) Storm cells activation or deactivation.		✓		
	(3) Visibility and runway visual range (RVR), including fog and patchy fog effect.		✓		
	(4) Effects on ownship external lighting.		✓		
	(5) Effects on airport lighting (including variable intensity and fog effects).		✓		
	(6) Surface contaminants (including wind blowing effect).		✓		
	(7) Variable precipitation effects (rain, hail, snow).		✓		
	(8) In-cloud airspeed effect.		✓		
	(9) Gradual visibility changes entering and breaking out of cloud.		✓		
	(10) Atmospheric model that supports representative effects of wake turbulence and mountain waves to support the training tasks. The wake turbulence model should support the representative effects of wake turbulence on the simulated aircraft. The wake model provides training for the recognition and corrective pilot actions throughout the flight regime. The mountain wave model should support the atmospheric climb, descent, and roll rates which can be encountered in mountain wave and rotor conditions.		✓		Several wake turbulence and mountain wave models should be offered to support variety in the training. The model effects should be appropriately related to the simulated aircraft. The use of scenarios is encouraged.
11.3.G	Visibility as observed on the visual system should be simulated and respective instructor controls should be provided.	✓			Applicable if a visual system is fitted. A subjective test is required. See CS FSTD(A).FST.105.
11.4	INSTRUCTOR CONTROLS				
11.4.R 11.4.G	The following features should be simulated with appropriate instructor controls provided:				A subjective test is required. See CS FSTD(A).FST.105.
	(1) surface wind speed, direction and gusts;	✓	✓		
	(2) intermediate and high-altitude wind speed and direction;		✓		

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	(3) thunderstorms and microbursts; and (4) turbulence.	✓	✓ ✓		For devices without motion, turbulence effects should be simulated on the instruments.
12	**ENVIRONMENT – AERODROMES AND TERRAIN**				
12.S	*Reserved for future use- N/A.*			✓	
12.R	Specific airport models with topographical features to support the intended use. Correct terrain modelling, runway orientation, markings, lighting, dimensions and taxiways. Visual terrain and enhanced ground proximity system (EGPWS) databases should be matched to support training to avoid controlled flight into terrain (CFIT) accidents. Where the device is required to perform low-visibility operations, at least one airport scene with functionality to support the required approval level, e.g. low-visibility taxi route with marker boards, stop bars, runway guard lights plus the required approach and runway lighting. Airport details must be developed using airport pictures, construction drawings, maps, or other similar data, or developed in accordance with published regulatory material.		✓		Note. The requirements should be read in conjunction with CS FSTD(A).FST.105, paragraph 12 (Visual system function and subjective tests) to fully understand the details to be provided.
12.G	Generic airport models with topographical features to support the intended use. Correct terrain modelling, runway orientation, markings, lighting, dimensions and taxiways.	✓			Note. The requirements should be read in conjunction with CS FSTD(A).FST.105, paragraph 12 (Visual system function and subjective tests) to fully understand the details to be provided.
12.1	VISUAL CUES				
12.1.1.R	Visual cues to assess sink rate and depth perception during take-off and landing should be provided. This should include: (1) surface on runways, taxiways, and ramps; (2) terrain features; and		✓		

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
	(3) detailed and accurate surface depiction of the terrain surface within an approximate area from 4 000 m (2.48 sm) before the runway approach end to 4 000 m (2.48 sm) beyond the runway departure end with a total width of approximately 4 000 m (2.48 sm) including the width of the runway.				
12.1.1.G	Visual cues to assess sink rate and depth perception during take-off and landing should be provided. This should include: (1) surface on runways, taxiways, and ramps; and (2) terrain features.	✓			
12.2	VISUAL EFFECTS				
12.2.1.R	The system should provide visual effects for: (1) light poles; (2) raised edge lights as appropriate; and (3) glow associated with approach lights in low visibility before physical lights are seen.		✓		
12.3	ENVIRONMENT ATTITUDE				
12.3.1.R 12.3.1.G	The simulator should provide for accurate portrayal of the visual environment relating to the FSTD attitude.	✓	✓		Visual attitude versus FSTD attitude is a comparison of pitch and roll of the horizon as displayed in the visual scene compared to the display on the attitude indicator. Required for initial qualification only (SoC acceptable).
12.4	AIRPORT SCENES				
12.4.1.R	The system should include at least three designated real-world airports available in daylight, twilight (dusk or dawn) and night illumination states.		✓		
12.4.1.G	The system should include a generic airport available in daylight, twilight (dusk or dawn) and night illumination states.	✓			
12.4.2.1.R	Daylight capability.	✓	✓		SoC required for system capability. System objective tests are required. See CS FSTD(A).QTG.105 – Tests in

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	**R**	**S**	
12.4.2.1. G					Section 4.a. Scene content tests are also required. See CS FSTD(A).FST.105.
12.4.2.2. R 12.4.2.2. G	The system should provide full-colour presentations and sufficient surfaces with appropriate textural cues to successfully accomplish a visual approach, landing and airport movement (taxi).	✓	✓		
12.4.2.3. R	Surface shading effects should be consistent with simulated sun position.		✓		This does not imply continuous time of day.
12.4.2.4. R	Total scene content comparable in detail to that produced by 10 000 visible textured surfaces and 6 000 visible lights should be provided.		✓		
12.4.2.4. G	Total scene content should be sufficient to identify the airport and represent the surrounding terrain.	✓			
12.4.2.R	The system should have sufficient capacity to display 16 simultaneously moving objects.		✓		
12.4.3.1. R	Twilight (dusk) capability.		✓		
12.4.3.2. R	The system should provide twilight (or dusk) visual scenes with full-colour presentations of reduced ambient intensity and typical terrain characteristics such as fields, roads and bodies of water and surfaces illuminated by representative ownship lighting (e.g. landing lights) sufficient to successfully accomplish visual approach, landing and airport movement (taxi).		✓		
12.4.3.3. R	Total scene content comparable in detail to that produced by 10 000 visible textured surfaces and 15 000 visible lights should be provided.		✓		
12.4.3.4. R	Scenes should include self-illuminated objects such as road networks, ramp lighting and airport signage, to conduct a visual approach, landing and airport movement (taxi).		✓		
12.4.3.5. R	The system should include a definable horizon.		✓		If provided, directional horizon lighting should have correct orientation and be consistent with surface shading effects.

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
12.4.3.6.R	The system should have sufficient capacity to display 16 simultaneously moving objects.		✓		
12.4.4.R	Night capability — The system should provide at night all features applicable to the twilight scene, as defined above, with the addition of the need to portray reduced ambient intensity that removes ground cues that are not self-illuminating or illuminated by aeroplane lights (e.g. landing lights).		✓		
12.5	AIRPORT CLUTTER				
12.5.1.R	Airport models should include representative static and dynamic clutter such as gates, aeroplanes, and ground handling equipment.		✓		Airport clutter need not be dynamic unless required. Airport clutter need not require correlation with simulated ATC environment or generate background radio traffic communications unless undertaking ground manoeuvres that would typically necessitate communication with ATC in real-world environments.
12.6	DATABASE CURRENCY				
12.6.1.R	The specific airports used in the system should be maintained current with the state of the corresponding real-world airports as identified in the airport charts.		✓		An update is required when, for example, additional runways or taxiways are added; when existing runway(s) are lengthened or permanently closed; when magnetic bearings to or from a runway are changed; when significant and recognisable changes are made to the terminal, other airport buildings, or surrounding terrain; etc., but need not include minor buildings or other less important airport features not represented on the airport charts.
12.7	VISUAL SYSTEM FOR REDUCED FOV Applies only when the fidelity level for Visual Cues feature is G.				
12.7.1.G	The system should provide a visual scene with sufficient scene content to allow a pilot to successfully accomplish a visual landing. Scenes should include a definable horizon and typical terrain characteristics such as fields, roads and bodies of water and surfaces illuminated by aeroplane landing lights.	✓			Airport model may be generic (no specific topographical features required).
12.7.2.G	Total scene content comparable in detail to that produced by 3 500 visible textured surfaces and 5 000 visible lights should be provided.	✓			
12.8	VFR TRAINING Not applicable – reserved for future use.				

FEATURE GENERAL REQUIREMENTS		FEATURE FIDELITY LEVEL			COMMENTS
		G	R	S	
12.9	LOW-VISIBILITY TRAINING				
12.9.1.R	The system should include at least one airport scene with functionality to support the required approval level, e.g. low-visibility taxi route with marker boards, stop bars, runway guard lights plus the required approach and runway lighting.		✓		

FEATURE GENERAL REQUIREMENTS		COMMENTS
13	**MISCELLANEOUS** **Note:** The requirements contained within this section are not feature fidelity-level-specific and are assumed to apply to all FSTDs unless otherwise annotated.	
13.1	INSTRUCTOR OPERATING STATION	
13.1.1	The instructor station should provide an adequate view of the pilots' panels and forward windows.	For an FSTD with a motion cueing system, any on-board instructor seat should be adequately secured and fitted with positive restraint devices of sufficient integrity to safely restrain the occupant during any known or predicted motion system excursion.
13.2	INSTRUCTOR CONTROLS	
13.2.1	Instructor controls should be provided for all required system variables, freezes, resets and for insertion of malfunctions to simulate abnormal or emergency conditions. The effects of these malfunctions should be sufficient to correctly exercise the procedures in relevant operating manuals.	
13.2.2	The FSTD must have a real-time feedback tool that provides the instructor/evaluator with visibility of whenever the FSTD training envelope or aeroplane operating limits have been exceeded. Additionally, and optionally, a recording mechanism may be utilised.	This requirement applies only to FSTDs being used for upset prevention and recovery training (UPRT). This feedback tool must include the following: (a) FSTD validation envelope: This must be in the form of an alpha/beta envelope (or equivalent method) depicting the 'confidence level' of the aerodynamic model. This 'confidence level' depends on the degree of flight validation or on the source of predictive methods. There must be a minimum of a flaps-up and flaps-down envelope available. (b) Flight control inputs: These must enable the instructor/evaluator to assess the pilot's flight control displacements and forces (including fly-by-wire, as appropriate).

FEATURE GENERAL REQUIREMENTS		COMMENTS
		(c) Aeroplane operational limits: This must display the aeroplane's operational limits during the manoeuvre as applicable for the configuration of the aeroplane. An SoC is required that defines the source data used to construct the FSTD validation envelope. Please refer to CS FSTD(A).UPRT.030 and GM1 to CS FSTD(A).UPRT.030.
13.2.3	Upset scenarios: When equipped with IOS selectable dynamic aeroplane upsets, the IOS is to provide guidance on the method used to drive the FSTD into an upset condition, including any malfunction or degradation of the FSTD's functionality, required to initiate the upset. The unrealistic degradation of simulator functionality (such as degrading flight control effectiveness) to drive an aeroplane upset is generally not acceptable unless used purely as a tool for repositioning the FSTD with the pilot out of the loop.	This requirement applies only to FSTDs being used for UPRT. An SoC is required to confirm that each upset prevention and recovery feature programmed at the IOS and the associated training manoeuvre have been evaluated by a suitably qualified pilot. Please refer to CS FSTD(A).UPRT.001(a)(1).
13.3	SELF-DIAGNOSTIC TESTING	
13.3.1	Self-diagnostic testing of FSTD should be available to determine the integrity of hardware and software operation and to provide a means for quickly and effectively conducting daily testing of the FSTD software and hardware.	An SoC is required.
13.4	COMPUTER CAPACITY	
13.4.1	Sufficient FSTD computer capacity, accuracy, resolution and dynamic response should be provided to fully support the overall FSTD fidelity needed to meet the qualification level sought.	An SoC is required.
13.5	AUTOMATIC TESTING FACILITIES	
13.5.1	Automatic QTG/validation testing of FSTD hardware and software to determine compliance with the validation requirements and to enable recurrent testing should be available.	Evidence of testing should include test identification, FSTD number, date, time, conditions, tolerances, and the appropriate dependent variables portrayed in comparison with the aeroplane and Master QTG test standards.
13.6	UPDATES TO FSTD HARDWARE AND SOFTWARE	
13.6.1	Timely permanent update of FSTD hardware and software should be conducted subsequent to aeroplane/class of aeroplane modification and FSTD manufacturer recommendation where it affects training or safety, sufficient for the qualification level sought.	
13.7	DAILY PRE-FLIGHT DOCUMENTATION	
13.7.1	Daily pre-flight documentation either in the daily log or in a location easily accessible for review is required.	

FEATURE GENERAL REQUIREMENTS		COMMENTS
13.8	SYSTEM INTEGRATION	
13.8.1	Relative response of the visual system (where fitted), cockpit/flight deck instruments and initial motion system coupled closely to provide integrated sensory cues.	Test required. See CS FSTD(A).QTG.105 – Test 6.a. Results required for instruments, motion and visual systems. Additional transport delay test results are required where HUD/EFVS systems are installed, which are simulated and not actual aeroplane systems. Where a visual system's mode of operation (daylight, twilight and night) can affect performance, additional tests are required. An SoC is required where the visual system's mode of operation does not affect performance, precluding the need to submit additional tests. Latency test may be used as an alternate means of compliance in place of the transport delay test. CS FSTD(A).QTG.260 provides guidance for transport delay and for latency test methodology.

CS FSTD(A).QB.115 General technical requirements for FSTD qualification levels

This CS establishes the general technical requirements for FFSs Level D, FTDs Levels A and B, and FNPTs Levels A, B, C, D and E.

Table 1: General technical requirements for FFSs Level D
This level of FFS is analogous to ICAO Doc 9625 Type VII to support all types of training, testing and checking. ***Flight deck layout and structure* = (S)** An enclosed full-scale replica of the aeroplane flight deck, which will have fully functional controls, instruments and switches to support the approved use. Anything not required to be accessed by the flight crew during normal, abnormal, emergency and, where applicable, non-normal operations does not need to be functional.
***Flight model (aero and engine)* = (S)** Aerodynamic and engine modelling for all combinations of drag and thrust, including the effects of change in aeroplane attitude, sideslip, altitude, temperature, gross mass, CoG location and configuration to support the intended use. Should address ground effect, Mach effect, aeroelastic representations, non-linearities due to sideslip, effects of airframe icing, forward and reverse dynamic thrust effect on control surfaces. Realistic aeroplane mass properties, including mass, CoG and moments of inertia as a function of payload and fuel loading should be implemented.
***Ground reaction and handling characteristic* = (S)** Represents ground reaction and handling characteristics of the aeroplane during surface operations to support the intended use. Brake and tyre failure dynamics (including anti-skid) and decreased brake efficiency should be specific to the aeroplane being simulated. Stopping and directional control forces should be representative for all environmental runway conditions.
***Aeroplane systems* = (S)** Aeroplane systems should be replicated with sufficient functionality for flight crew operation to support the intended use. System functionality should enable all normal, abnormal, and emergency operating procedures to be accomplished. To include communications, navigation, caution and warning equipment corresponding to the aeroplane. Circuit breakers required for operations should be functional.
***Flight controls and forces* = (S)** Control forces and control travel should correspond to those of the aeroplane to support the intended use. Control displacement should generate the same effect as the aeroplane under the same flight conditions. Control feel dynamics should replicate the aeroplane being simulated.
***Sound cues* = (S)** Significant sounds perceptible to the flight crew during flight operations to support the intended use. Comparable engine, airframe and environmental sounds of correct frequencies and amplitudes for a specific aeroplane type. The volume control should have an indication of sound level setting.
***Visual cues* = (S)** Continuous field of view with infinity perspective and textured representation of all ambient conditions for each pilot, to support the intended use. Horizontal and vertical field of view to support the most demanding manoeuvres requiring a continuous view of the runway.
***Motion cues* = (S)** Pilot receives an effective and representative motion cue and stimulus, which provides the appropriate sensations of acceleration of the aeroplane's 6 DOF. Motion cues should always provide the correct sensation to support the intended use. Replicates a specific aeroplane to the maximum extent possible within current physical limitations.
***Environment — ATC* =(S)** ATC services should be automatically provided for at least two airports featuring multiple connected runways, taxiways and parking locations, with terminal and en-route controlled airspace, that are characteristic of the location supporting standard and regional ATC procedures and associated radio communications during ownship normal, non-normal and emergency conditions. Automated weather reporting and data link communications should be supported. Multiple distinct voices should be used for both ATC and other traffic

radio transmissions. Other traffic should undertake airborne or ground manoeuvres correlated with ATC radio communications, and exhibit characteristic performance, follow appropriate routes and be visible in the scene and on cockpit and instructor displays, including ADS-B traffic information. The instructor should be able to configure traffic flow, have access to all radio communications, as well as the capability to mute and restore background radio communications.
***Environment — Navigation* = (S)** Navigational data with the corresponding approach facilities to support the intended use. Navigation aids should be usable within range or line of sight without restriction, as applicable to the geographic area.
***Environment — Atmosphere and weather* = (R)** Fully integrated dynamic environment simulation including a representative atmosphere with weather effects to support the intended use. The environment should be synchronised with appropriate aeroplane and simulation features to provide integrity. Environment simulation should include thunderstorms, wind shear, turbulence, microbursts and appropriate types of precipitation.
***Environment — Aerodromes and terrain* = (R)** Specific airport models with topographical features to support the intended use. Correct terrain modelling, runway orientation, markings, lighting, dimensions and taxiways. Visual terrain and EGPWS databases should be matched to support training to avoid CFIT accidents. Where the device is required to perform low-visibility operations, at least one airport scene with functionality to support the required approval level, e.g. low-visibility taxi route with marker boards, stop bars, runway guard lights plus the required approach and runway lighting. Airport detail must be developed using airport pictures, construction drawings, maps, or other similar data, or developed in accordance with published regulatory material.

Table 2: General technical requirements for FTD Level A
This level of FTD is intended to support aircraft systems operations and procedures training. ***Flight deck layout and structure* = (G)** An open, enclosed or perceived to be enclosed, flight deck, excluding distraction, which will represent that of the aeroplane derived from, and appropriate to class, to support the intended use.
***Flight model (aero and engine)* = (R)** Aerodynamic, engine and ground effect modelling, aeroplane-like, derived from and appropriate to class to support the intended use. 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.
***Ground reaction and handling characteristics* = (G)** Represents ground reaction, aeroplane-like, derived from and appropriate to class. Simple aeroplane-like ground reactions, appropriate to the aeroplane geometry and mass.
***Aeroplane systems* = (S)** Aeroplane systems should be replicated with sufficient functionality for flight crew operation to support the intended use. System functionality should enable all normal, abnormal, and emergency operating procedures to be accomplished. To include communications, navigation, caution and warning equipment corresponding to the aeroplane. Circuit breakers required for operations should be functional.
***Flight controls and forces* = (G)** Aeroplane-like to support the intended use. Active force feedback not required.
***Sound cues* = (G)** Significant sounds perceptible to the flight crew during flight operations to support the intended use. Comparable engine and airframe sounds. The volume control should have an indication of sound level setting.
***Visual cues* = (N)** Not required.
***Motion cues* = (N)** Not required.
***Environment — ATC* = (N)** Not required.
***Environment — Navigation* = (S)** Navigational data with the corresponding approach facilities to support the intended use. Navigation aids should be usable within range or line of sight without restriction, as applicable to the geographic area.

***Environment — Atmosphere and weather* = (G)** Basic atmospheric model, pressure, temperature, visibility, cloud base and winds to support the intended use. The environment should be synchronised with appropriate aeroplane and simulation features to provide integrity.
***Environment — Aerodromes and terrain* = (N)** Not required.

Table 3: General technical requirements for FTD Level B
This level of FTD is analogous to ICAO Doc 9625 Type V (FAA FTD L7) to support all types of training. ***Flight deck layout and structure* = (S)** An enclosed full-scale replica of the aeroplane flight deck, which will have fully functional controls, instruments and switches to support the intended use. Anything not required to be accessed by the flight crew during normal, abnormal, emergency and, where applicable, non-normal operations does not need to be functional.
***Flight model (aero and engine)* = (S)** Aerodynamic and engine modelling for all combinations of drag and thrust, including the effects of change in aeroplane attitude, sideslip, altitude, temperature, gross mass, CoG location and configuration to support the intended use. Should address ground effect, Mach effect, aeroelastic representations, non-linearities due to sideslip, effects of airframe icing, forward and reverse dynamic thrust effect on control surfaces. Realistic aeroplane mass properties, including mass, CoG and moments of inertia as a function of payload and fuel loading should be implemented.
***Ground reaction and handling characteristic* = (S)** Represents ground reaction and handling characteristics of the aeroplane during surface operations to support the intended use. Brake and tyre failure dynamics (including anti-skid) and decreased brake efficiency should be specific to the aeroplane being simulated. Stopping and directional control forces should be representative for all environmental runway conditions.
***Aeroplane systems* = (S)** Aeroplane systems should be replicated with sufficient functionality for flight crew operation to support the intended use. System functionality should enable all normal, abnormal, and emergency operating procedures to be accomplished. To include communications, navigation, caution and warning equipment corresponding to the aeroplane. Circuit breakers required for operations should be functional.
***Flight controls and forces* = (S)** Control forces and control travel should correspond to those of the aeroplane to support the intended use. Control displacement should generate the same effect as the aeroplane under the same flight conditions. Control feel dynamics should replicate the aeroplane being simulated.
***Sound cues* = (R)** Significant sounds perceptible to the flight crew during flight operations to support the intended use. Comparable engine, airframe and environmental sounds representative for the aeroplane type or of an aeroplane of its class. The volume control should have an indication of sound level setting.
***Visual cues* = (R)** Continuous field of view with textured representation of all ambient conditions for each pilot, to support the intended use. Horizontal and vertical field of view to support the most demanding manoeuvres requiring a continuous view of the runway.
***Motion cues* = (N)** Not required.
***Environment — ATC* = (G)** ATC services should be automatically provided for at least one airport featuring at least one connected runway, taxiway and parking location, with terminal and en-route controlled airspace, supporting standard ATC procedures and associated radio communications during ownship normal operations. Automated weather reporting should be supported. Distinct voices should be used for both ATC and other traffic radio transmissions. Other traffic should undertake airborne or ground manoeuvres correlated with ATC radio communications, and be visible in the scene and on cockpit and instructor displays, including ADS-B traffic information. The instructor should be able to configure traffic flow, have access to all radio communications, as well as the capability to mute or restore background radio communications.
***Environment — Navigation* = (S)**

Navigational data with the corresponding approach facilities to support the intended use. Navigation aids should be usable within range or line of sight without restriction, as applicable to the geographic area.
***Environment — Atmosphere and weather* = (R)** Fully integrated dynamic environment simulation including a representative atmosphere with weather effects to support the intended use. The environment should be synchronised with appropriate aeroplane and simulation features to provide integrity. Environment simulation should include thunderstorms, wind shear, turbulence, microbursts and appropriate types of precipitation.
***Environment — Aerodromes and terrain* = (R)** Specific airport models with topographical features to support the intended use. Correct terrain modelling, runway orientation, markings, lighting, dimensions and taxiways. Visual terrain and EGPWS databases should be matched to support training to avoid CFIT accidents. Where the device is required to perform low-visibility operations, at least one airport scene with functionality to support the required approval level, e.g. low-visibility taxi route with marker boards, stop bars, runway guard lights plus the required approach and runway lighting. Airport detail must be developed using airport pictures, construction drawings, maps, or other similar data, or developed in accordance with published regulatory material.

Table 4: General technical requirements for FNPT Level A
This level of FNPT is analogous to ICAO Doc 9625 Type I to support training in approved courses for PPL, CPL and MPL Phase I. ***Flight deck layout and structure* = (R)** An enclosed or perceived to be enclosed flight deck, excluding distraction, which will represent that of the aeroplane derived from, and appropriate to class, to support the intended use.
***Flight model (aero and engine)* = (R)** Aerodynamic, engine and ground reaction modelling, aeroplane-like, derived from and appropriate to class to support the approved use. 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.
***Ground reaction and handling characteristics* = (R)** Represents ground reaction and handling, aeroplane-like, derived from and appropriate to class
***Aeroplane systems* = (R)** Aeroplane systems should be replicated with sufficient functionality for flight crew operation to support the intended use. System functionality should enable sufficient normal and appropriate abnormal and emergency operating procedures to be accomplished.
***Flight controls and forces* = (R)** Aeroplane-like, derived from class, appropriate to the aeroplane mass to support the intended use. Active force feedback required.
***Sound cues* = (G)** Significant sounds perceptible to the flight crew during flight operations to support the intended use. Comparable engine and airframe sounds. The volume control should have an indication of sound level setting.
***Visual cues* = (R)** Continuous field of view with textured representation of all ambient conditions for each pilot, to support the intended use. Horizontal and vertical field of view to support the most demanding manoeuvres requiring a continuous view of the runway.
***Motion cues* = (N)** Not required.
***Environment — ATC* = (N)** Not required.
***Environment — Navigation* = (S)** Navigational data with the corresponding approach facilities to support the intended use. Navigation aids should be usable within range or line of sight without restriction, as applicable to the geographic area.
***Environment — Atmosphere and weather* = (G)** Basic atmospheric model, pressure, temperature, visibility, cloud base and winds to support the intended use. The environment should be synchronised with appropriate aeroplane and simulation features to provide integrity. Environment modelling sufficient to permit accurate systems operation and indication.

***Environment — Aerodromes and terrain* = (R)** Specific airport models with topographical features to support the intended use. Correct terrain modelling, runway orientation, markings, lighting, dimensions and taxiways. Visual terrain and EGPWS databases should be matched to support training to avoid CFIT accidents. Where the device is required to perform low-visibility operations, at least one airport scene with functionality to support the required approval level, e.g. low-visibility taxi route with marker boards, stop bars, runway guard lights plus the required approach and runway lighting. Airport detail must be developed using airport pictures, construction drawings, maps, or other similar data, or developed in accordance with published regulatory material.

Table 5: General technical requirements for FNPT Level B
This level of FNPT is analogous to ICAO Doc 9625 Type II to support training in approved courses for IR. ***Flight deck layout and structure* = (G)** An open, enclosed or perceived to be enclosed, flight deck, excluding distraction, which will represent that of the aeroplane derived from, and appropriate to class, to support the intended use.
***Flight model (aero and engine)* = (G)** Aerodynamic and engine modelling, aeroplane-like, not specific to class, model, type or variant to support the intended use. 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.
***Ground reaction and handling characteristics* = (G)** Represents ground reaction, aeroplane-like, derived from and appropriate to class. Simple aeroplane-like ground reactions, appropriate to the aeroplane geometry and mass.
***Aeroplane systems* = (R)** Aeroplane systems should be replicated with sufficient functionality for flight crew operation to support the intended use. System functionality should enable sufficient normal and appropriate abnormal and emergency operating procedures to be accomplished.
***Flight controls and forces* = (G)** Aeroplane-like to support the intended use. Active force feedback not required.
***Sound cues* = (G)** Significant sounds perceptible to the flight crew during flight operations to support the intended use. Comparable engine and airframe sounds. The volume control should have an indication of sound level setting.
***Visual cues* = (G)** A textured representation of appropriate ambient conditions, to support the intended use. Horizontal and vertical field of view to support basic instrument flying and transition to visual from straight-in instrument approaches.
***Motion cues* = (N)** Not required.
***Environment — ATC* = (G)** ATC services should be automatically provided for at least one airport featuring at least one connected runway, taxiway and parking location, with terminal and en-route controlled airspace, supporting standard ATC procedures and associated radio communications during ownship normal operations. Automated weather reporting should be supported. Distinct voices should be used for both ATC and other traffic radio transmissions. Other traffic should undertake airborne or ground manoeuvres correlated with ATC radio communications, and be visible in the scene and on cockpit and instructor displays, including ADS-B traffic information. The instructor should be able to configure traffic flow, have access to all radio communications, as well as the capability to mute/restore background radio communications.
***Environment — Navigation* = (S)** Navigational data with the corresponding approach facilities to support the intended use. Navigation aids should be usable within range or line of sight without restriction, as applicable to the geographic area.
***Environment — Atmosphere and weather* = (G)** Basic atmospheric model, pressure, temperature, visibility, cloud base and winds to support the intended use. The environment should be synchronised with appropriate aeroplane and simulation features to provide integrity. Environment modelling sufficient to permit accurate systems operation and indication.

Environment — Aerodromes and terrain ***= (G)*** Generic airport models with topographical features to support the intended use. Correct terrain modelling, runway orientation, markings, lighting, dimensions and taxiways.

Table 6: General technical requirements for FNPT Level C
This level of FNPT is analogous to ICAO Doc 9625 Type III to support training in approved courses for class ratings and MCC. ***Flight deck layout and structure*** ***= (R)*** An enclosed or perceived to be enclosed flight deck, excluding distraction, which will represent that of the aeroplane derived from, and appropriate to class, to support the intended use.
Flight model (aero and engine) ***= (R)*** Aerodynamic, engine and ground reaction modelling, aeroplane-like, derived from and appropriate to class to support the intended use. 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
Ground reaction and handling characteristics ***= (R)*** Represents ground reaction and handling, aeroplane-like, derived from and appropriate to class
Aeroplane systems ***= (R)*** Aeroplane systems should be replicated with sufficient functionality for flight crew operation to support the intended use. System functionality should enable sufficient normal and appropriate abnormal and emergency operating procedures to be accomplished.
Flight controls and forces ***= (R)*** Aeroplane-like, derived from class, appropriate to the aeroplane mass to support the intended use. Active force feedback required.
Sound cues ***= (G)*** Significant sounds perceptible to the flight crew during flight operations to support the intended use. Comparable engine and airframe sounds. The volume control should have an indication of sound level setting.
Visual cues ***= (R)*** Continuous field of view with textured representation of all ambient conditions for each pilot, to support the intended use. Horizontal and vertical field of view to support the most demanding manoeuvres requiring a continuous view of the runway.
Motion cues ***= (N)*** Not required.
Environment — ATC ***= (N)*** Not required.
Environment — Navigation ***= (S)*** Navigational data with the corresponding approach facilities to support the intended use. Navigation aids should be usable within range or line of sight without restriction, as applicable to the geographic area.
Environment — Atmosphere and weather ***= (G)*** Basic atmospheric model, pressure, temperature, visibility, cloud base and winds to support the intended use. The environment should be synchronised with appropriate aeroplane and simulation features to provide integrity. Environment modelling sufficient to permit accurate systems operation and indication.
Environment — Aerodromes and terrain ***= (G)*** Generic airport models with topographical features to support the intended use. Correct terrain modelling, runway orientation, markings, lighting, dimensions and taxiways.

Table 7: General technical requirements for FNPT Level D
This level of FNPT is analogous to ICAO Doc 9625 Type IV to support training in approved courses for MPL Phase II and MCC. ***Flight deck layout and structure* = (R)** An enclosed or perceived to be enclosed flight deck, excluding distraction, which will represent that of the aeroplane derived from, and appropriate to class, to support the intended use.
***Flight model (aero and engine)* = (G)** Aerodynamic and engine modelling, aeroplane-like, not specific to class, model, type or variant to support the intended use. 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.
***Ground reaction and handling characteristics* = (G)** Represents ground reaction, aeroplane-like, derived from and appropriate to class. Simple aeroplane-like ground reactions, appropriate to the aeroplane geometry and mass.
***Aeroplane systems* = (R)** Aeroplane systems should be replicated with sufficient functionality for flight crew operation to support the intended use. System functionality should enable sufficient normal and appropriate abnormal and emergency operating procedures to be accomplished.
***Flight controls and forces* = (G)** Aeroplane-like to support the intended use. Active force feedback not required.
***Sound cues* = (G)** Significant sounds perceptible to the flight crew during flight operations to support the intended use. Comparable engine and airframe sounds. The volume control should have an indication of sound level setting.
***Visual cues* = (G)** A textured representation of appropriate ambient conditions, to support the intended use. Horizontal and vertical field of view to support basic instrument flying and transition to visual from straight-in instrument approaches.
***Motion cues* = (N)** Not required.
***Environment — ATC* = (G)** ATC services should be automatically provided for at least one airport featuring at least one connected runway, taxiway and parking location, with terminal and en-route controlled airspace, supporting standard ATC procedures and associated radio communications during ownship normal operations. Automated weather reporting should be supported. Distinct voices should be used for both ATC and other traffic radio transmissions. Other traffic should undertake airborne or ground manoeuvres correlated with ATC radio communications, and be visible in the scene and on cockpit and instructor displays, including ADS-B traffic information. The instructor should be able to configure traffic flow, have access to all radio communications, as well as the capability to mute or restore background radio communications.
***Environment — Navigation* = (S)** Navigational data with the corresponding approach facilities to support the intended use. Navigation aids should be usable within range or line of sight without restriction, as applicable to the geographic area. Basic atmospheric model, pressure, temperature, visibility, cloud base and winds to support the approved use. The environment should be synchronised with appropriate aeroplane and simulation features to provide integrity.
***Environment — Atmosphere and weather* = (G)** Basic atmospheric model, pressure, temperature, visibility, cloud base and winds to support the intended use. The environment should be synchronised with appropriate aeroplane and simulation features to provide integrity. Environment modelling sufficient to permit accurate systems operation and indication.
***Environment — Aerodromes and terrain* = (R)** Specific airport models with topographical features to support the intended use. Correct terrain modelling, runway orientation, markings, lighting, dimensions and taxiways. Visual terrain and EGPWS databases should be matched to support training to avoid CFIT accidents. Where the device is required to perform low-visibility operations, at least one airport scene with functionality to support the required approval level, e.g. low-visibility taxi route with marker boards, stop bars, runway guard lights plus the required approach and runway

lighting. Airport detail must be developed using airport pictures, construction drawings, maps, or other similar data, or developed in accordance with published regulatory material.

Table 8: General technical requirements for FNPT Level E
This level of FNPT is analogous to ICAO Doc 9625 Type VI to support training in approved courses for MPL Phase III. ***Flight deck layout and structure* = (R)** An enclosed or perceived to be enclosed flight deck, excluding distraction, which will represent that of the aeroplane derived from, and appropriate to class, to support the intended use.
***Flight model (aero and engine)* = (R)** Aerodynamic, engine and ground effect modelling, aeroplane-like, derived from and appropriate to class to support the intended use. 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.
***Ground reaction and handling characteristics* = (R)** Represents ground reaction and handling, aeroplane-like, derived from and appropriate to class
***Aeroplane systems* = (R)** Aeroplane systems should be replicated with sufficient functionality for flight crew operation to support the intended use. System functionality should enable sufficient normal and appropriate abnormal and emergency operating procedures to be accomplished.
***Flight controls and forces* = (R)** Aeroplane-like, derived from class, appropriate to the aeroplane mass to support the intended use. Active force feedback required.
***Sound cues* = (R)** Significant sounds perceptible to the flight crew during flight operations to support the intended use. Comparable engine, airframe and environmental sounds representative for the aeroplane type or of an aeroplane of its class. The volume control should have an indication of sound level setting.
***Visual cues* = (S)** Continuous field of view with infinity perspective and textured representation of all ambient conditions for each pilot, to support the intended use. Horizontal and vertical field of view to support the most demanding manoeuvres requiring a continuous view of the runway
***Motion cues* = (R)** Pilot receives an effective and representative motion cue and stimulus, which provides the appropriate sensations of acceleration of the aeroplane's 6 DOF. Motion cues should always provide a correct sensation, to support the intended use. These sensations may be generated by a variety of methods which are specifically not prescribed. The sensation of motion can be less for simplified non-type specific training, the magnitude of the cues being reduced. Replicates an aeroplane of its class to the maximum extent possible within current physical limitations
***Environment — ATC* = (S)** ATC services should be automatically provided for at least two airports featuring multiple connected runways, taxiways and parking locations, with terminal and en-route controlled airspace, that are characteristic of the location supporting standard and regional ATC procedures and associated radio communications during ownship normal, non-normal and emergency conditions. Automated weather reporting and data link communications should be supported. Multiple distinct voices should be used for both ATC and other traffic radio transmissions. Other traffic should undertake airborne or ground manoeuvres correlated with ATC radio communications, and exhibit characteristic performance, follow appropriate routes and be visible in the scene and on cockpit and instructor displays, including ADS-B traffic information. The instructor should be able to configure traffic flow, have access to all radio communications, as well as the capability to mute and restore background radio communications.
***Environment — Navigation* = (S)** Navigational data with the corresponding approach facilities to support the intended use. Navigation aids should be usable within range or line of sight without restriction, as applicable to the geographic area.

***Environment — Atmosphere and weather* = (R)** Fully integrated dynamic environment simulation including a representative atmosphere with weather effects to support the intended use. The environment should be synchronised with appropriate aeroplane and simulation features to provide integrity. Environment simulation should include thunderstorms, wind shear, turbulence, microbursts and appropriate types of precipitation.
***Environment — Aerodromes and terrain* = (R)** Specific airport models with topographical features to support the intended use. Correct terrain modelling, runway orientation, markings, lighting, dimensions and taxiways. Visual terrain and EGPWS databases should be matched to support training to avoid CFIT accidents. Where the device is required to perform low-visibility operations, at least one airport scene with functionality to support the required approval level, e.g. low-visibility taxi route with marker boards, stop bars, runway guard lights plus the required approach and runway lighting. Airport detail must be developed using airport pictures, construction drawings, maps, or other similar data, or developed in accordance with published regulatory material.

SUBPART C – QUALIFICATION TEST GUIDE (QTG)

CS FSTD(A).QTG.001 General

Subpart C establishes the criteria that define the validation tests and documentation requirements for the evaluation of FSTDs.

GM1 CS FSTD(A).QTG.001 General

An early contact with the competent authority is required at the initial stage of FSTD build to verify the acceptability of the data.

(a) 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 aeroplanes also encourage 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.

(b) The methods, procedures, and testing criteria contained in this CS are the result of the experience and expertise of competent 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, was the core document used to establish these criteria together with ICAO Doc 9625 'Manual of Criteria for the Qualification of Flight Simulators'.

At the flight simulation conference of the RAeS held in London in November 2005, the FAA requested that the RAeS consider leading an international working group to review the technical criteria contained within the second edition of ICAO Doc 9625 and to expand these criteria to include all flight simulation training devices for both aeroplanes and helicopters. In response, the RAeS flight simulation group established in March 2006 an international working group (IWG) to review the technical criteria contained within the second edition of ICAO Doc 9625 and to expand these accordingly. The IWG also decided that a fundamental review was necessary to establish the simulation features and fidelity levels required to support each of the required training tasks for each type of pilot licence, qualification, rating or training type. The goal of the IWG was to develop a manual that, through ICAO, would form the basis for all national and international standards for a complete range of FSTDs.

The IWG comprised members from the regulatory community, pilot representative bodies, the airlines, and the training and flight simulation industry, and developed a unified set of technical criteria and training considerations. Since then the 4th edition of ICAO Doc 9625 was published containing updates for UPRT and simulated air traffic control environment (SATCE) as well as updated objective motion cueing tests to reduce motion system tests' reliance on subjective evaluations and improve harmonisation of motion system fidelity.

This edition of CS FSTD(A) is to a great degree based upon ICAO Doc 9625 Edition 4 Volume I Part III.

(c) In showing compliance with CS FSTD(A).QB.100, the competent authority expects account to be taken of the ARINC document entitled 'Flight Simulation Training Device Design & Performance Data Requirements, ARINC 450', as amended and as appropriate to the FSTD capability signature (FCS).

(d) In showing compliance with CS FSTD(A).QB.100, the competent authority expects account to be taken of the ARINC document entitled 'Guidance for Design of Aircraft Equipment and Software For Use In Training Devices, ARINC Report 610', as amended. See also GM2 CS FSTD(A).FST.105 Guidance for simulator functions.

(e) In showing compliance with CS FSTD(A).QB.100, the competent authority expects account to be taken of the ARINC document entitled 'ARINC Specification 439, Guidance for Simulated Air Traffic Control Environments in Flight Simulation Training Devices', as amended, which defines the features, fidelity, and requirements of a SATCE system for use in varying levels of flight training devices.

(f) In showing compliance with CS FSTD(A).QB.100, the competent authority expects account to be taken of the ARINC document entitled 'ARINC 436 Guidelines For Electronic Qualification Test Guide'.

CS FSTD(A).QTG.002 Testing for FSTD qualification

This CS provides principles for testing FSTDs.

(a) The FSTD should be assessed in those areas that 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, 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) should be evaluated to ensure their proper operation. Tolerances listed for parameters in the validation tests (paragraph (b)) of this CS are the maximum acceptable for FSTD qualification and should not be confused with FSTD design tolerances. The validation testing for initial and recurrent evaluations listed in the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105 should be conducted in accordance with the FSTD type against approved data.

(b) The FSTD should be evaluated objectively, and should be subjected to validation, and function and subjective tests listed in Subparts C and D, where pilot acceptance has to be taken into consideration.

Validation tests are used to compare objectively FSTDs with validation data or an approved reference data standard, as appropriate, to ensure that they are in agreement with the specified tolerances.

Functions tests are objective tests of systems using aeroplane documentation. Subjective tests provide a basis for evaluating the FSTD capability to perform over a typical training period and to verify correct operation and handling characteristics of the FSTD.

(c) Where the fidelity level is S for the aircraft simulation and cueing features, the initial evaluation should be based on objective evaluation against approved data for the specific aeroplane type, as defined in the Validation Data Roadmap (VDR). The aeroplane manufacturer’s validation flight test data is preferred. Data from other sources may be used, subject to the review and concurrence of the competent authority. The tolerances listed in the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105 are applicable for the initial and recurrent evaluations.

(d) Where the fidelity level is R for the aircraft simulation feature, the initial evaluation should be based on objective evaluation against validation data, complemented if necessary, by approved subjective development, to determine a reference data standard. The aeroplane manufacturer’s validation flight test data is preferred. Data from other sources may be used, subject to the review and concurrence of the competent authority. The tolerances listed in the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105 are applicable for the initial and recurrent evaluations.

(e) Where the fidelity level is G for the aircraft simulation feature, the initial evaluation should be based on subjective evaluation against validation data, where available, complemented if necessary, by approved subjective development, to determine a reference data standard. Correct trend and magnitude (CT&M) tolerances can be used for the initial evaluation only. Recurrent validations should be objectively measured against the reference data standard. The tolerances listed in the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105 are applicable for recurrent evaluations and should be applied to ensure the device remains at the standard initially qualified.

(f) Requirements for validation data used to evaluate aeroplane simulation feature fidelity levels G and R data are defined below:

(1) Generic or representative data may be derived from a specific aeroplane within the class of aeroplane the FSTD is representing or it may be based on information from

several aeroplanes within the class. With the concurrence of the competent authority, it may be in the form of an FSTD manufacturer's previously approved set of validation data for the applicable FSTD. Once the set of data for a specific FSTD has been accepted and approved by the competent authority, it will become the reference data standard for subsequent recurrent evaluations with the application of the stated tolerances.

(2) The substantiation of the set of data used to build validation data should be in the form of a reference data report and should show that the proposed validation data is 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, recognised theoretical results, information from the public domain, or other sources as deemed necessary by the FSTD manufacturer to substantiate the proposed model.

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

(h) Organisations operating FSTDs seeking initial or upgrade evaluation of an FSTD should be aware that performance and handling data for older aeroplanes may not be of sufficient quality to meet some of the test standards contained in this CS. In this instance, it may be necessary for an operator to acquire additional flight test data.

(i) 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 organisation operating FSTDs error. Following this, if the test problem persists, an organisation operating FSTDs should be prepared to offer an alternative test.

(j) Validation tests that do not meet the test criteria should be addressed to the satisfaction of the competent authority.

CS FSTD(A).QTG.005 Document layout

This CS establishes the minimum elements needed to set up the qualification test guide (QTG).

(a) The QTG is reviewed during the evaluation of an 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 CS. In particular, it is designed to demonstrate that the performance and handling qualities of an FSTD are within prescribed limits with those of the aeroplane or class of aeroplane and that all applicable requirements have been met.

(b) The organisation operating the FSTD should submit a QTG which includes the following:

(1) title page including (as a minimum) the:

(i) Organisation operating FSTDs's name and principal place of business address;

(ii) aeroplane model and series or class, as applicable, being simulated;

(iii) FSTD qualification level including the corresponding FCS;

(iv) FSTD location;

(v) FSTD manufacturer's unique identification or serial number; and

(vi) provision for dated signature blocks:

(A) one for the organisation operating the FSTD to attest:

(a) that the device has been tested using a documented acceptance testing procedure covering flight deck layout, all simulated aeroplane systems and the instructor operating station (IOS), as well as the engineering facilities, the motion, visual and other systems, as applicable;

(b) that all manual validation tests have been conducted in a satisfactory manner using only procedures as contained in the QTG manual test procedure;

(c) that the function and subjective testing have been conducted in a satisfactory manner; and

(d) the overall acceptance of the QTG; and

(B) one for the CAA indicating.

(a) the CAA FSTD identification number;

(b) the approval of the QTG as Master Qualification Test Guide (MQTG)

(2) An FSTD information page (for each configuration in the case of convertible FSTDs) providing the following information:

(i) applicable primary reference document (PRD);

(ii) identification number given by the organisation operating the device;

(iii) FSTD type and qualification level;

(iv) FSTD capability signature (FCS);

(v) Equipment and specifications list (ESL);

(vi) aeroplane model and series being simulated — for FNPTs, aeroplane model or class being simulated;

(vii) references to aerodynamic data or sources for aerodynamic model;

(viii) references to engine data or sources for engine models;

(ix) references to flight control data or sources for flight controls model;

(x) avionic equipment system identification where the revision level affects the training and checking capability of the FSTD;

(xi) FSTD model and manufacturer;

(xii) serial number and date of FSTD manufacture;

(xiii) FSTD computer identification;

(xiv) visual system type and manufacturer (if fitted);

(xv) motion system type and manufacturer (if fitted);

(xvi) visual airport scenes presented for the FSTD qualification (if fitted).

(xvii) supplemental information for additional areas of simulation which are not sufficiently important for the competent authority to require a separate QTG.

(3) Table of contents to include a list of all QTG tests including all sub-cases, unless provided elsewhere in the QTG.

(4) List of effective pages and log of revisions.

(5) Listing of all reference and source data.

6) Glossary of terms and symbols used.

(7) Statements of compliance (SoCs) with certain requirements. SoCs should refer to sources of information and show the compliance rationale to explain how the referenced material is used, applicable mathematical equations and parameter values, and conclusions reached (see the comments column of CS FSTD(A).QTG.400 and CS FSTD(A).QTG.105 for SoC requirements)

(8) Recording procedures and required equipment for the validation tests.

(9) The following items are required for each validation test:

(i) Test number: the test number which follows the numbering system in CS FSTD(A).QTG.105;

(ii) Test title: this should be short and definitive, based on the test title referred to in CS FSTD(A).QTG.105;

(iii) Test objective: this should be a brief summary of what the test is intended to demonstrate and 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 and if applicable any data query references;

(v) Initial conditions: a full and comprehensive list of the test initial conditions is required. These conditions should include as a minimum:

(A) gross weight, CoG and moments of inertia;

(B) fuel tank quantities;

(C) pressure altitude;

(D) field elevation*;

(E) radar altitude or mean gear height above ground*;

(F) airspeed (calibrated, indicated, etc. but as specified in the validation data);

(G) trailing edge flap positions and leading edge flap/slat positions;

(H) landing gear positions;

(I) Mach number (for cruise/high altitude condition);

(J) outside air temperature;

(K) wind speed and direction*;

(L) runway condition*;

(M) engine bleed condition;

(N) stability augmentation status (each axis);

(O) key engine parameters (N1, EPR, Torque, etc.);

(P) trim settings (pitch, roll and yaw);

(Q) linear & rotational velocities and accelerations (each axis);

** denotes extra parameters required for tests performed on or near the ground.*

(vi) Manual test procedures: they should describe clearly and distinctly how the FSTD will be set up and operated for each test when flown manually by the pilot and, when required, automatically tested. 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. Reference to reference data or test results is encouraged for complex tests, as applicable. Manual tests should be capable of being conducted from either pilot seat, although the cockpit controller positions and forces may not necessarily be available from the other seat;

(vii) Automatic test procedures (if applicable): a test identification number for automatic tests should be provided;

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

(ix) Expected result(s): the validation data result, including tolerances and, if necessary, a further definition of the point at which the information was extracted from the source data. Where the fidelity level is G for the relevant features, the initial validation test result including tolerances is sufficient;

(x) Test result. FSTD validation test results obtained by the organisation operating FSTDs from the FSTD. Tests run on a computer, which is independent of the FSTD, are not acceptable; the results should:

(A) be computer-generated;

(B) be produced on appropriate media acceptable to the competent authority conducting the test;

(C) be time histories unless otherwise indicated and:

(a) should plot for each test the list of parameters contained in CS FSTD(A).QTG.106;

(b) be clearly marked with appropriate time reference points to ensure an accurate comparison between FSTD and aeroplane;

(c) the FSTD result and validation data plotted should be clearly identified; and

(d) in those cases where a 'snapshot' result in lieu of a time history result is authorised, the organisation operating FSTDs should ensure that a steady state condition exists at the instant of time captured by the 'snapshot';

(D) be clearly labelled as a product of the device being tested;

(E) have each page reflect the date and time completed;

(F) have each page reflect the test page number and the total number of pages in the test;

(G) have parameters with specified tolerances identified, with tolerance criteria and units given. Automatic flagging of 'out-of-tolerance' situations is encouraged; and

(H) have incremental scales on graphical presentations that provide the resolution necessary for evaluation of the tolerance parameters shown in CS FSTD(A).QTG.105, as appropriate.

(xi) Validation data

(A) Computer-generated displays of flight test or engineering data overplotted with FSTD data should be provided.

(B) To ensure authenticity of the validation data, a copy of the original aeroplane source data referenced in the VDR (in the case where the fidelity level is S for the relevant features) or reference data report (in the case of non-type-specific FSTDs where the fidelity level is G or R for the relevant features), clearly marked with the document name, page number, the issuing organisation and the test number and title as specified in (a) and (b) above, should also be provided.

(C) Aeroplane data documents included in the QTG may be photographically reduced only if such reduction will not cause distortions or difficulties in scale interpretation or resolution.

(D) Validation data variables should be defined in a nomenclature list along with sign convention. This list should be included at some appropriate location in the QTG.

(E) As applicable (ref. CS-SIMD), the source data should be the data as defined by the OSD established in accordance with Part 21.

(xii) Comparison of results. One generally accepted means of comparing FSTD test results to the validation data is overplotting. In case colour codes are used to assess if a result is in tolerance or not, the MQTG should show clearly the colours.

(xiii) A block for the operator validation signature.

(10) As applicable, a copy of the VDR to clearly identify (in matrix format only) sources of data for all required tests including sound and vibration data documents.

(11) Function and subjective tests records. A copy of the validated and completed function and subjective tests list as described in CS FSTD(A).FST.100 should be included. The list should be signed by the operator.

(c) Use of an electronic qualification test guide (eQTG) may reduce costs, save time and improve timely communication, and is becoming a common practice. ARINC Report 436 provides guidelines for an eQTG.

(d) The QTG will provide the documented proof of compliance with the FSTD validation tests in CS FSTD(A).QTG.105. FSTD test 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 overplotting or other acceptable means. For tests involving time histories, the overplotting of the FSTD data to the aeroplane data is essential to verify FSTD performance in each test. The evaluation serves to validate the FSTD test results given in the QTG.

(e) When an FSTD represents several alternate configurations (e.g. alternate avionics, systems, engines, aeroplane types, interchangeable assemblies, etc.), refer to CS FSTD(A).QTG.500 for guidance related to the presentation of the MQTG.

CS FSTD(A).QTG.100 Validation tests

This CS establishes the validation tests criteria:

(a) General

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

(2) Certain tests 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.

(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.

'It is not 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.'[12] This to ensure that the overall testing philosophy within a QTG fulfils the original intent of validating the FSTD as a whole whether the testing was carried out automatically or manually.

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

A manual test procedure with explicit and detailed steps for completion of each test should also be provided. The function of the manual test procedure is to confirm that the results obtained when using an automated driver are the same as those that would be experienced by a pilot flying the same test and using the same control inputs as were used by the pilot in the aeroplane from which the validation flight test data was recorded, or in the FSTD from which the reference data standard was recorded. The manual test results should be able to be achieved using the same tolerances as those utilised for the automatic test. Manual test results may not meet the tolerances; however, the competent authority should be confident they could meet the tolerances if enough effort was spent trying to reproduce the pilot inputs exactly.

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

For FSTDs representing aeroplanes for which the application for TC was made after 17 February 2014, where the fidelity level is S for the aeroplane simulation features, the source data should be the data as defined by the OSD established in accordance with Part 21.

For FSTDs representing aeroplanes certified after January 2002, where the fidelity level is S for the aeroplane simulation features, the MQTG should be supported by a VDR as described in CS FSTD(A).QTG.400. Data providers are encouraged to supply a VDR for older aeroplanes.

For FSTDs representing aeroplanes certified prior to January 1992, where the fidelity level is S for the aeroplane simulation features, an operator may, after reasonable

[12] Quote from a RAeS Working Group during the development of ICAO Doc 9625 Manual of Criteria for the Qualification of Flight Simulators, 1993.

attempts have failed to obtain suitable flight test data, indicate in the MQTG where flight test data is unavailable or unsuitable for a specific test. For such a test, alternative data should be submitted to the competent authority for approval.

(5) The table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105 indicates the required tests. Unless noted otherwise, FSTD tests should represent aeroplane performance and handling qualities at operating weights and CoG positions typical of normal operation.

Simulator tests at extreme weight or CoG conditions may be acceptable where required to be concurrent with aeroplane certification testing. Tests of handling qualities should include validation of augmentation devices.

(6) For the testing of computer-controlled aeroplane (CCA) FSTDs, flight test data is 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 Subpart. 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 competent authority at the time of definition of a set of specific aeroplane tests for FSTD data. Where applicable, flight test data should record:

(i) pilot controller deflections or electronically generated inputs including location of input; and

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

(7) The recording requirements of (6)(i) and (6)(ii) above apply to both normal and non-normal states. All tests in the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105 require test results in the normal control state unless specifically noted otherwise in the comments section following the CCA designation. However, if the test results are independent of control state, non-normal control data may be substituted.

(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.

(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 VDR, which is described in CS FSTD(A).QTG.400.

(b) Test requirements

(1) The ground and flight tests required for qualification are listed in the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105. Computer-generated FSTD test results should be provided for each test. The results should be produced on an appropriate recording device acceptable to the competent authority. Time histories are required unless otherwise indicated in the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105.

(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 the 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.

(i) Parameters, tolerances, and flight conditions. The table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105 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 per cent, or parameters normally displayed in the cockpit in units of per cent (e.g. N1, N2, engine torque or power), then a percentage tolerance should be interpreted as an absolute tolerance unless otherwise specified (i.e. for an observation of 50 % N1 and a tolerance of 5 %, the acceptable range should be from 45 % to 55 %); and

— for parameters not displayed in units of per cent, a tolerance expressed only as a percentage should be interpreted as the percentage of the current reference value of that parameter during the test, except for parameters varying around a zero value for which a minimum absolute value should be agreed with the competent authority.

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

(ii) Flight condition verification. When comparing the parameters listed to those of the aeroplane, sufficient data should also be provided to verify the correct flight condition. For example, to show the control force is within ± 2.2daN (5lb) 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 an 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 are used for comparison.

(iii) Where the tolerances have been replaced by CT&M, the FSTD should be tested and assessed as representative of the aeroplane or class of aeroplane to the satisfaction of the competent authority. Sufficient parameters should be recorded to establish a reference data standard, 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.

(iv) 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 take-off 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 in any normal approach positions as recommended by the aeroplane manufacturer; and

(G) landing — gear down with flaps in any certified landing position.

CS FSTD(A).QTG.105 Table of FSTD validation tests versus feature fidelity levels

This CS provides the validation tests table.

Note (1)

The following FSTD feature abbreviations apply in the table below:-

FLT: flight model (aero and engine)

GND: ground handling

SYS: aeroplane systems

FCF: flight controls and forces

SND: sound cues

VIS: visual cues

MOT: motion cues

EAT: environment — airports and terrain

Note (2) How to use this table:

Each validation test may have a dependency upon more than one FSTD feature and ideally these FSTD feature fidelity levels would be to the same fidelity level to support cohesive objective testing. Thus the column entitled 'Relevant Features' in the table below should be referred to for each test to determine the applicable FSTD features that should be at the same level (if more than one FSTD feature is applicable). Refer to CS FSTD(A).QTG.105 FSTD Features requirements for objective validation tests, for further guidance and alternative process for determining the applicable objective validation tests when the applicable FSTD features are not at the same fidelity level.

In order to identify all the FSTD validation tests applicable to the considered FSTD, the organisation operating FSTDs should select in the table below, all the validation tests corresponding to the fidelity level (marked by a tick in the 'Feature Fidelity Level' columns) of the considered set of relevant FSTD feature(s) (listed in the 'Relevant Features' column).

Examples:

1.a.1: test applicable where FLT, GND, SYS, FCF are 'Specific', test not required for lower fidelity levels.

1.b.1: test applicable where FLT, GND, SYS, FCF are 'Specific' or 'Representative', test not required for lower fidelity levels.

- For fidelity level 'Specific', tolerances are: ± 5% or ± 1.5 s time and ± 5 % or ± 61 m (200 ft) distance.

- For fidelity level 'Representative', tolerances are: ± 5 % or ± 1.5 s time.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
1.	PERFORMANCE							
1.a	TAXI							
1.a.1	Minimum radius turn.	± 0·9 m (3 ft), or ± 20 % of aeroplane turn radius.	Ground			✓	FLT GND SYS FCF	Plot both main and nose gear-turning loci and key engine parameter(s). Data for no brakes and the minimum thrust required to maintain a steady turn except for aeroplanes requiring asymmetric thrust or braking to achieve the minimum radius turn.
1.a.2	Rate of turn versus nosewheel steering angle (NWA).	± 10 %, or ± 2°/s turn rate.	Ground			✓	FLT GND SYS FCF	Record for a minimum of two speeds, greater than minimum turning radius speed with one at a typical taxi speed, and with a spread of at least 5 kt.
1.b	TAKE-OFF *Note. All aeroplane manufacturer commonly used certified take-off flap settings should be demonstrated at least once either in minimum unstick speed 1.b(3), normal take-off 1.b(4), critical engine failure on take-off 1.b(5) or cross wind take-off 1.b(6).*							
1.b.1	Ground acceleration time and distance.	± 5 % or ± 1.5 s time and ± 5 % or ± 61 m (200 ft) distance	Take-off			✓	FLT GND SYS FCF	Acceleration time and distance should be recorded for a minimum of 80 % of the total time from brake release to V_R.. May be combined with normal take-off 1.b(4) or rejected take-off 1.b(7). Plotted data should be shown using appropriate scales for each portion of the manoeuvre.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
		For fidelity level R: ± 5 % or ± 1.5 s time			✓		FLT GND SYS FCF	
1.b.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 reached or ± 1.5 m (5 ft) For aeroplanes with reversible flight control systems: ± 10 % or ± 2.2 daN (5 lb) of rudder pedal force	Take-off			✓	FLT GND SYS FCF	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 FSTD under test. If the modelled engine is not the same as the aeroplane manufacturer's flight test engine, a further test may be run with the same initial conditions using the thrust from the flight test data as the driving parameter. To ensure only aerodynamic control, nosewheel steering should be disabled (i.e. castored) or the nosewheel held slightly off the ground. If a VMCG test is not available, an acceptable alternative is a flight test snap engine deceleration to idle at a speed between V1 and V1-10 kt, followed by control of heading using aerodynamic control only and recovery should be achieved with the main gear on the ground.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
1.b.3	Minimum unstick speed (V_{MU}) or equivalent test to demonstrate early rotation take-off characteristics.	± 3 kt airspeed ± 1.5° pitch angle	Take-off			✓	FLT GND SYS FCF	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. If either of these alternative solutions is selected, aft body contact/tail strike protection functionality, if present on the aeroplane, should be active. Record time history data from 10 kt before start of rotation until at least 5 s after the occurrence of main gear lift-off.
1.b.4	Normal take-off.	± 3 kt 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			✓	FLT GND SYS FCF	Data required for near maximum certified take-off weight at mid centre of gravity location and light take-off weight at an aft centre of gravity location. If the aeroplane has more than one certified 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. The test may be used for ground acceleration time and distance 1.b(1). Plotted data should be shown using appropriate scales for each portion of the manoeuvre.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
1.b.5	Critical engine failure on take-off.	± 3 kt airspeed ± 1.5° pitch angle ± 1.5° AOA ± 6 m (20 ft) height ± 2° roll angle ± 2° 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			✓	FLT GND SYS FCF	Record take-off profile to at least 61 m (200 ft) AGL. Engine failure speed should be within ± 3 kt of the aeroplane data. Test at near maximum take-off weight.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
1.b.6	Crosswind take-off.	± 3 kt airspeed ± 1.5° pitch angle ± 1.5° AOA ± 6 m (20 ft) height ± 2° roll angle ± 2° sideslip angle ± 3° heading Correct trends at airspeeds below 40 kt for rudder/pedal and 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			✓	FLT GND SYS FCF	Record take-off profile from brake release to at least 61 m (200 ft) AGL. This test requires test data, including wind profile, for a crosswind component of at least 60 % of the aeroplane performance data value measured at 10m (33 ft) above the runway. Wind components should be provided as headwind and crosswind values with respect to the runway.
1.b.7	Rejected take-off.	± 5 % time or ± 1.5s ± 75 % distance or ± 76 m (250 ft)	Take-off			✓	FLT GND SYS FCF	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. Where a maximum braking demonstration is not available, an acceptable alternative is a test using approximately 80 % braking and

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
		For fidelity level R: ± 5% time, or ± 1·5s			✓		FLT GND SYS FCF	full reverse, if applicable. Time and distance should be recorded from brake release to a full stop. For fidelity level R: Record time for at least 80 % of the time segment from initiation of the rejected take-off to full stop.
1.b.8	Dynamic engine failure after take-off.	± 20 % or ± 2°/s body angular rates	Take-off			✓	FLT GND SYS FCF	Engine failure speed should be within ± 3 kt of the aeroplane data. Engine failure may be a snap deceleration to idle. Record hands off from 5 s before engine failure to + 5 s or 30 deg bank, whichever occurs first. Note: For safety considerations, aeroplane flight test may be performed out of ground effect at a safe altitude, but with correct aeroplane configuration and airspeed. CCA: Test in normal AND non-normal control state.
1.c	CLIMB							
1.c.1	Normal climb all engines operating	± 3 kt airspeed ± 5 % or ± 0.5 m/s (100 ft/min) R/C	Clean	CT&M	✓	✓	FLT SYS FCF	Flight test data is preferred; however, aeroplane performance manual data is an acceptable alternative. 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 fidelity levels G and R: This test may be a snapshot test.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
1.c.2	One engine inoperative second segment climb.	± 3 kt airspeed ± 5 % or ± 0.5 m/s (100 ft/min) R/C but not less than aeroplane performance data requirements.	2nd segment climb For FNPTs gear up and take-off flaps	C T & M	✓	✓	FLT SYS FCF	Flight test data is preferred; however, aeroplane performance manual data is an acceptable alternative. Record at nominal climb speed. FSTD performance to be recorded over an interval of at least 300 m (1 000 ft). Test at WAT (weight, altitude, or temperature) limiting condition. For fidelity levels G and R: This test may be a snapshot test.
1.c.3	One engine inoperative en-route climb.	± 10 % time ± 10 % distance ± 10 % fuel used	Clean			✓	FLT SYS FCF	Flight test data or aeroplane performance manual data may be used. Test for at least a 1 550 m (5 000 ft) segment.
1.c.4	One engine inoperative approach climb for aeroplanes with icing accountability if provided in the aeroplane performance data for this phase of flight.	± 3 kt airspeed ± 5 % or ± 0.5 m/s (100 ft/min) R/C but not less than aeroplane performance data requirements.	Approach			✓	FLT SYS FCF	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 certified 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 aeroplane performance data for an approach in icing conditions, should be applied.
1.d	CRUISE/DESCENT							

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
1.d.1	Level flight acceleration	± 5 % time	Cruise		✓	✓	FLT SYS FCF	Time required to increase airspeed a minimum of 50 kt, using maximum continuous thrust rating or equivalent. For aeroplanes with a small operating speed range, speed change may be reduced to 80 % of operational speed range.
1.d.2	Level flight deceleration	± 5 % time	Cruise		✓	✓	FLT SYS FCF	Time required to decrease speed a minimum of 50 kt, using idle power. For aeroplanes with a small operating speed range, speed change may be reduced to 80 % of operational speed range.
1.d.3	Cruise performance	± 0.05 EPR or ± 3 % N1 or ± 5 % torque ± 5% fuel flow	Cruise		✓	✓	FLT SYS FCF	The test 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.
1.d.4	Idle descent	± 3 kt airspeed ± 5 % or ± 1.0 m/s (200 ft/min) R/D	Clean			✓	FLT SYS FCF	Idle power stabilised descent at normal descent speed at mid altitude. FSTD performance to be recorded over an interval of at least 300 m (1 000 ft).
1.d.5	Emergency descent	± 5 kt airspeed ± 5 % or ± 1.5m/s (300 ft/min) R/D	As per aeroplane performance data			✓	FLT SYS FCF	Stabilised descent to be conducted with speed brakes 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).
1.e	STOPPING							

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
1.e.1	Deceleration time and distance, manual wheel brakes, dry runway, no reverse thrust.	± 5 % or ±1.5 s time. For distances up to 1220 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			✓	FLT GND SYS FCF	Time and distance should be recorded for at least 80 % of the total time from touchdown to a full stop. Position of ground spoilers and brake system pressure should be plotted (if applicable). Data required for medium and near maximum certified landing mass. Engineering data may be used for the medium mass condition.
1.e.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			✓	FLT GND SYS FCF	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. Position of ground spoilers should be plotted (if applicable). Data required for medium and near maximum certified landing mass. Engineering data may be used for the medium mass condition.
1.e.3	Stopping distance, wheel brakes, wet runway.	± 10 % or ± 61 m (200 ft) distance	Landing			✓	FLT GND SYS FCF	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.
1.e.4	Stopping distance, wheel brakes, icy runway.	± 10 % or ± 61 m (200 ft) distance	Landing			✓	FLT GND SYS FCF	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	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	**R**	**S**		
1.f	ENGINES							
1.f.1	Acceleration	± 10 % T_i or ± 0.25 s and ± 10 % T_t or ± 0.25 s	Approach or landing			✓	FLT SYS FCF	T_i = Total time from initial throttle movement until a critical engine parameter reaches 10 % of its total response above idle power. T_t = Total time from initial throttle movement until a critical engine parameter reaches 90 % of its total response above idle power. Total response is the incremental change in the critical engine parameter from idle power to go-around power. Refer to CS FSTD(A).QTG.200.
		For fidelity level R: ± 10 % T_i or ± 1 s and ± 10 % T_t or ± 1 s			✓		FLT SYS FCF	
		For fidelity level G: ± 10 % T_i or ± 1 s and ± 10 % T_t or ± 1 s		C T & M			FLT SYS FCF	
1.f.2	Deceleration	± 10 % T_i or ± 0.25 s and ± 10 % T_t or ± 0.25 s	Ground			✓	FLT SYS FCF	Ti = Total time from initial throttle movement until a critical engine parameter reaches 10 % of its total response below maximum take-off power. Tt = Total time from initial throttle movement until a critical engine parameter reaches 90 % of its total response below maximum take-off power. Total response is the incremental change in the critical engine parameter from maximum take-off power to idle power. Refer to CS FSTD(A).QTG.200.
		For fidelity level R: ± 10 % T_i or ± 1 s and ± 10 % T_t or ± 1 s			✓		FLT SYS FCF	
		For fidelity level G: ± 10 % T_i or ± 1 s and ± 10 % T_t or ± 1 s		C T & M			FLT SYS FCF	

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	**R**	**S**		
2.	HANDLING QUALITIES							
2.a	STATIC CONTROL CHECKS NOTE: Pitch, roll and yaw controller position versus force or time should be measured at the control. An alternative method in lieu of external test fixtures at the flight controls would be to have recording and measuring instrumentation built into the FSTD. The force and position data from this instrumentation could be directly recorded and matched to the aeroplane data. Provided the instrumentation was verified by using external measuring equipment while conducting the static control checks, or equivalent means, and that evidence of the satisfactory comparison is included in the MQTG, the instrumentation could be used for both initial and recurrent evaluations for the measurement of all required control checks. Verification of the instrumentation by using external measuring equipment should be repeated if major modifications or repairs are made to the control loading system. Such a permanent installation could be used without any time being lost for the installation of external devices. Static and dynamic flight control tests should be accomplished at the same feel or impact pressures as the validation data where applicable. NOTE: FSTD static control testing from the second set of pilot controls is only required if both sets of controls are not mechanically interconnected on the FSTD. A rationale is required from the data provider if a single set of data is applicable to both sides. If controls are mechanically interconnected in the FSTD, a single set of tests is sufficient. CCA: Testing of position versus force is not applicable if forces are generated solely by use of aeroplane hardware in the FSTD.							
2.a.1	Pitch controller position versus force and surface position calibration.	± 0.9 daN (2 lb) breakout. ± 2.2 daN (5 lb), or ± 10 % force. ± 2° elevator angle	Ground		✓	✓	FLT SYS FCF	Uninterrupted control sweep to stops. Test results should be validated from in-flight data from tests such as longitudinal static stability, stalls, etc.
	Pitch controller position versus force.	± 0.9 daN (2 lb) breakout ± 2.2 daN (5 lb), or ± 10 % force.	Approach	CT&M			FLT SYS FCF	Control forces and travel should broadly correspond to those of the replicated class of aeroplane

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
2.a.2	Roll controller position versus force and surface position calibration.	± 0.9 daN (2 lb) breakout ± 1.3 daN (3 lb), or ± 10 % force ± 2° aileron angle ± 3° spoiler angle	Ground		✓	✓	FLT SYS FCF	Uninterrupted control sweep to stops. Test results should be validated with in-flight data from tests such as engine out trims, steady state sideslips, etc.
	Roll controller position versus force.	± 0.9 daN (2 lb) breakout ± 1.3 daN (3 lb), or ± 10 % Force	Approach	C T & M			FLT SYS FCF	Control forces and travel should broadly correspond to those of the replicated class of aeroplane
2.a.3	Rudder pedal position versus force and surface position calibration.	± 2.2 daN (5 lb) breakout ± 2.2 daN (5 lb) or ± 10 % force ± 2° rudder angle	Ground		✓	✓	FLT SYS FCF	Uninterrupted control sweep to stops. Test results should be validated with in flight data from tests such as engine out trims, steady state sideslips, etc.
	Rudder pedal position versus force.	± 2.2 daN (5 lb) breakout ± 2.2 daN (5 lb), or ± 10 % force.	Approach	C T & M			FLT SYS FCF	Control forces and travel should broadly correspond to those of the replicated class of aeroplane
2.a.4	Nosewheel steering controller force and position calibration.	± 0.9 daN (2 lb) breakout ± 1.3 daN (3 lb), or ± 10 % force ± 2° NWA	Ground		✓	✓	FLT SYS FCF	Uninterrupted control sweep to stops.
2.a.5	Rudder pedal steering calibration.	± 2° NWA	Ground		✓	✓	FLT SYS FCF	Uninterrupted control sweep to stops.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
2.a.6	Pitch trim versus surface position calibration.	± 0.5° trim angle	Ground			✓	FLT SYS FCF	The purpose of this test is to compare the FSTD surface position indicator against the FSTD flight controls model computed value.
		± 1° of trim angle		CT&M	✓		FLT SYS FCF	
2.a.7	Pitch trim rate.	± 10 % of trim rate(°/s), or ± 0.1°/s trim rate	Ground and approach		✓	✓	FLT SYS FCF	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. For CCA, representative flight test conditions should be used.
2.a.8	Alignment of cockpit throttle lever versus selected engine parameter.	When matching engine parameters: ± 5° of TLA When matching detents: or ± 3 % N1 or ± 0.03 EPR or ± 3 % torque or equivalent. Where the levers do not have angular travel, a tolerance of ± 2 cm (± 0.8 in) applies.	Ground	CT&M	✓	✓	FLT SYS FCF	Simultaneous recording for all engines. The tolerances apply against the aeroplane data. For aeroplanes with throttle detents, all detents to be presented and at least one position between detents/endpoints (where practical). For aeroplanes without detents, end points and at least three other positions are to be presented. Data from a test aeroplane or engineering test bench is acceptable, provided that the correct engine controller (both hardware and software) is used. 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. This test may be a series of snapshot tests.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
2.a.9	Brake pedal position versus force and brake system pressure calibration.	± 2.2 daN (5 lb) or ± 10 % force. ± 1.0 MPa (150 psi) or ± 10 % brake system pressure.	Ground			✓	FLT SYS FCF	FSTD computer output results may be used to show compliance. Relate the hydraulic system pressure to pedal position in a ground static test. Both left and right pedals should be checked.
		± 2.2 daN (5 lb) ,or ± 10 % of force			✓		FLT SYS FCF	
2.a.10	Stick pusher system force calibration (if applicable).	± 10 % or ± 5 lb (2.2 daN) stick/column transient force	Ground or flight			✓	FLT SYS FCF	This test is intended to validate the stick/column transient force resulting from a stick pusher system activation. This test may be conducted in an on-ground condition through stimulation of the stall protection system in a manner that generates a stick pusher response representative of an in-flight condition. Aeroplane manufacturer design data may be utilised as validation data, if acceptable to the competent authority. The test provisions may be met through column force validation testing in conjunction with the stall characteristics test (FSTD validation test 2.c.8a). This test is required only for FSTDs that are to be qualified to conduct full-stall training tasks.
2.b	DYNAMIC CONTROL CHECKS Note: Tests 2.b(1), 2.b(2), and 2.b(3) are not applicable for FSTDs where the control forces are completely generated within the aeroplane controller unit installed in the FSTD. Power setting may be that required for level flight unless otherwise specified.							

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL G	R	S	RELEVANT FEATURES	COMMENTS
2.b.1	Pitch control.	**For underdamped systems:** $T(P_0) \pm 10$ % of P_0 or ± 0.05 s. $T(P_1) \pm 20$ % of P_1 or ± 0.05 s. $T(P_2) \pm 30$ % of P_2 or ± 0.05 s. $T(P_n) \pm 10*(n+1)$% of P_n or ± 0.05 s. $T(A_n) \pm 10$ % of A_{max}, where A_{max} is the largest amplitude or ± 0.5 % of the total control travel (stop to stop). $T(A_d) \pm 5$ % of A_d = residual band or ± 0.5 % of the maximum control travel = residual band. ± 1 significant overshoots (minimum of 1 significant overshoot). Steady state position within residual band. *Note 1. Tolerances should not be applied on period or amplitude after the last significant overshoot.* *Note 2. Oscillations within the residual band are not considered significant and are not subject to tolerances.* **For overdamped and critically damped systems only**, the following tolerance applies: $T(P_0) \pm 10$ % of P_0 or ± 0.05 s.	Take-off, cruise, and landing			✓	FLT SYS FCF	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. Please refer to CS FSTD(A).QTG.210.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
2.b.2	Roll control.	Same as 2. b.1.	Take-off, cruise, and landing			✓	FLT SYS FCF	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). Please refer to CS FSTD(A).QTG.210.
2.b.3	Yaw control.	Same as 2.b.1.	Take-off, cruise, and landing			✓	FLT SYS FCF	Data should be for normal displacement (approximately 25 to 50 % of full throw). Please refer to CS FSTD(A).QTG.210.
2.b.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			✓	FLT SYS FCF	Control inputs should be typical of minor corrections made while established on an ILS approach (approximately 0.5 to 2°/s pitch rate). Test in both directions. Show time history data from 5 s before until at least 5 s after initiation of control input. If a single test is used to demonstrate both directions, there should be a minimum of 5 s before control reversal to the opposite direction. CCA: Test in normal AND non-normal control state.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	**R**	**S**		
2.b.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			✓	FLT SYS FCF	Control inputs should be typical of minor corrections made while established on an ILS approach (approximately 0·5 to 2°/s roll rate). Test in one direction. For aeroplanes that exhibit non-symmetrical behaviour, test in both directions. Show time history data from 5 s before until at least 5s after initiation of control input. If a single test is used to demonstrate both directions, there should be a minimum of 5 s before control reversal to the opposite direction. CCA: Test in normal AND non-normal control state.
2.b.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			✓	FLT SYS FCF	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 both directions. Show time history data from 5 s before until at least 5 s after initiation of control input. If a single test is used to demonstrate both directions, there should be a minimum of 5 s before control reversal to the opposite direction. CCA: Test in normal AND non-normal control state.
2.c	LONGITUDINAL Note. Power setting may be that required for level flight unless otherwise specified.							

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	**R**	**S**		
2.c.1	Power change dynamics.	± 3 kt airspeed ± 30 m (100 ft) altitude. ± 1.5° or ± 20 % pitch angle	Approach	CT&M	✓	✓	FLT SYS FCF	Power change from thrust for approach or level flight to maximum continuous or go-around power. Time history of uncontrolled free response for a time increment equal to at least 5 s before initiation of the power change to completion of the power change +15 s. CCA: Test in normal AND non-normal control state. For fidelity levels G and R: Test in normal mode only.
	OR for fidelity level G Power change force	± 2.2 daN (5 lb),or ± 20 % pitch controller force		CT&M			FLT SYS FCF	Force tests (fidelity level G devices) should provide the force required to maintain constant airspeed or altitude to complete the configuration change.
2.c.2	Flap change dynamics.	± 3 kt airspeed ± 30 m (100 ft) altitude. ± 1.5° or ± 20 % pitch angle	Take-off through initial flap retraction and approach to landing	CT&M	✓	✓	FLT SYS FCF	Time history of uncontrolled free response for a time increment equal to at least 5 s before initiation of the reconfiguration change to completion of the reconfiguration change +15 s. CCA: Test in normal AND non-normal control state. For fidelity levels G and R: Test in normal mode only.
	OR for fidelity level G Flap change force	± 2.2 daN (5 lb),or ± 20 % pitch controller force		CT&M			FLT SYS FCF	Force tests (fidelity level G devices) should provide the force required to maintain constant airspeed or altitude to complete the configuration change.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	**R**	**S**		
2.c.3	Spoiler / speed brake change dynamics.	± 3 kt airspeed ± 30 m (100 ft) altitude. ± 1.5° or ± 20 % pitch angle	Cruise	CT&M	✓	✓	FLT SYS FCF	Time history of uncontrolled free response for a time increment equal to at least 5 s before initiation of the reconfiguration change to completion of the reconfiguration change +15 s. Results required for both extension and retraction. CCA: Test in normal AND non-normal control state. <u>For fidelity levels G and R:</u> Test in normal mode only.
2.c.4	Gear change dynamics	± 3 kt airspeed ± 30 m (100 ft) altitude. ± 1.5° or ± 20 % pitch angle	Take-off (retraction) and approach (extension)	CT&M	✓	✓	FLT SYS FCF	Time history of uncontrolled free response for a time increment equal to at least 5 s before initiation of the configuration change to completion of the reconfiguration change +15 s. CCA: Test in normal AND non-normal control state. <u>For fidelity levels G and R:</u> Test in normal mode only.
	<u>**OR** for fidelity level G</u> Gear change force	± 2.2 daN (5 lb),or ± 20 % pitch controller force.		CT&M			FLT SYS FCF	Force tests (fidelity level G devices) should provide the force required to maintain constant airspeed or altitude to complete the configuration change.
2.c.5	Longitudinal trim.	<u>For fidelity level S:</u> ± 1° elevator ± 0.5°stabiliser ± 1° pitch angle ± 5 % of net thrust or equivalent	Cruise, approach, and landing			✓	FLT SYS FCF	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, as applicable.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	**R**	**S**		
		For fidelity level R : ± 2° elevator ± 1° stabiliser) ± 2° pitch ± 5 % of net thrust or equivalent			✓		FLT SYS FCF	For fidelity level R: May use pitch controller position instead of elevator angle and trim control position instead of stabiliser angle. May be a series of snapshot tests.
		For fidelity level G: ± 2° elevator angle. ± 1° stabiliser angle. ± 2° pitch angle. ± 5 % of net thrust or equivalent.		CT&M			FLT SYS FCF	For fidelity level G: May use pitch controller position instead of elevator angle and trim control position instead of stabiliser angle. May be a series of snapshot tests.
2.c.6	Longitudinal manoeuvring stability (stick force/g).	± 2.2 daN (5 lb) or ± 10 % pitch controller force	Cruise, approach, and landing	CT&M	✓	✓	FLT SYS FCF	Continuous time history data or a series of snapshot tests may be used. Test up to approximately 30° of roll angle for approach and landing configurations. Test up to approximately 45° of roll angle for the cruise configuration. Force tolerance not applicable if forces are generated solely by the use of aeroplane hardware in the FSTD. CCA: Test in normal AND non-normal control state, as applicable. For fidelity levels G and R: Test in normal mode only.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
		Alternative method: ± 1° or ± 10 % of the change of elevator angle		CT&M	✓	✓	FLT SYS FCF	Alternative method applies to aeroplanes which do not exhibit stick-force-per-g characteristics. For the alternative method, fidelity level R devices may use pitch controller position instead of elevator angle. For fidelity levels G and R: Tests in cruise, approach or landing if appropriate.
2.c.7	Longitudinal static stability.	± 2.2 daN (5lb) or ± 10 % pitch controller force.	Approach	CT&M	✓	✓	FLT SYS FCF	Data for at least two speeds above and two speeds below trim speed. The speed range should be sufficient to demonstrate stick force versus speed characteristics. This test 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. CCA: Test in normal OR non-normal control state, as applicable.
		Alternative method: ± 1° or ± 10 % of the change of elevator angle		CT&M	✓	✓	FLT SYS FCF	Alternative method applies to aeroplanes which do not exhibit speed stability characteristics. For the alternative method, fidelity level R devices may use pitch controller position instead of elevator angle.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
2.c.8.a	Stall characteristics.	± 3 kt airspeed for stall warning and stall speeds. ± 2° angle of attack for the buffet threshold of perception and for the initial buffet based upon the Nz component. Control inputs should be plotted and demonstrate correct trend and magnitude. Approach to stall: ± 2.0° pitch angle; ± 2.0° angle of attack; and ± 2.0° bank angle. Stall warning up to stall: ± 2.0° pitch angle; ± 2.0° angle of attack; and correct trend and magnitude for roll rate and yaw rate. Stall break and recovery: see CS FSTD(A).UPRT.005. Additionally, for those simulators with reversible flight control systems or equipped with stick pusher systems: ± 10 % or ± 2.2 daN (5 lb) stick/column force (prior to the stall angle of attack).	2nd segment climb, high-altitude cruise (near performance-limited condition) and approach or landing			✓	FLT SYS FCF	Applicable only for those FSTDs that are to be qualified for full-stall training tasks. Please refer to CS FSTD(A).UPRT.001(b)(1). For CCA aeroplanes with stall envelope protection systems: test in normal and non-normal control states. In normal control state, it is expected that envelope protections will take effect, and it may not be possible to reach the aerodynamic stall condition for some aeroplanes. The test is only required for an angle of attack range necessary to demonstrate the correct operation of the system. These tests may be used to satisfy the required (angle of attack) flight manoeuvre and envelope protection tests (2.h.6.). In non-normal state, it is necessary to perform the test to the aerodynamic stall. It is understood that flight test data may not be available and, in this circumstance, engineering validation data may be used and the extent of the test should be adequate to allow training through to recovery, in accordance with the training objectives. For safety of flight considerations, the flight test data may be limited to the stall angle of attack, and the modelling beyond the stall angle of attack is only required to ensure it is limited to continuity and completion of the recovery.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
2.c.8.b	Approach-to-stall characteristics	± 3 kt airspeed for stall waning speeds. ± 2.0° angle of attack for initial buffet: ± 2.0° pitch angle; ± 2.0° angle of attack; and ± 2.0° bank angle. Additionally, for those aeroplanes with reversible flight control systems: ± 10 % or ± 5 lb (2.2 daN)) stick/column force.	Second-segment climb, high-altitude cruise (near performance-limited condition) and approach or landing			✓	FLT SYS FCF	Applicable for FSTDs not qualified to conduct full-stall training tasks. Please refer to CS FSTD(A).UPRT.001(b)(2). CCA: Test in normal and non-normal control states.
		± 3 kt airspeed for stall warning.		CT&M	✓		FLT SYS FCF	For fidelity levels G and R: Test in normal mode only, as applicable.
2.c.9	Phugoid dynamics.	± 10 % period. ± 10 % time to one half or double amplitude, or ± 0.02 of damping ratio.	Cruise			✓	FLT SYS FCF	The test should include three full cycles or those necessary to determine time to one half or double amplitude, whichever is less. CCA: Test in non-normal control state.
		For fidelity levels R and G: ± 10 % period with representative damping.		CT&M	✓		FLT SYS FCF	
2.c.10	Short-period dynamics.	± 1.5° pitch angle or ± 2°/s pitch rate. ± 0.1 g normal acceleration.	Cruise			✓	FLT SYS FCF	CCA: Test in normal AND non-normal control state.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
2.d	LATERAL DIRECTIONAL Note. Power setting may be that required for level flight unless otherwise specified.							
2.d.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 kt airspeed	Take-off or landing (whichever is most critical in the aeroplane)	CT&M	CT&M	✓	FLT SYS FCF	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. For fidelity levels G and R: It is important that there exists a realistic speed relationship between Vmca (or Vmcl) and Vs for all configurations and in particular the most critical full-power engine-out configuration.
2.d.2	Roll response (rate).	± 10 % or ± 2°/s roll rate	Cruise and approach or landing	CT&M	✓	✓	FLT SYS FCF	Test with normal roll control displacement (about one third of maximum roll controller travel). This test may be combined with step input of flight deck roll controller test 2.d(3).
		For aeroplanes with reversible flight control systems: ± 10 % or ± 1.3 daN (3 lb) roll controller force		CT&M	✓	✓	FLT SYS FCF	

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
2.d.3	Step input of cockpit roll controller (or roll overshoot).	± 10 % or ± 2° bank angle	Approach or landing		✓	✓	FLT SYS FCF	With wings level, apply a step roll control input using approximately one third of maximum roll controller travel. At approximately 20° to 30° roll angle, abruptly return the roll controller to neutral and allow at least 10 s of aeroplane free response. This test may be combined with roll response (rate) test 2.d(2). CCA: Test in normal AND non-normal control state. <u>For fidelity level R:</u> Test in normal mode only.
2.d.4	Spiral stability.	Correct trend and ± 2° or ± 10 % bank angle in 20 s If alternate test is used: correct trend and ± 2° aileron angle.	Cruise and approach or landing			✓	FLT SYS FCF	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 roll angle of approximately 30°. CCA: Test in non-normal control state.
		<u>For fidelity levels G and R:</u> Correct trend and ± 3° or ± 10 % of roll angle in 20 s.		C T & M	✓		FLT SYS FCF	
2.d.5	Engine inoperative trim.	± 1° rudder angle or ± 1° tab angle or equivalent rudder pedal. ± 2° sideslip angle.	2nd segment climb and approach or landing		✓	✓	FLT SYS FCF	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. This test may be snapshot tests. <u>For fidelity level R:</u> Sideslip angle is matched only for repeatability and only on continuing recurrent evaluations.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
2.d.6	Rudder response.	± 2°/s or ± 10 % yaw rate	Approach or landing		✓	✓	FLT SYS FCF	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. <u>For fidelity levels G and R:</u> Test in normal mode only.
		<u>**OR** for fidelity level G:</u> ± 2°/s or ± 10 % of yaw rate or ± 10 % of heading change		CT&M			FLT SYS FCF	
2.d.7	Dutch roll (yaw damper OFF).	± 0.5 s or ± 10 % of period. ± 10 % of time to one half or double amplitude or ± 0.02 of damping ratio. ± 20 % or ± 1 s of time difference between peaks of roll angle and sideslip	Cruise and approach or landing			✓	FLT SYS FCF	Test for at least six cycles with stability augmentation OFF. CCA: Test in non-normal control state.
		<u>For fidelity level R:</u> ± 0.5 s or ± 10 % of period, with representative damping.			✓		FLT SYS FCF	

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
2.d.8	Steady state sideslip.	For a given rudder position: ± 2° roll angle ± 1° sideslip angle ± 2° or ± 10 % aileron angle; and ± 5° or ± 10 % of spoiler or equivalent roll controller position or force.	Approach or landing	CT&M	✓	✓	FLT SYS FCF	This test 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 the maximum allowable rudder. <u>For fidelity level R:</u> Roll controller position instead of aileron angle may be used. Sideslip angle is matched only for repeatability and only on continuing recurrent evaluations.
		For aeroplanes with reversible flight control systems: ± 1.3 daN (3 lb) or ± 10 % of wheel force. ± 2.2 daN (5lb) or ± 10 % of rudder pedal force.		CT&M	✓	✓	FLT SYS FCF	

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
2.e	LANDINGS							
2.e.1	Normal landing	± 3 kt airspeed ± 1.5° pitch angle ± 1.5° AOA ± 3 m (10ft) or ± 10 % of height For aeroplanes with reversible flight control systems: ± 10 % or ± 2.2 daN (5 lb) of column force	Landing			✓	FLT GND SYS FCF	Test from a minimum of 61 m (200 ft) AGL to nosewheel touchdown. Two tests should be shown, including two normal landing flaps (if applicable) one of which should be near maximum certified landing mass, the other at light or medium mass. CCA: Test in normal AND non-normal control state if applicable.
2.e.2	Minimum flap landing.	± 3 kt airspeed ± 1.5° pitch angle ± 1.5° AOA ± 3 m (10 ft) or ± 10 % of height For aeroplanes with reversible flight control systems: ± 10 % or ± 2.2 daN (5 lb) of column force	Minimum certified landing flap configuration			✓	FLT GND SYS FCF	Test from a minimum of 61 m (200 ft) AGL to nosewheel touchdown. Test at near maximum landing mass.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
2.e.3	Crosswind landing.	± 3 kt airspeed ± 1.5° pitch angle ± 1.5° AOA ± 3 m (10 ft) or ± 10 % height ± 2° roll angle ± 2° sideslip angle ± 3° heading angle For aeroplanes with reversible flight control systems: ± 10 % or ± 2.2 daN (5 lb) of column force ± 10 % or ± 1.3 daN (3 lb) of wheel force ± 1 0% or ± 2.2 daN (5 lb) of rudder pedal force.	Landing			✓	FLT GND SYS FCF	Test from a minimum of 61 m (200ft) 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 aeroplane performance data value measured at 10 m (33 ft) above the runway. Wind components should be provided as headwind and crosswind values with respect to the runway.
2.e.4	One engine inoperative landing.	± 3 kt airspeed ± 1.5° pitch angle ± 1.5° AOA ± 3 m (10 ft) or ± 10 % height ± 2° roll angle ± 2° sideslip angle ± 3° heading angle	Landing			✓	FLT GND SYS FCF	Test from a minimum of 61 m (200 ft) AGL to a 50 % decrease in main landing gear touchdown speed.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	**R**	**S**		
2.e.5	Autopilot landing (if applicable).	± 1.5 m (5 ft) flare height. ± 0.5 s or ± 10 % Tf. ± 0.7 m/s (140 ft/min) R/D at touchdown. ± 3 m (10ft) lateral deviation during rollout.	Landing			✓	FLT GND SYS FCF	If autopilot provides rollout guidance, record lateral deviation from touchdown to a 50 % decrease in main landing gear touchdown speed. Time of autopilot flare mode engage and main gear touchdown should be noted. This test <u>is not</u> a substitute for the ground effects test requirement. T_f = Duration of flare.
2.e.6	All engine autopilot go around.	± 3 kt airspeed ± 1.5° pitch angle ± 1.5° AOA	As per aeroplane performance data.			✓	FLT GND SYS FCF	Normal all engine autopilot go-around should be demonstrated (if applicable) at medium mass.
2.e.7	One-engine-inoperative go-around	± 3 kt airspeed ± 1.5° pitch angle ± 1.5° AOA ± 2° bank angle ± 2° sideslip angle	As per aeroplane performance data.			✓	FLT GND SYS FCF	Engine inoperative go-around required near maximum certified landing mass 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.
2.e.8	Directional control (rudder effectiveness) with reverse thrust symmetric).	± 5 kt airspeed ± 2°/s yaw rate	Landing			✓	FLT GND SYS FCF	Apply rudder pedal input in both directions using full reverse thrust until reaching full thrust reverser minimum operating speed.
2.e.9	Directional control (rudder effectiveness) with reverser thrust (asymmetric)	± 5 kt airspeed ± 3° heading angle	Landing			✓	FLT GND SYS FCF	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.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
2.f.	GROUND EFFECT							
2.f.1	A test to demonstrate ground effect.	± 1° elevator ± 0.5° stabiliser angle. ± 5 % net thrust or equivalent. ± 1° AOA ± 1.5 m (5ft) or ± 10 % height ± 3 kt airspeed ± 1° pitch angle	Landing			✓	FLT SYS FCF	Please refer to CS FSTD(A).QTG.220. A rationale should be provided with justification of results. CCA: Test in normal OR non-normal control state.
2.g	WIND SHEAR							
2.g.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			✓	FLT GND SYS FCF	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.
2.h	FLIGHT AND MANOEUVRE ENVELOPE PROTECTION FUNCTIONS Note: 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 reac h the envelope protection function.							
2.h.1	Overspeed.	± 5 kt airspeed	Cruise			✓	FLT SYS FCF	

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
2.h.2	Minimum speed.	± 3 kt airspeed	Take-off, cruise and approach or landing			✓	FLT SYS FCF	
2.h.3	Load factor.	± 0.1 g normal acceleration	Take-off, cruise			✓	FLT SYS FCF	
2.h.4	Pitch angle.	± 1.5° pitch angle	Cruise, approach			✓	FLT SYS FCF	
2.h.5	Bank angle.	± 2° or ± 10 % roll angle	Approach			✓	FLT SYS FCF	
2.h.6	Angle of attack.	± 1.5° AOA	Second segment climb and approach or landing			✓	FLT SYS FCF	
2.i	ENGINE AND AIRFRAME ICING EFFECTS							

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
2.i.1	Engine and airframe icing effects Demonstration (high angle of attack)		Take-off or approach or landing (one flight condition, two tests: ice on and ice off)			✓	FLT SYS FCF	This validation test is applicable only for those FSTDs that are to be qualified for full-stall training tasks. Please refer to CS FSTD(A).UPRT.001(b)(3).
3.	MOTION SYSTEM							
3.a	Frequency response	As specified by the applicant for FSTD qualification.	n/a		✓	✓	MOT	Appropriate test to demonstrate the frequency response required. See also CS FSTD(A).QTG.230(b).
3.b	Turn-around check	As specified by the applicant for FSTD qualification.	n/a		✓	✓	MOT	Appropriate test to demonstrate required smooth turn-around. See also CS FSTD(A).QTG.230(b).
3.c	Motion effects						MOT	Refer to CS FSTD(A).FST.105 (13) MOTION AND VIBRATION EFFECTS.
3.d	Motion system repeatability	± 0.05 g actual platform linear accelerations.	None		✓	✓	MOT	This test ensures that motion system hardware and software (in normal FSTD operating mode) continue to perform as originally qualified. Performance changes from the original baseline can be readily identified with this information. See CS FSTD(A).QTG.230(c).

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
3.e	Motion cueing fidelity – Frequency-domain criterion.	Please refer to CS FSTD(A).QTG.235.	Ground and flight			✓	MOT	For the motion system as applied during training, record the combined modulus and phase of the motion cueing algorithm and motion platform over the frequency range appropriate to the characteristics of the simulated aeroplane. This test is only required during the initial FSTD qualification or if changes are made to the motion drive algorithms. Please refer to CS FSTD(A).QTG.235.
3.f	Characteristic motion vibrations. 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. <u>For motion cues feature fidelity level S:</u> The validation data and FSTD results should be produced using comparable data analysis techniques. The recorded test results for characteristic buffets should allow the comparison of relative amplitude versus frequency. See CS FSTD(A).QTG.230(e). <u>For motion cues feature fidelity level R:</u> Footprint tests only are required. Where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations.							
3.f.1	Thrust effects with brakes set.	The FSTD test results should exhibit the overall appearance and trends of the aeroplane data, with at least three (3) of the predominant frequency ‘spikes’ being present within ± 2 Hz of the aeroplane data.	Ground		✓	✓	MOT	The test should be conducted at maximum possible thrust with brakes set.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
3.f.2	Landing gear extended buffet.	The FSTD test results should exhibit the overall appearance and trends of the aeroplane data, with at least three (3) of the predominant frequency 'spikes' being present within ± 2 Hz of the aeroplane data.	Flight		✓	✓	MOT	Test condition should be for a normal operational speed and not at the gear limiting speed.
3.f.3	Flaps extended buffet.	The FSTD test results should exhibit the overall appearance and trends of the aeroplane data, with at least three (3) of the predominant frequency 'spikes' being present within ± 2 Hz of the aeroplane data.	Flight		✓	✓	MOT	Test condition should be for a normal operational speed and not at the flap limiting speed.
3.f.4	Speed brake deployed buffet.	The FSTD test results should exhibit the overall appearance and trends of the aeroplane data, with at least three (3) of the predominant frequency 'spikes' being present within ± 2 Hz of the aeroplane data.	Flight		✓	✓	MOT	Test condition should be at a typical speed for a representative buffet.

TESTS		TOLERANCE	FLIGHT CONDITIONS	FEATURE FIDELITY LEVEL			RELEVANT FEATURES	COMMENTS
				G	R	S		
3.f.5	Stall buffet	The FSTD test results should exhibit the overall appearance and trends of the aeroplane data, with at least three (3) of the predominant frequency 'spikes' being present within ± 2 Hz of the aeroplane data.	Cruise (high altitude), second-segment climb, and approach or landing		✓	✓	MOT	Test required only for FSTDs that are to be qualified for full-stall training tasks or for those aeroplanes which exhibit stall buffet before the activation of the stall warning system. Tests must be conducted for an angle of attack range between the buffet threshold of perception to the pilot and the stall angle of attack. Post-stall characteristics are not required. If stabilised flight data between buffet threshold of perception and stall angle of attack are not available, PSD analysis should be conducted for a time span between initial buffet and stall angle of attack. Please refer to the table of function and subjective tests: CS FSTD(A).FST.105, Test 13.(h).
3.f.6	High speed or Mach buffet	The FSTD test results should exhibit the overall appearance and trends of the aeroplane data, with at least three (3) of the predominant frequency 'spikes' being present within ± 2 Hz of the aeroplane data.	Flight		✓	✓	MOT	Test condition should be for high-speed manoeuvre buffet/wind-up-turn or alternatively Mach buffet.
3.f.7	In-flight vibrations	The FSTD test results should exhibit the overall appearance and trends of the aeroplane data, with at least three (3) of the predominant frequency 'spikes' being present within ± 2Hz of the aeroplane data.	Flight in clean configuration		✓	✓	MOT	The test should be conducted to be representative of in-flight vibrations for propeller-driven aeroplanes.

4.	VISUAL SYSTEM							
	The validation tests in this section have a dependency upon the following simulation features: — Visual cue provides the dynamic performance of the visual system with the view presented to the pilot. — Environment — Airports and terrain provides the visual database from which the content of the scene is presented. Together these make up the visual display. However, as separate device features, they have their own fidelity levels. So, a particular device will need to have the appropriate combination of fidelity levels for these two device features. This must be accounted for when checking the operational system.							
4.a	VISUAL SCENE QUALITY							
4.a.1.a	Continuous collimated cross-cockpit visual field of view.	Cross-cockpit collimated visual display providing each pilot with a minimum of 200° horizontal and 40° vertical continuous field of view.	n/a			✓	VIS	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 an SoC (this would generally consist of results from acceptance testing).
4.a.1.b	Continuous cross-cockpit visual field of view.	Visual display providing each pilot with a minimum of 200° horizontal and 40° vertical continuous field of view.	n/a		✓		VIS	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 an SoC (this would generally consist of results from acceptance testing).
4.a.1.c	Display field of view.	Visual field-of-view for each pilot with a minimum of 45° horizontally and 30° vertically, unless restricted by the type of aeroplane, simultaneously for each pilot.	n/a	✓			VIS	The minimum distance from the pilot's eye position to the surface of a direct view display may not be less than the distance to any front panel instrument. 30° vertical field of view may be insufficient to meet the requirements of the visual ground segment (if required). This needs to be considered in the FOV calculation.

4.a.2.a.1	System geometry – image position.	From each eyepoint position, the centre of the image is between 0° and 2° inboard in the horizontal plane and within +/-0.25° vertically. The difference between the left and right horizontal angles should not exceed 1°.	n/a			✓	VIS	The image position should be checked relative to the FSTD centreline. Where there is a design offset in the vertical display centre, this should be stated.
4.a.2.a.2	System geometry – absolute geometry.	Within the central 200° x 40°, all points on a 5°grid should fall within 3° of the design position as measured from each pilot eyepoint.	n/a			✓	VIS	Where a system with more than 200° x 40° is supplied, the geometry outside the central area should not have any distracting discontinuities.

4.a.2.a.3	System geometry – relative geometry.	Measurements of relative dot positions should be made every 5°. In the area from -10° to the lowest visible point at 15° azimuth inboard, 0°, 30°, 60° and 90° outboard for each pilot position, vertical measurements should be made every 1° to the edge of the visible image. The relative position from one point to the next should not exceed: Zone 1: 0.075°/degree; Zone 2: 0.15°/degree; Zone 3: 0.2°/degree.	n/a			✓	VIS	For a diagram showing zones 1, 2 and 3 and further discussion of this test, see CS FSTD(A).QTG.240(c) Image geometry. *Note. A means to perform this check with a simple go/no go gauge is encouraged for recurrent testing.*
4.a.2.b		Geometry of image should have no distracting discontinuities		✓	✓		VIS	
4.a.3	Surface resolution (object detection).	Not greater than 2 arc minutes	n/a			✓	VIS	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 object will subtend 2 arc minutes to the eye. This may be demonstrated using threshold bars for a horizontal test. A vertical test should also be demonstrated. The subtended angles should be confirmed by calculations in an SoC.

		Not greater than 4 arc minutes.			✓		VIS	Resolution will 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 eyepoint. The object will subtend 4 arc minutes to the eye. This may be demonstrated using threshold bars for a horizontal test. A vertical test should also be demonstrated. The subtended angles should be confirmed by calculations in an SoC.
4.a.4	Lightpoint size.	Not greater than 5 arc minutes.	n/a			✓	VIS	Light point size should be measured using a test pattern consisting of a centrally located single row of white light points displayed as both a horizontal and vertical row. It should be possible to move the light points relative to the eyepoint in all axes. At a point where modulation is just discernible in each visual channel, a calculation should be made to determine the light spacing. An SoC is required to state test method and calculation.
		Not greater than 8 arc minutes.			✓		VIS	
4.a.5	Raster surface contrast ratio.	Not less than 5:1	n/a	✓	✓	✓	VIS	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 (2ft-lamberts). Measure any adjacent dark squares. The contrast ratio is the bright square value divided by the dark square value. Note 1. During contrast ratio testing, FSTD aft-cab and flight deck ambient light levels should be as low as possible. Note 2. Measurements should be taken at the centre of squares to avoid light spill into the measurement device.

4.a.6	Lightpoint contrast ratio.	Not less than 25:1	n/a			✓	VIS	Lightpoint contrast ratio should be measured using a test pattern demonstrating an area of greater than 1° area filled with white lightpoints and should be compared to the adjacent background. Note. Light point modulation should be just discernible on calligraphic systems but will not be discernible on raster systems. Measurements of the background should be taken such that the bright square is just out of the light meter FOV. Note. During contrast ratio testing, FSTD aft-cab and flight deck ambient light levels should be as low as possible.
		Not less than 10:1			✓		VIS	
4.a.7	Light point brightness.	Not less than 20 cd/m² (5.8 ft-lamberts).	n/a		✓	✓	VIS	Light points should be displayed as a matrix creating a square. On calligraphic systems, the light points should just merge. If projectors using solid-state illuminators are employed, refer to CS FSTD(A).QTG.240. On raster systems, the light points should overlap such that the square is continuous (individual light points will not be visible).
4.a.8	Surface brightness	Not less than 20 cd/m² (5.8 ft-lamberts) on the display	n/a			✓	VIS	Surface brightness should be measured on a white raster, measuring the brightness using the 1° spot photometer. Lightpoints are not acceptable. Use of calligraphic capabilities to enhance raster brightness is acceptable.
		Not less than 14 cd/m² (4.1 ft-lamberts) on the display.			✓		VIS	

4.a.9	Black level and sequential contrast.	Black intensity: Background brightness – Black polygon brightness < 0.015 cd/m² (0.004 ft-lamberts). Sequential contrast: Maximum brightness – (Background brightness – Black polygon brightness) > 2 000:1.	n/a			✓	VIS	The light meter should be mounted in a fixed position viewing the forward centre area of each display. All projectors should be turned off and the cockpit environment made as dark as possible. A background reading should be taken of the remaining ambient light on the screen. The projectors should then be turned on and a black polygon displayed. A second reading should then be taken and the difference between this and the ambient level recorded. A full brightness white polygon should then be measured for the sequential contrast test. This test is generally only required for light valve projectors. An SoC should be provided if the test is not run, stating why.
4.a.10	Motion blur.	When a pattern is rotated about the eyepoint at 10°/s, the smallest detectable gap should be 4 arc min or less.	n/a			✓	VIS	A test pattern consists of an array of 5 peak white squares with black gaps of decreasing width between them. The range of black gap widths should at least extend above and below the required detectable gap, and be in steps of 1 arc min. The pattern is rotated at the required rate. Two arrays of squares should be provided, one rotating in heading and the other in pitch, to provide testing in both axes. A series of stationary numbers identifies the gap number. Note. This test can be limited by the display technology. Where this is the case, the competent authority should be consulted on the limitations. This test is generally only required for light valve projectors. An SoC should be provided if the test is not run, stating why.
4.a.11	Speckle test.	Speckle contrast should be < 10 %.	n/a			✓	VIS	An SoC is required describing the test method. This test is generally only required for laser projectors. An SoC should be provided if the test is not run, stating why.

4.b	HEAD-UP DISPLAY (HUD)							
4.b.1	Static alignment.	Static alignment with displayed image. HUD bore sight should align with the centre of the displayed image spherical pattern. Tolerance +/- 6 arc min.	n/a			✓	VIS	The alignment requirement applies to any HUD system in use or both simultaneously if they are used simultaneously for training.
					✓		VIS	The alignment requirement only applies to the pilot flying.
4.b.2	System display.	All functionality in all flight modes should be demonstrated.			✓	✓	VIS	A statement of the system capabilities should be provided and the capabilities demonstrated.
4.b.3	HUD attitude versus FSTD attitude indicator (pitch and roll of horizon).	Pitch and roll align with aeroplane instruments.	Flight.		✓	✓	VIS	For fidelity level R: The alignment requirement only applies to the pilot flying.
4.c	ENHANCED FLIGHT VISION SYSTEM (EFVS)							
4.c.1	Registration test.	Alignment between EFVS display and the window image should represent the alignment typical of the aeroplane and system type.	Take-off point and on approach at 61 m (200 ft).			✓	VIS	Note. The effects of the alignment tolerance in 4.b.1 should be taken into account
					✓		VIS	Alignment requirement only applies to the pilot flying. Note. The effects of the alignment tolerance in 4.b.1 should be taken into account.

4.c.2	EFVS RVR and visibility calibration.	The scene represents the EFVS view at 350 m (1 200 ft) and 1 609 m (1 sm) RVR including correct light intensity.	Flight.		✓	✓	VIS	Infrared scene representative of both 350 m (1 200 ft), and 1 609 m (1 sm) RVR. The visual scene may be removed.
4.c.3	Thermal crossover.	Demonstrate thermal crossover effects during day to night transition.	Day and night.		✓	✓	VIS	The scene will correctly represent the thermal characteristics of the scene during a day to night transition.
4.d	VISUAL GROUND SEGMENT							
4.d.1	Visual ground segment (VGS).	Near end. The correct number of approach lights within the computed VGS should be visible. Far end: ± 20 % of the computed VGS. The threshold lights computed to be visible should be visible in the FSTD.	Trimmed in the landing configuration at 30 m (100 ft) wheel height above touchdown zone on glide slope at a RVR setting of 300 m (1 000 ft) or 350 m (1 200 ft).		✓	✓	VIS EAT	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/visibility, — 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; and, — radio altimeter. NOTE. 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. For non-type specific 'Flight Deck Layout and Structure', an appropriate cut-off angle representative of the class of aeroplane should be used. Otherwise, a value of 15 degrees is assumed to be acceptable.

4.e	VISUAL SYSTEM CAPACITY							
4.e.1	System capacity – day mode.	Not less than: 1 000 visible textured surfaces, 6 000 light points, 16 moving models.	Not applicable.		✓	✓	VIS EAT	Demonstrated through use of a visual scene rendered with the same image generator modes used to produce scenes for training. The required surfaces, light points and moving models should be displayed simultaneously.
4.e.2	System capacity – twilight/night mode.	Not less than: 10 000 visible textured surfaces, 15 000 light points, 16 moving models.	Not applicable.		✓	✓	VIS EAT	Demonstrated through use of a visual scene rendered with the same image generator modes used to produce scenes for training. The required surfaces, light points, and moving models should be displayed simultaneously.
4.e.3	System capacity – reduced FOV visual systems.	Not less than: 3 500 visible textured surfaces, 5 000 light points, 16 moving models.	Not applicable.	✓			VIS EAT	Demonstrated through use of a visual scene rendered with the same image generator modes used to produce scenes for training. The required surfaces, light points and moving models should be displayed simultaneously. The stated capacity should be available in all time of day conditions.

5.	SOUND SYSTEMS							
5.a	TURBO-JET / TURBO FAN-AEROPLANES <u>For sound feature fidelity level G:</u> All tests in this section may be presented as a single overall SPL level and are only required when the cockpit is fully or partially enclosed (e.g. installed in a dedicated room). <u>For sound feature fidelity levels R and S:</u> All tests in this section should be presented using an unweighted 1/3-octave band format from band 17 to 42 (50 Hz to 16 kHz). A minimum 20 s average should be taken at the location corresponding to the reference data set. <u>For sound feature fidelity level S:</u> The validation data and FSTD results should be produced using comparable data analysis techniques. it would be acceptable to have some 1/3 octave bands out of ± 5dB tolerance but not more than 2 that are consecutive and in any case within ± 7 dB from approved reference data, providing that the overall trend is correct. Where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations. See CS FSTD(A).QTG.250.							
5.a.1	Ready for engine start.	Initial evaluation: ± 5 dB per 1/3 octave band Recurrent evaluation: cannot exceed ± 5 dB difference 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.	Ground			✓	SND	Normal condition prior to engine start. The auxiliary power unit (APU) should be on if appropriate.

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		Initial evaluation: subjective assessment of 1/3 octave bands. Recurrent evaluation: cannot exceed ± 5 dB difference 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.			✓			
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ± 3 dB SPL RMS compared to initial evaluation.		✓				
5.a.2	All engines at idle	As 5.a.1	Ground.			✓	SND	Normal condition prior to take-off.
		As 5.a.1			✓			
		As 5.a.1		✓				
5.a.3	All engines at maximum allowable thrust with brakes set	As 5.a.1	Ground.			✓	SND	Normal condition prior to take-off. This test is intended to check the maximum stabilised allowable thrust with brakes set, without jeopardising the aeroplane and safety.
		As 5.a.1			✓			
		As 5.a.1		✓				
5.a.4	Climb	As 5.a.1	En-route climb.			✓	SND	Medium altitude.
		As 5.a.1			✓			
		As 5.a.1		✓				
5.a.5	Cruise	As 5.a.1	Cruise			✓	SND	Normal cruise configuration.
		As 5.a.1			✓			
		As 5.a.1		✓				
5.a.6	Speed brake/ spoilers	As 5.a.1	Cruise			✓	SND	Normal and constant speed brake deflection for descent at a

	extended (as appropriate)	As 5.a.1			✓			constant airspeed and power setting.
		As 5.a.1		✓				
5.a.7	Initial approach	As 5.a.1	Approach			✓	SND	Constant airspeed, gear up, flaps/slats as appropriate.
		As 5.a.1			✓			
		As 5.a.1		✓				
5.a.8	Final approach	As 5.a.1	Landing			✓	SND	Constant airspeed, gear down, landing configuration flaps.
		As 5.a.1			✓			
		As 5.a.1		✓				
5.b	PROPELLER AEROPLANES <u>For sound feature fidelity level G:</u> All tests in this section may be presented as a single overall SPL level and are only required when the cockpit is fully or partially enclosed (e.g. installed in a dedicated room). <u>For sound feature fidelity levels R and S:</u> All tests in this section should be presented using an unweighted 1/3-octave band format from band 17 to 42 (50 Hz to 16 kHz). A minimum 20 s average should be taken at the location corresponding to the reference data set. <u>For sound feature fidelity level S:</u> The validation data and FSTD results should be produced using comparable data analysis techniques. it would be acceptable to have some 1/3-octave bands out of ± 5d B tolerance but not more than 2 that are consecutive and in any case within ± 7 dB from approved reference data, providing that the overall trend is correct. Where initial evaluation employs approved subjective tuning to develop the approved reference standard, recurrent evaluation tolerances should be used during recurrent evaluations. See CS FSTD(A).QTG.250.								
5.b.1	Ready for engine start.	As for 5.a.1	Ground			✓	SND	Normal condition prior to engine start. The APU should be on if appropriate.
		As for 5.a.1			✓			
		As for 5.a.1		✓				
5.b.2	All propellers feathered, if applicable.	As for 5.a.1	Ground			✓	SND	Normal condition prior to take-off.
		As for 5.a.1			✓			
		As for 5.a.1		✓				
5.b.3	Ground idle or equivalent.	As for 5.a.1	Ground			✓	SND	Normal condition prior to take-off.
		As for 5.a.1			✓			

		As for 5.a.1		✓				
5.b.4	Flight idle or equivalent.	As for 5.a.1	Ground			✓	SND	Normal condition prior to take-off.
		As for 5.a.1			✓			
		As for 5.a.1		✓				
5.b.5	All engines at maximum allowable power with brakes set.	As for 5.a.1	Ground			✓	SND	Normal condition prior to take-off.
		As for 5.a.1			✓			
		As for 5.a.1		✓				
5.b.6	Climb.	As for 5.a.1	En-route climb			✓	SND	Medium altitude.
		As for 5.a.1			✓			
		As for 5.a.1		✓				
5.b.7	Cruise.	As for 5.a.1	Cruise			✓	SND	Normal cruise configuration.
		As for 5.a.1			✓			
		As for 5.a.1		✓				
5.b.8	Initial approach.	As for 5.a.1	Approach			✓	SND	Constant airspeed, gear up, flaps extended as appropriate, RPM as per operations manual.
		As for 5.a.1			✓			
		As for 5.a.1		✓				
5.b.9	Final approach.	As for 5.a.1	Landing			✓	SND	Constant airspeed, gear down, landing configuration flaps, RPM as per operations manual.
		As for 5.a.1			✓			
		As for 5.a.1		✓				
5.c	Special cases	As for 5.a.1				✓	SND	This applies to special steady-state cases identified as particularly significant to the pilot, important in training, or unique to a specific aeroplane type or model. See CS FSTD(A).QTG.250.
		As for 5.a.1			✓			
		As for 5.a.1		✓				

5.d	FSTD background noise	Initial evaluation: background noise levels should fall below the plot in Figure 10 of CS FSTD(A).QTG.250(f). Recurrent evaluation: ±3 dB per 1/3-octave band compared to initial evaluation.			✓	✓	SND	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 CS FSTD(A).QTG.250(f). The measurements should be made with the simulation running, the sound muted and a dead cockpit.
		Initial evaluation: subjective assessment of measured overall SPL. Recurrent evaluation: ± 3 dB SPL RMS compared to initial evaluation.		✓				
5.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.	Ground. (Static with all systems switched off)		✓	✓	SND	Only required if the results are to be used during recurrent evaluations according to CS FSTD(A).QTG.250(g). The results should be acknowledged by the competent authority at initial qualification. This test should be presented using an unweighted 1/3 octave band format from bands 17 to 42 (50 Hz to 16 kHz). This test should be run at three frequencies (high, mid-range, and low).

		Initial evaluation: not applicable. Recurrent evaluation: ± 3 dB SPL RMS compared to initial evaluation.		✓				
6	SYSTEMS INTEGRATION							
6.a	SYSTEMS RESPONSE TIME The test to determine compliance with these requirements should include simultaneously recording the output from the pilot's pitch, roll and yaw controllers, 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 competent authority. Tolerances are based upon the requirement to support the highest device type employing that fidelity level.							
6.a.1	(1) Transport delay.	Motion system response: 100 ms or less after controller movement	Pitch, roll and yaw		✓	✓	MOT	A separate test is required in each axis. Motion system test where system installed. Motion onset should also occur within the system dynamic response limit of 100 ms. While motion onset should occur before the start of the scan of the first video field containing different information, it needs to occur before the end of the scan of the same video field. See CS FSTD(A).QTG.260.

		Visual system response: 120 ms or less after controller movement. 200 ms or less after controller movement.		 ✓	 ✓	✓	VIS	A separate test is required in each axis. Visual scene changes from steady state disturbance (i.e. the start of the scan of the first video field containing different information) should occur within the system dynamic response limit of 120 ms. Where EFVS/HUD systems are installed, even when software is simulated, the EFVS/HUD response should be within ± 30 ms from visual system response, and not before motion system response. *Note. The delay from the aeroplane EFVS electronic elements should be added to the 3 0ms tolerance before comparison with visual system reference as described in CS FSTD(A).QTG.260.*
		Instruments system response: 100 ms or less after controller movement. 200 ms or less after controller movement.			 ✓	✓	SYS	A separate test is required in each axis.

GM1 CS FSTD(A).QTG.105 Table of FSTD validation tests versus feature fidelity levels

FEATURE REQUIREMENTS FOR OBJECTIVE VALIDATION TESTS

(a) Background

The objective validation tests have a dependency on either a single FSTD feature or a number of relevant FSTD features as defined for each test in the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105. For example, most performance tests in Section 1 of said table depend on four features (FLT, GND, SYS, FCF).

When there is more than one relevant feature indicated for a particular test, then the interdependency of these features is important in obtaining a satisfactory and meaningful test result and will vary depending on the nature of the tests within the sections.

For most FSTDs, the likelihood is that the relevant FCS features will all be at the same fidelity level which guarantees the highest level of cohesive testing. However, there may be instances where the proposed FCS of the device results in FSTD features that are relevant to a particular test being at different fidelity levels with respect to each other. In these cases, the following sections explain how an organisation operating FSTDs in conjunction with the training device manufacturer can proceed with determining the objective validation testing requirements that will together form the QTG for any given FCS.

(b) Compatible FSTD features and fidelities process

The process for determining and assembling a QTG validation test list (having already determined the applicable FCS proposed for the device) may be summarised as shown in Figure 1.

Where the FSTD relevant FCS features for any given test are all at the same fidelity level, then the process to determine the relevant tests, tolerances and conditions is simple. This is shown in the left-hand side of Figure 1, from the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105.

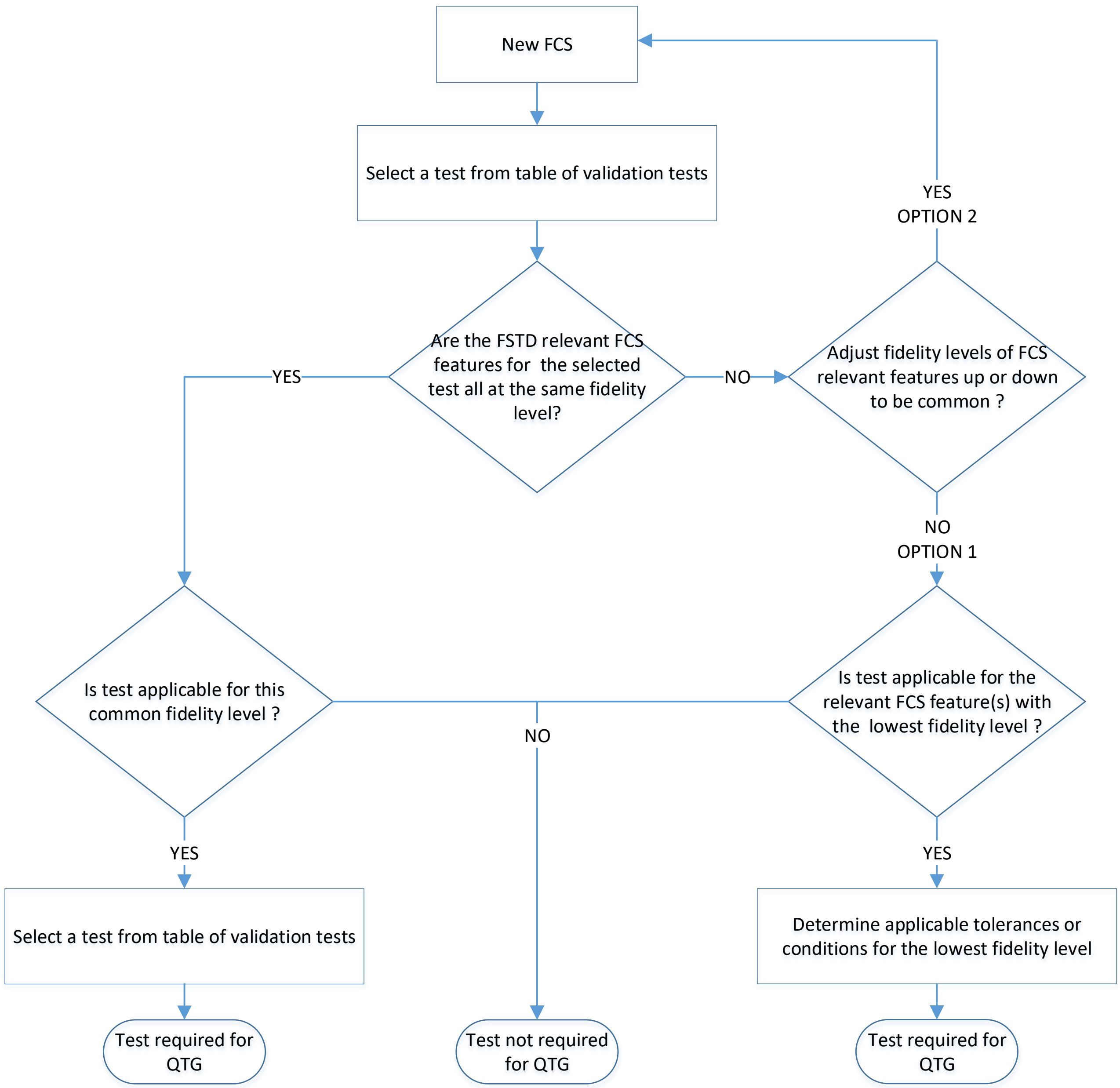


Figure 1: FSTD feature fidelity process

(c) Incompatible FSTD features and fidelities

Where the FSTD relevant FCS features for any given test are not the same, then there are two options available as described below and as shown in the right-hand side of Figure 1.

In this example, flight controls and forces are at a lower fidelity level (R) than the flight model, ground handling and aeroplane systems (all at S)

Flight model – S, ground handling – S, aeroplane systems – S, flight controls and forces – R

Option 1

If it is not desirable or possible to change the FCS, then the applied methodology for determining applicable QTG tests, tolerances and conditions is by selecting the lowest fidelity level from the relevant FSTD features.

Flight model – S, ground handling – S, aeroplane systems – S, flight controls and forces – R

In this example, it would be considered that the requirements defined in the Feature Fidelity Level 'R' column of the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105 will apply for tests where these features are relevant.

Option 2

The selected FSTD features are adjusted downwards or upwards to achieve a common fidelity level with the other relevant features. The objective testing requirements will then be based on the adjusted FCS feature fidelity levels that are now common for the relevant tests, as described in (b) above.

For example, the flight model, ground handling and aeroplane systems are all lowered to R to match the current fidelity levels for flight controls and forces. The QTG tests where these features are applicable are then based on fidelity level R requirements.

Flight model – R, ground handling – R, aeroplane systems – R, flight controls and forces – R

Alternatively, it may be decided to upgrade the fidelity level of flight controls and forces to S to match that of the flight model, ground handling and aeroplane systems. The objective testing requirements are then based on the adjusted FCS feature fidelity levels that are now common for the relevant tests at S fidelity level.

Flight model – S, ground handling – S, aeroplane systems – S, flight controls and forces – S

Note however that this also then changes the FCS and thus the potential training credits as indicated in the relevant parts of the regulation where an FCS is specified for a training task or tasks.

GM2 CS FSTD(A).QTG.105 Table of FSTD validation tests versus feature fidelity levels

VALIDATION TEST TOLERANCES

(a) Background

(1) The tolerances listed in CS FSTD(A).QTG.105 are designed to be a measure of quality of match using flight test data as a reference.

(2) There are many reasons, however, why a particular test may not fully comply with the prescribed tolerances. For example:

(i) a flight test is subject to many sources of potential error, e.g. instrumentation errors and atmospheric disturbance during data collection;

(ii) data that exhibits rapid variation or noise may also be difficult to match; or

(iii) engineering simulator data and other calculated data may exhibit errors due to a variety of potential differences discussed below.

(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 acceptable reason, then it should be judged to have failed.

(4) When engineering simulator data is used, the basis for its use is that the reference data is produced using the same simulation models as used in the equivalent FSTD; i.e. the two sets of results should be 'essentially' similar. When engineering simulation validation data is used, it is understood that the flight-test-based tolerances should be reduced since applied tolerances should not include measurement errors inherent to flight test data.

(5) There are, of course, reasons why the results from an FSTD would differ from engineering simulation validation test data. There reasons include, but are not limited to:

(i) hardware (avionics units and flight controls);

(ii) modelling solutions used in the FSTD different from those used by the aeroplane original equipment manufacturer (ground handling models, braking models, engine models, etc.);

(iii) model cascading effects:

(A) iteration rates;

(B) execution order;

(C) integration methods; and

(D) processor architecture;

(iv) digital drift:

(A) interpolation methods;

(B) data handling differences; and

(C) auto-test trim tolerances, etc.

(v) open loop versus closed loop responses, and test duration:

(vi) extent of dependency on contributory aeroplane systems adding to the complexity of the test; and

(vii) accuracy of the match of the initial conditions.

(6) Any differences between FSTD results and engineering simulation validation data should, however, be small and the reasons for any differences, other than those listed above, should be clearly explained.

(7) Historically, engineering simulation validation data was used only to demonstrate compliance with certain extra modelling features because:

(i) flight test data could not reasonably be made available;

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

(iii) key areas were validated against flight test data.

(8) The current increase in the use and projected use of engineering simulation validation data is an important issue because:

(i) flight test data is often not available due to sound technical reasons;

(ii) alternative technical solutions are being advanced; and

(iii) cost is an ever-present consideration.

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

(b) Non-flight test tolerances

(1) Where engineering simulation validation data or other non-flight test data is used as an allowable form of reference validation data for the objective tests listed in the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105, 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 reaching other than an exact match will vary depending upon a number of factors discussed in point (a) of this GM.

(2) As guidance, when non-flight test validation data is used for reference data, unless a rationale justifies a significant variation between the reference data and the FSTD

results, the tolerance applied should be 40 % of the corresponding flight test tolerances, and out-of-tolerance flagging should be in accordance with this guideline.

(3) The validation data provider should supply a well-documented mathematical model and a testing procedure that enable an exact replication of their engineering simulation results.

(4) Where the engineering simulation used to generate reference data includes aeroplane hardware, the tolerances applied may have to be increased above the suggested 40 %. A rationale should be provided.

(5) FSTD results should be obtained without having to change the simulation models of the FSTD to meet the criteria for exact replication of the engineering simulation results.

GM3 CS FSTD(A).QTG.105 Table of FSTD validation tests versus feature fidelity levels

RAeS FSTD EVALUATION HANDBOOK

The RAeS Aeroplane Flight Simulator Evaluation Handbook, as amended, is a useful source of guidance for conducting the tests required to establish that the FSTD under evaluation complies with the criteria set out in this manual. This two-volume document can be obtained through the RAeS.

CS FSTD(A).QTG.106 List of parameters to be recorded

For each test listed in CS FSTD(A).QTG.105, the parameters contained in the table of this CS should be recorded as a minimum.

TESTS NUMBER	PARAMETERS TO BE RECORDED
1.a All tests	NOSEWHEEL STEERING CONTROLLER POSITION NOSEWHEEL ANGLE GROUND SPEED ENGINE KEY PARAMETERS YAW RATE (turn rate) HEADING ANGLE OTHER GEAR ANGLES (if applicable) BRAKE PEDAL POSITION BRAKE PRESSURES
1.a.1 In addition to the 1.a list	TURN RADIUS C.G. DISTANCE ALONG RUNWAY C.G. DISTANCE ACROSS RUNWAY NOSEWHEEL DISTANCE ALONG RUNWAY NOSEWHEEL DISTANCE ACROSS RUNWAY MAIN GEAR DISTANCE ALONG RUNWAY MAIN GEAR DISTANCE ACROSS RUNWAY
1.a.2 In addition to the 1.a list	RUDDER ANGLE

TESTS NUMBER	PARAMETERS TO BE RECORDED
1.b.1	CALIBRATED AIRSPEED GROUND SPEED PITCH CONTROLLER POSITION ELEVATOR ANGLE HEADING ANGLE PITCH ANGLE STABILISER ANGLE WIND SPEED COMPONENTS ENGINES KEY PARAMETERS DISTANCE ALONG RUNWAY BRAKE PEDAL POSITION BRAKE PRESSURES
1.b.2	CALIBRATED AIRSPEED GROUND SPEED ENGINES KEY PARAMETERS LATERAL DEVIATION FROM RUNWAY CENTRELINE RUDDER PEDAL POSITION RUDDER ANGLE NOSEWHEEL ANGLE ROLL CONTROLLER POSITION AILERON ANGLE(S) SPOILER ANGLES SIDESLIP ANGLE HEADING ANGLE YAW RATE BANK ANGLE WIND SPEED COMPONENTS RUDDER PEDAL FORCE (if reversible controls) PITCH ANGLE
1.b.3	CALIBRATED AIRSPEED GROUND SPEED MAIN GEAR HEIGHT ABOVE GROUND/RADIO ALTITUDE PITCH ANGLE HEADING ANGLE ANGLE OF ATTACK PITCH CONTROLLER POSITION ELEVATOR ANGLE STABILISER ANGLE GEAR STRUT VERTICAL LOADS or DEFLECTIONS ENGINES KEY PARAMETERS WIND SPEED COMPONENTS

TESTS NUMBER	PARAMETERS TO BE RECORDED
1.b.4	CALIBRATED AIRSPEED GROUND SPEED ELEVATOR ANGLE WIND SPEED COMPONENTS ANGLE OF ATTACK PITCH CONTROLLER POSITION PITCH CONTROLLER FORCE (if reversible controls) MAIN GEAR HEIGHT ABOVE GROUND/RADIO ALTITUDE PITCH ANGLE RATE OF CLIMB LANDING GEAR POSITION STABILISER ANGLE BANK ANGLE HEADING ANGLE ROLL CONTROLLER POSITION RUDDER PEDAL POSITION AILERON ANGLE(S) SPOILER ANGLES ENGINES KEY PARAMETERS
1.b.5 1.b.6	ROLL CONTROLLER POSITION PITCH CONTROLLER POSITION RUDDER PEDAL POSITION NOSEWHEEL ANGLE BANK ANGLE PITCH ANGLE RUDDER ANGLE ELEVATOR ANGLE STABILISER ANGLE PITCH CONTROL FORCE (if reversible controls) ROLL CONTROLLER FORCE (if reversible controls) RUDDER PEDAL FORCE (if reversible controls) LANDING GEAR POSITIONS ANGLE OF ATTACK MAIN GEAR HEIGHT ABOVE GROUND/RADIO ALTITUDE CALIBRATED AIRSPEED ENGINES KEY PARAMETERS GROUND SPEED SIDESLIP ANGLE HEADING ANGLE WIND SPEED COMPONENTS AILERON ANGLE(S) SPOILER ANGLES
1.b.7	DISTANCE ALONG RUNWAY STABILISER ANGLE ENGINES KEY PARAMETERS CALIBRATED AIRSPEED GROUND SPEED HEADING ANGLE SPOILER ANGLES SPEED BRAKE POSITION BRAKE PEDAL POSITION BRAKE PRESSURES BRAKE TEMPERATURE ELEVATOR ANGLE PITCH ANGLE WIND SPEED COMPONENTS

TESTS NUMBER	PARAMETERS TO BE RECORDED
1.b.8	ROLL CONTROLLER POSITION PITCH CONTROLLER POSITION RUDDER PEDAL POSITION ROLL ANGLE BANK ANGLE PITCH ANGLE RUDDER ANGLE ELEVATOR ANGLE STABILISER ANGLE PITCH RATE YAW RATE ANGLE OF ATTACK PRESSURE ALTITUDE CALIBRATED AIRSPEED ENGINES KEY PARAMETERS SIDESLIP ANGLE HEADING ANGLE WIND SPEED COMPONENTS AILERON ANGLE(S) SPOILER ANGLES
1.c All tests	ENGINES KEY PARAMETERS ELEVATOR ANGLE PRESSURE ALTITUDE RATE OF CLIMB STABILISER ANGLE WIND SPEED COMPONENTS
1.c.1 In addition to the 1.c list	CALIBRATED AIRSPEED BANK ANGLE PITCH ANGLE PITCH CONTROLLER POSITION
1.c.2 In addition to the 1.c list	AILERON ANGLE(S) CALIBRATED AIRSPEED BANK ANGLE PITCH ANGLE HEADING ANGLE PITCH CONTROLLER POSITION ROLL CONTROLLER POSITION RUDDER ANGLE SIDESLIP ANGLE SPOILER ANGLES RUDDER PEDAL POSITION
1.c.3 In addition to the 1.c list	AILERON ANGLE(S) PITCH ANGLE HEADING ANGLE SIDESLIP ANGLE CALIBRATED AIRSPEED or MACH NUMBER ROLL CONTROLLER POSITION FUEL FLOW or FUEL QUANTITY RUDDER ANGLE RUDDER PEDAL POSITION SPOILER ANGLES

TESTS NUMBER	PARAMETERS TO BE RECORDED
1.c.4 In addition to the 1.c list	AILERON ANGLE(S) CALIBRATED AIRSPEED BANK ANGLE PITCH ANGLE PITCH CONTROLLER POSITION ROLL CONTROLLER POSITION RUDDER ANGLE SIDESLIP ANGLE SPOILER ANGLES RUDDER PEDAL POSITION ANTI-ICE FLAGS
1.d All tests	CALIBRATED AIRSPEED or MACH NUMBER BANK ANGLE ELEVATOR ANGLE ENGINES KEY PARAMETERS PITCH ANGLE PITCH CONTROLLER POSITION PRESSURE ALTITUDE STABILISER ANGLE
1.d.1 In addition to the 1.d list	ANGLE OF ATTACK RATE OF CLIMB WIND SPEED COMPONENTS LINEAR ACCELERATIONS only if snapshots (longitudinal, lateral, vertical)
1.d.2 In addition to the 1.d list	ANGLE OF ATTACK RATE OF CLIMB SPEEDBRAKE POSITION SPOILER ANGLES WIND SPEED COMPONENTS
1.d.3 In addition to the 1.d list	TOTAL FUEL WEIGHT or FUEL FLOW LINEAR ACCELERATIONS only if snapshots (longitudinal, lateral, vertical) RATE OF CLIMB only if snapshots
1.d.4 In addition to the 1.d list	ANGLE OF ATTACK RATE OF CLIMB SPEEDBRAKE POSITION SPOILER ANGLES WIND SPEED COMPONENTS
1.d.5 In addition to the 1.d list	ANGLE OF ATTACK RATE OF CLIMB SPEEDBRAKE POSITION SPOILER ANGLES WIND SPEED COMPONENTS
1.e 1.e.1 1.e.2 1.e.3 1.e.4	CALIBRATED AIRSPEED GROUND SPEED DISTANCE ALONG RUNWAY BRAKE PEDAL POSITION SPEEDBRAKE HANDLE POSITION ENGINES KEY PARAMETERS HEADING ANGLE ELEVATOR ANGLE SPOILER ANGLES BRAKE PRESSURES WIND SPEED COMPONENTS PITCH ANGLE

TESTS NUMBER	PARAMETERS TO BE RECORDED
1.f 1.f.1 1.f.2	For each engine, as appropriate to the engine type: POWER LEVER ANGLE (or equivalent) NET THRUST EGT CALIBRATED AIRSPEED or MACH NUMBER ENGINE PRESSURE RATIO (EPR) or N1 & N2 PRESSURE ALTITUDE FUEL FLOW
2.a.1	PITCH CONTROLLER POSITION PITCH CONTROLLER FORCE ELEVATOR ANGLE
2.a.2	ROLL CONTROLLER POSITION ROLL CONTROLLER FORCE AILERON AND SPOILER ANGLES
2.a.3	RUDDER PEDAL POSITION RUDDER PEDAL FORCE RUDDER ANGLE
2.a.4	NOSEWHEEL STEERING CONTROLLER FORCE NOSEWHEEL STEERING CONTROLLER POSITION NOSEWHEEL ANGLE MAIN GEAR ANGLE (if applicable)
2.a.5	RUDDER PEDAL POSITION NOSEWHEEL ANGLE
2.a.6	INDICATED PITCH TRIM POSITION COMPUTED TRIM POSITION STABILISER ANGLE
2.a.7	INDICATED PITCH TRIM POSITION COMPUTED TRIM POSITION STABILISER ANGLE TRIM RATE TRIMMED SURFACE ANGLE RATE PILOT PRIMARY TRIM SWITCH POSITION AUTOPILOT TRIM SIGNAL (for go-around case)
2.a.8	For each engine, as appropriate to the engine type: POWER LEVER ANGLE (or equivalent) ENGINE PRESSURE RATIO (EPR) or N1 & N2 TORQUE (turboprop only)
2.a.9	BRAKE PEDAL FORCE (left & right) BRAKE PEDAL POSITION (left & right) BRAKE HYDRAULIC PRESSURE (left & right) BRAKE SYSTEM HYDRAULIC PRESSURE(S)
2.a.10	STICK PUSHER ACTIVATION SIGNAL PITCH CONTROLLER POSITION PITCH CONTROLLER FORCE ELEVATOR ANGLE
2.b.1	PITCH CONTROLLER POSITION
2.b.2	ROLL CONTROLLER POSITION
2.b.3	RUDDER PEDAL POSITION

TESTS NUMBER	PARAMETERS TO BE RECORDED
2.b.4	PRESSURE ALTITUDE CALIBRATED AIRSPEED PITCH ANGLE ANGLE OF ATTACK PITCH RATE ELEVATOR ANGLE ENGINES KEY PARAMETERS PITCH CONTROLLER POSITION STABILISER ANGLE WIND SPEED COMPONENTS
2.b.5	PRESSURE ALTITUDE CALIBRATED AIRSPEED BANK ANGLE ROLL RATE ROLL CONTROLLER POSITION AILERON ANGLE(S) SPOILER ANGLES SIDESLIP ANGLE HEADING ANGLE YAW RATE ENGINES KEY PARAMETERS RUDDER PEDAL POSITION RUDDER ANGLE PITCH ANGLE WIND SPEED COMPONENTS
2.b.6	PRESSURE ALTITUDE CALIBRATED AIRSPEED BANK ANGLE HEADING ANGLE ENGINES KEY PARAMETERS YAW RATE RUDDER ANGLE SIDESLIP ANGLE RUDDER PEDAL POSITION ROLL CONTROLLER POSITION AILERON ANGLE(S) SPOILER ANGLES ROLL RATE PITCH ANGLE WIND SPEED COMPONENTS
2.c All tests	CALIBRATED AIRSPEED/MACH NUMBER ANGLE OF ATTACK ELEVATOR ANGLE ENGINES KEY PARAMETERS PITCH ANGLE PITCH CONTROLLER POSITION PRESSURE ALTITUDE STABILISER ANGLE
2.c.1 In addition to the 2.c list	BANK ANGLE RATE OF CLIMB WIND SPEED COMPONENTS PITCH CONTROLLER FORCE (only for the power change force test) ROLL CONTROLLER POSITION (only for propeller aeroplanes) PITCH CONTROLLER POSITION (only for propeller aeroplanes)

TESTS NUMBER	PARAMETERS TO BE RECORDED
2.c.2 In addition to the 2.c list	BANK ANGLE FLAP LEVER POSITION FLAP SURFACE ANGLE(S) RATE OF CLIMB WIND SPEED COMPONENTS AILERON ANGLE(S) PITCH CONTROLLER FORCE (only for the flap change force test)
2.c.3 In addition to the 2.c list	BANK ANGLE RATE OF CLIMB SPEEDBRAKE HANDLE POSITION SPOILER ANGLES WIND SPEED COMPONENTS
2.c.4 In addition to the 2.c list	BANK ANGLE LANDING GEAR HANDLE POSITION LANDING GEAR INDIVIDUAL POSITIONS RATE OF CLIMB WIND SPEED COMPONENTS PITCH CONTROLLER FORCE (only for the gear change force test)
2.c.5 In addition to the 2.c list	LINEAR ACCELERATIONS only if snapshots (longitudinal, lateral, vertical) RATE OF CLIMB
2.c.6 In addition to the 2.c list	BANK ANGLE NORMAL ACCELERATION or NORMAL LOAD FACTOR PITCH CONTROLLER FORCE (not applicable if aeroplane hardware controller) PITCH RATE WIND SPEED COMPONENTS
2.c.7 In addition to the 2.c list	BANK ANGLE LINEAR ACCELERATIONS only if snapshots (longitudinal, lateral, vertical) PITCH CONTROLLER FORCE PITCH RATE only if snapshots RATE OF CLIMB only if snapshots WIND SPEED COMPONENTS
2.c.8.a 2.c.8.b In addition to the 2.c list	STICK SHAKER SIGNAL (or other stall warning indication) INITIAL BUFFET SIGNAL BANK ANGLE NORMAL LOAD FACTOR or NORMAL ACCELERATION PITCH CONTROLLER FORCE (if reversible controls) WIND SPEED COMPONENTS
2.c.9 In addition to the 2.c list	BANK ANGLE NORMAL LOAD FACTOR or NORMAL ACCELERATION PITCH RATE WIND SPEED COMPONENTS
2.c.10 In addition to the 2.c list	BANK ANGLE NORMAL LOAD FACTOR or NORMAL ACCELERATION PITCH RATE WIND SPEED COMPONENTS

TESTS NUMBER	PARAMETERS TO BE RECORDED
2.d All tests	AILERON ANGLE(S) CALIBRATED AIRSPEED BANK ANGLE ELEVATOR ANGLE ENGINES KEY PARAMETERS PITCH ANGLE PRESSURE ALTITUDE ROLL CONTROLLER POSITION ROLL RATE RUDDER ANGLE RUDDER PEDAL POSITION SIDESLIP ANGLE SPOILER ANGLES WIND SPEED COMPONENTS YAW RATE
2.d.1 In addition to 2d list	ANGLE OF ATTACK HEADING ANGLE PITCH CONTROLLER POSITION
2.d.2 In addition to 2d list	HEADING ANGLE ROLL CONTROLLER FORCE (if reversible controls)
2.d.3 In addition to 2d list	HEADING ANGLE ROLL CONTROLLER FORCE (if reversible controls)
2.d.4 In addition to 2d list	None
2.d.5 In addition to 2d list	RUDDER TRIM POSITION LINEAR ACCELERATIONS only if snapshots (longitudinal, lateral, vertical) HEADING ANGLE
2.d.6 In addition to 2d list	HEADING ANGLE
2.d.7 In addition to 2d list	HEADING ANGLE
2.d.8 In addition to 2d list	HEADING ANGLE STABILISER ANGLE ROLL CONTROLLER FORCE (if reversible controls) RUDDER PEDAL FORCE (if reversible controls) LINEAR ACCELERATIONS only if snapshots (longitudinal, lateral, vertical)
2.e.1 2.e.2	MAIN GEAR HEIGHT ABOVE GROUND/RADIO ALTITUDE CALIBRATED AIRSPEED PITCH ANGLE STABILISER ANGLE PITCH CONTROLLER POSITION PITCH CONTROLLER FORCE (if reversible controls) ELEVATOR ANGLE BANK ANGLE HEADING ANGLE ANGLE OF ATTACK WIND SPEED COMPONENTS RUDDER ANGLE SIDESLIP ANGLE ENGINES KEY PARAMETERS ROLL CONTROLLER POSITION SPEEDBRAKE POSITION GEAR STRUT VERTICAL LOADS or DEFLECTIONS RUDDER PEDAL POSITION AILERON ANGLE(S) SPOILER ANGLES

TESTS NUMBER	PARAMETERS TO BE RECORDED
2.e.3	MAIN GEAR HEIGHT ABOVE GROUND/RADIO ALTITUDE CALIBRATED AIRSPEED PITCH ANGLE STABILISER ANGLE PITCH CONTROLLER POSITION PITCH CONTROLLER FORCE (if reversible controls) ELEVATOR ANGLE BANK ANGLE HEADING ANGLE ANGLE OF ATTACK WIND SPEED COMPONENTS RUDDER ANGLE SIDESLIP ANGLE ENGINES KEY PARAMETERS ROLL CONTROLLER POSITION AILERON ANGLE(S) SPOILER ANGLES SPEEDBRAKE POSITION GEAR STRUT VERTICAL LOADS or DEFLECTIONS RUDDER PEDAL POSITION ROLL CONTROLLER FORCE (if reversible controls) RUDDER PEDAL FORCE (if reversible controls) BRAKE PEDAL POSITION BRAKE PRESSURES GROUND SPEED
2.e.4	MAIN GEAR HEIGHT ABOVE GROUND/RADIO ALTITUDE CALIBRATED AIRSPEED PITCH ANGLE STABILISER ANGLE PITCH CONTROLLER POSITION ELEVATOR ANGLE BANK ANGLE HEADING ANGLE ANGLE OF ATTACK WIND SPEED COMPONENTS RUDDER ANGLE SIDESLIP ANGLE ENGINES KEY PARAMETERS ROLL CONTROLLER POSITION AILERON ANGLE(S) SPOILER ANGLES SPEEDBRAKE POSITION GEAR STRUT VERTICAL LOADS or DEFLECTIONS RUDDER PEDAL POSITION BRAKE PEDAL POSITION BRAKE PRESSURES GROUND SPEED

TESTS NUMBER	PARAMETERS TO BE RECORDED
2.e.5	RADIO ALTITUDE CALIBRATED AIRSPEED RATE OF CLIMB PITCH ANGLE STABILISER ANGLE PITCH CONTROLLER POSITION (if applicable) ELEVATOR ANGLE BANK ANGLE HEADING ANGLE ANGLE OF ATTACK WIND SPEED COMPONENTS RUDDER ANGLE SIDESLIP ANGLE ENGINES KEY PARAMETERS ROLL CONTROLLER POSITION (if applicable) AILERON ANGLE(S) SPOILER ANGLES LATERAL DISPLACEMENT FROM RUNWAY CENTRELINE FLARE ENGAGE DISCRETE WEIGHT ON WHEELS/GEAR CONTACT FLAG GEAR STRUT VERTICAL LOADS or DEFLECTIONS BRAKE PEDAL POSITION BRAKE PRESSURES SPEEDBRAKE POSITION GROUND SPEED
2.e.6	RADIO ALTITUDE CALIBRATED AIRSPEED RATE OF CLIMB PITCH ANGLE STABILISER ANGLE PITCH CONTROLLER POSITION (if applicable) ELEVATOR ANGLE BANK ANGLE HEADING ANGLE ANGLE OF ATTACK WIND SPEED COMPONENTS RUDDER ANGLE SIDESLIP ANGLE ENGINES KEY PARAMETERS ROLL CONTROLLER POSITION (if applicable) AILERON ANGLE(S) SPOILER ANGLES FLAP SURFACE ANGLES RUDDER PEDAL POSITION LANDING GEAR POSITIONS

TESTS NUMBER	PARAMETERS TO BE RECORDED
2.e.7	MAIN GEAR HEIGHT ABOVE GROUND/RADIO ALTITUDE CALIBRATED AIRSPEED RATE OF CLIMB PITCH ANGLE STABILISER ANGLE PITCH CONTROLLER POSITION (if applicable) ELEVATOR ANGLE BANK ANGLE HEADING ANGLE ANGLE OF ATTACK WIND SPEED COMPONENTS RUDDER ANGLE SIDESLIP ANGLE ENGINES KEY PARAMETERS ROLL CONTROLLER POSITION (if applicable) AILERON ANGLE(S) SPOILER ANGLES FLAP SURFACE ANGLES RUDDER PEDAL POSITION LANDING GEAR POSITIONS
2.e.8 2.e.9	CALIBRATED AIRSPEED GROUND SPEED RUDDER PEDAL POSITION RUDDER ANGLE NOSEWHEEL STEERING ANGLE HEADING ANGLE YAW RATE ENGINES KEY PARAMETERS LATERAL DEVIATION FROM RUNWAY CENTRELINE WIND SPEED COMPONENTS SPOILER ANGLES
2.f	MAIN GEAR HEIGHT ABOVE GROUND/RADIO ALTITUDE CALIBRATED AIRSPEED STABILISER ANGLE PITCH ANGLE ANGLE OF ATTACK RATE OF CLIMB ENGINES KEY PARAMETERS PITCH CONTROLLER POSITION ELEVATOR ANGLE BANK ANGLE WIND SPEED COMPONENTS

TESTS NUMBER	PARAMETERS TO BE RECORDED
2.g	MAIN GEAR HEIGHT ABOVE GROUND/RADIO ALTITUDE CALIBRATED AIRSPEED LANDING GEAR POSITION WIND SPEED COMPONENTS RATE OF CLIMB PITCH ANGLE ELEVATOR ANGLE PITCH CONTROLLER POSITION ROLL CONTROLLER POSITION RUDDER PEDAL POSITION AILERON ANGLE(S) SPOILER ANGLES ANGLE OF ATTACK SIDESLIP ANGLE ENGINES KEY PARAMETERS BANK ANGLE HEADING ANGLE STABILISER ANGLE FLAP SURFACE ANGLES RUDDER ANGLE
2.h.1 2.h.2	PITCH CONTROLLER POSITION CALIBRATED AIRSPEED PITCH ANGLE ANGLE OF ATTACK ELEVATOR ANGLE PRESSURE ALTITUDE STABILISER ANGLE ENGINES KEY PARAMETERS PROTECTION SIGNAL (if available) WIND SPEED COMPONENTS
2.h.3	PITCH CONTROLLER POSITION ROLL CONTROLLER POSITION CALIBRATED AIRSPEED PITCH ANGLE NORMAL LOAD FACTOR BANK ANGLE STABILISER ANGLE ELEVATOR ANGLE PRESSURE ALTITUDE ENGINES KEY PARAMETERS PROTECTION SIGNAL (if available) WIND SPEED COMPONENTS
2.h.4	PITCH CONTROLLER POSITION CALIBRATED AIRSPEED PITCH ANGLE ANGLE OF ATTACK ELEVATOR ANGLE PRESSURE ALTITUDE STABILISER ANGLE ENGINES KEY PARAMETERS PROTECTION SIGNAL (if available) WIND SPEED COMPONENTS

TESTS NUMBER	PARAMETERS TO BE RECORDED
2.h.5	ROLL CONTROLLER POSITION CALIBRATED AIRSPEED BANK ANGLE AILERON ANGLE(S) SPOILER ANGLES PITCH ANGLE PRESSURE ALTITUDE STABILISER ANGLE ELEVATOR ANGLE ENGINES KEY PARAMETERS PROTECTION SIGNAL (if available) WIND SPEED COMPONENTS
2.h.6	PITCH CONTROLLER POSITION CALIBRATED AIRSPEED PITCH ANGLE ANGLE OF ATTACK ELEVATOR ANGLE PRESSURE ALTITUDE ENGINES KEY PARAMETERS STABILISER ANGLE PROTECTION SIGNAL (if available) WIND SPEED COMPONENTS NORMAL LOAD FACTOR
2.i.1	ICE ON SIGNAL ENGINE ICING LEVEL AIRFRAME ICING LEVEL CALIBRATED AIRSPEED PITCH ANGLE STABILISER ANGLE PITCH CONTROLLER POSITION PITCH CONTROLLER FORCE (if reversible controls) ELEVATOR ANGLE BANK ANGLE HEADING ANGLE ANGLE OF ATTACK WIND SPEED COMPONENTS RUDDER ANGLE SIDESLIP ANGLE ENGINES KEY PARAMETERS ROLL CONTROLLER POSITION
3.a	REFERENCE (DRIVING) INPUT SIGNAL ACTUATOR POSITION FEEDBACK SIGNAL or PLATFORM ACCELERATION
3.b	REFERENCE (DRIVING) INPUT SIGNAL PLATFORM ACCELERATIONS
3.c	Qualitative assessment only is required
3.d	TIME MOTION LINEAR ACCELERATION DEMANDS MOTION ROTATIONAL ACCELERATION DEMANDS MOTION ROTATIONAL VELOCITY DEMANDS MOTION LINEAR ACCELEROMETER - X, Y, Z MOTION ACTUATOR POSITIONS
3.e	See CS FSTD(A).QTG.230

TESTS NUMBER	PARAMETERS TO BE RECORDED	
3.f.1 3.f.2 3.f.3 3.f.4 3.f.5 3.f.6 3.f.7	VERTICAL POWER SPECTRAL DENSITY versus FREQUENCY LONGITUDINAL POWER SPECTRAL DENSITY versus FREQUENCY LATERAL POWER SPECTRAL DENSITY versus FREQUENCY VERTICAL ACCELERATION (G) versus TIME LONGITUDINAL ACCELERATION (G) versus TIME LATERAL ACCELERATION (G) versus TIME	
4. All tests	See CS FSTD(A).QTG.240.	
5. All tests	SOUND PRESSURE LEVELS	
6.a.1	CONTROL POSITION or STEP INPUT MOTION SYSTEM ACCELERATION VISUAL SYSTEM SIGNAL INSTRUMENT SIGNAL	longitudinal, lateral or directional as appropriate; in the appropriate pitch, roll or yaw axis; 'X', 'Y' or 'Video' drive from the image generator or, where display has a processing delay, a light sensor output; pitch angle and bank angle from the main attitude direction indicator, yaw signal from the simulated slip bubble – or corresponding electronic flight instrumentation system parameters.

CS FSTD(A).QTG.120 Engineering simulator validation data

This CS defines the procedures for engineering simulator validation data.

(a) When a fully flight test validation simulation is modified as a result of changes to the simulated aeroplane configuration, a qualified aeroplane manufacturer may choose, with the prior agreement of the competent authority, to supply validation data from an 'audited' engineering simulator/simulation to selectively supplement flight test data.

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

(b) To be qualified to supply engineering simulator validation data, an aeroplane manufacturer should:

(1) have a proven track record of developing successful data packages;

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

(3) have an engineering simulator that:

(i) has models that run in an integrated manner;

(ii) uses the same models as released to the training community (which are also used to produce stand-alone proof-of-match and checkout documents); and

(iii) is used to support aeroplane development and certification;

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

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

(c) Aeroplane manufacturers seeking to take advantage of this alternative arrangement should contact the competent authority at the earliest opportunity.

(d) For the initial application, each applicant should demonstrate their ability to qualify to the satisfaction of the Agency, in accordance with the criteria in this CS and in CS FSTD(A).QTG.125.

GM1 CS FSTD(A).QTG.120 Engineering simulator validation data

APPROVAL GUIDELINES

(a) Background

(1) In the case of fully flight test validated simulation models of a new or major derivative aeroplane, it is likely that these models will progressively become unrepresentative as the aeroplane configuration is revised.

(2) Traditionally, as the aeroplane 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.

(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.

(4) Major aeroplane 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 aeroplane hardware to non-real-time workstation-based simulations.

(b) Approval clarifications — for using engineering simulator validation data

(1) The current system of requiring flight test data as a reference for validating training simulators should continue.

(2) When a fully flight test-validated simulation is modified as a result of changes to the simulated aeroplane configuration, a qualified aeroplane manufacturer may choose, with prior agreement of the competent authority, to supply validation data from an engineering simulator/simulation to selectively supplement flight test data.

(3) In cases where data from an engineering simulator is used, the engineering simulation process should be audited by the competent authority.

(4) In all cases, a data package verified to current standards against flight testing should be developed for the aeroplane entry-into-service configuration of the baseline aeroplane.

(5) Where engineering simulator data is used as part of a QTG, an essential match is expected as described in CS FSTD(A).QTG.300.

(6) In cases where the use of engineering simulator data is envisaged, a complete proposal should be presented to the appropriate competent authority. Such a proposal should contain evidence of the aeroplane manufacturer's past achievements in high-fidelity modelling.

(7) The process should be applicable to one step away from a fully flight-validated simulation. The flight test validated data may be modified once to produce derived data, but the derived data may not be processed further. In the event that subsequent changes are necessary, the original flight-test validated data should be used to produce a new set of derived data.

(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 test validated) version.

(9) The competent authorities should conduct technical reviews of the proposed plan and the subsequent validation data to establish acceptability of the proposal.

(10) The procedure should be considered complete when an approval statement is issued. This statement should identify acceptable validation data sources.

(11) To be admissible as an alternative source of validation data, an engineering simulator should:

(i) have to exist as a physical entity, complete with a flight deck representative of the affected class of aeroplane, with controls sufficient for manual flight;

(ii) have a visual system and preferably also a motion system;

(iii) where appropriate, have actual avionics boxes interchangeable with the equivalent software simulations, to support validation of released software;

(iv) have a rigorous configuration control system covering hardware and software; and

(v) have been found to be a high-fidelity representation of the aeroplane by the pilots of the manufacturers, operators and the competent authority.

(12) Engineering simulators used to produce system data may not need all the above features.

(13) The precise procedure followed to gain acceptance of engineering simulator data will vary from case to case between aeroplane manufacturers and type of change. Irrespective of the solution proposed, engineering simulations/simulators should conform to the following criteria:

(i) the original (baseline) simulation models should have been fully flight test validated;

(ii) the models as released by the aeroplane manufacturer to the industry for use in training FSTDs should be essentially identical to those used by the aeroplane manufacturer in their engineering simulations/simulators; and

(iii) these engineering simulation/simulators should have been used as part of the aeroplane design, development and certification process.

(14) Training FSTDs utilising these baseline simulation models should be currently qualified to an internationally recognised standard such as those contained in ICAO Doc 9625 'Manual of Criteria for the Qualification of Flight Simulators' as amended.

(15) The type of modifications covered by this alternative procedure will be restricted to those with well-understood effects, such as:

(i) software (e.g. flight control computer, autopilot, etc.);

(ii) simple (in aerodynamic terms) geometric revisions (e.g. body length);

(iii) engines – limited to non-propeller-driven aeroplane;

(iv) control system gearing/rigging/deflection limits; and

(v) brake, tyre and steering revisions.

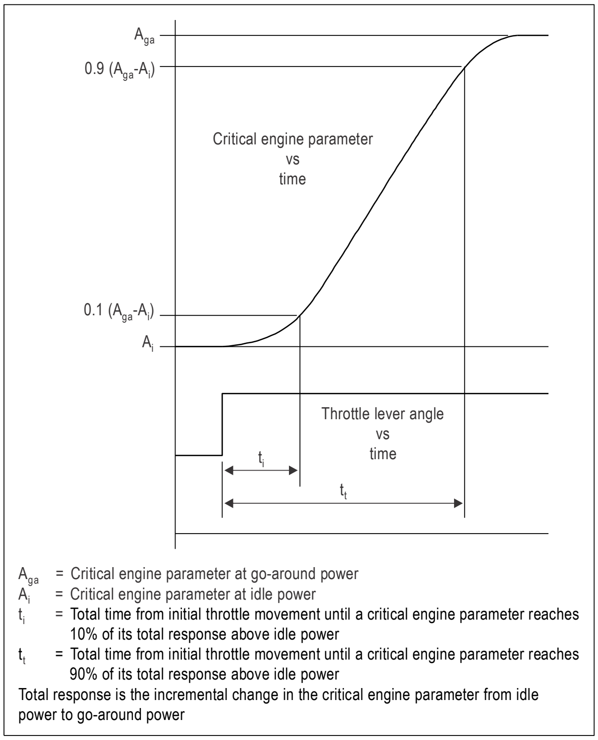
(16) The organisation operating FSTDs, with the assistance of the aeroplane manufacturer, that wishes to take advantage of this alternative procedure, is expected to demonstrate a sound engineering basis for the proposed approach. Such a sound engineering basis should include an analysis that should show that the predicted effects of the change(s) were incremental in nature and both easily understood and well-defined, confirming that additional flight test data was not required. In the event that the predicted effects are not deemed to be sufficiently accurate, it might be necessary to collect a limited set of flight test data to validate the predicted increments.

(17) Any applications for this procedure should be reviewed by EASA.

CS FSTD(A).QTG.200 Engines

This CS provides standards for the assessment of engine validation tests parameters.

Tests are required to show the response of the critical engine parameter to a rapid throttle movement for an engine acceleration and an engine deceleration. The procedure for evaluating the response is illustrated in Figures 1 and 2.



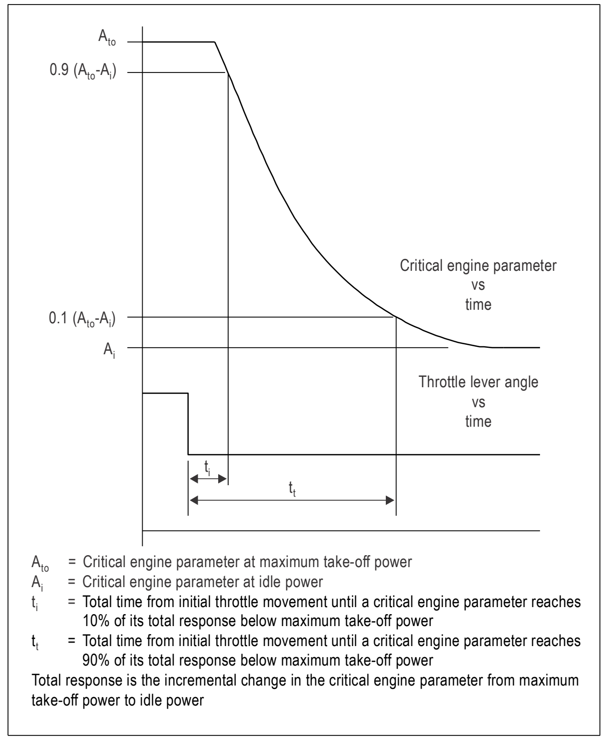


Figure 1: Engine acceleration

Figure 2: Engine deceleration

CS FSTD(A).QTG.210 Control dynamics

This CS provides standards for the assessment of flight controls dynamic tests parameters.

(a) General

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

(1) 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 aeroplane systems is essential. The required dynamic control checks are indicated in 2.b(1) to (3) of the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105.

(2) For initial and upgrade evaluations, control dynamics characteristics should be measured at and recorded directly from the flight controls. This procedure is usually accomplished by measuring the free response of the controls using a step input or pulse input to excite the system. The procedure should be accomplished in the take-off, cruise and landing flight conditions and configurations.

(3) 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 configuration may suffice. 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 should not be required during initial and upgrade evaluations if the MQTG shows both test fixture results and the results of an alternate approach, such as computer plots which were produced concurrently and show satisfactory agreement. Repeat of the alternate method during the initial evaluation would then satisfy this test requirement.

(b) 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 various documents available on control systems. In order to establish a consistent means of validating test results for FSTD control loading, criteria are needed that 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 those 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. The response is as follows:

(1) 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 should be independently compared with the respective period of the aeroplane control system and, consequently, should enjoy the full tolerance specified for that period.

(ii) The damping tolerance should be applied to overshoots on an individual basis. Care should be taken when applying the tolerance to small overshoots since the significance of such overshoots becomes questionable. Only those overshoots larger than 5 % of the total initial displacement should be considered. The residual band, labelled $T(A_d)$ in Figure 3 is ± 5 % of the initial displacement amplitude Ad from the steady state value of the oscillation. Only oscillations outside the residual band are considered significant. When comparing FSTD data to the 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 when compared against the aeroplane data. This procedure for evaluating the response is illustrated in Figure 3.

(2) Critically damped and overdamped response

Due to the nature of critically damped and overdamped responses (no overshoots), the time to ravel from 90 % of the initial displacement to 10 % of the steady state (neutral point) value should be the same as the aeroplane within ± 10 % or ± 0.05 s. Figure 4 illustrates the procedure.

(3) Special considerations

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

(c) Tolerances

The following table summarises the tolerances, T. See Figures 3 and 4 for an illustration of the referenced measurements.

$T(P_0)$ ± 10 % of P_0 or ± 0.05 s.

$T(P_1)$ ± 20 % of P_1 or ± 0.05 s.

$T(P_2)$ ± 30 % of P_2 or ± 0.05 s.

$T(P_n)$ ± 10(n+1) % of P_n or ± 0.05 s.

$T(A_n)$ ± 1 % of A_{max}, where A_{max} is the largest amplitude or ± 0.5 % of the total control travel (stop to stop).

$T(A_d)$ ± 5 % of A_d = residual band or ± 0.5 % of the maximum control travel = residual band.

± 1 significant overshoots (minimum of 1 significant overshoot).

Steady state position within residual band.

Note 1. Tolerances should not be applied on period or amplitude after the last significant overshoot.

Note 2. Oscillations within the residual band are not considered significant and are not subject to tolerances.

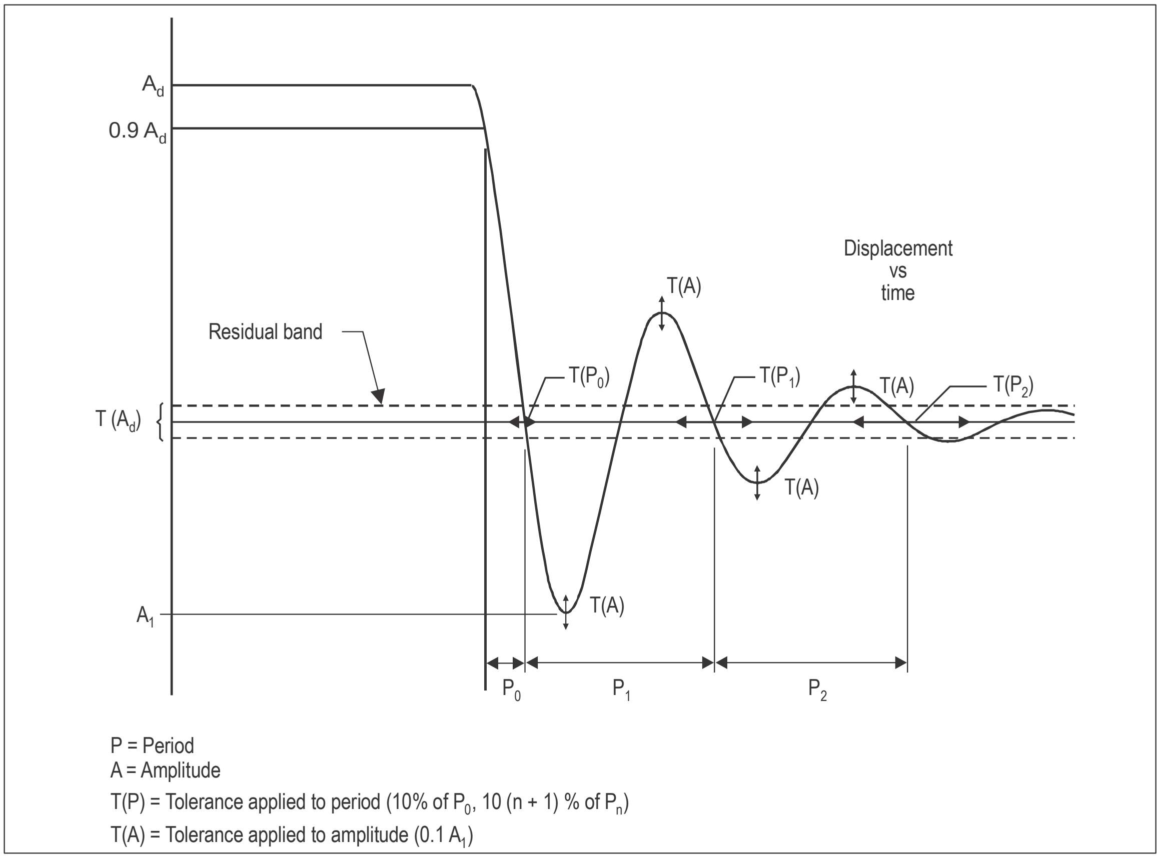


Figure 3: Underdamped step response

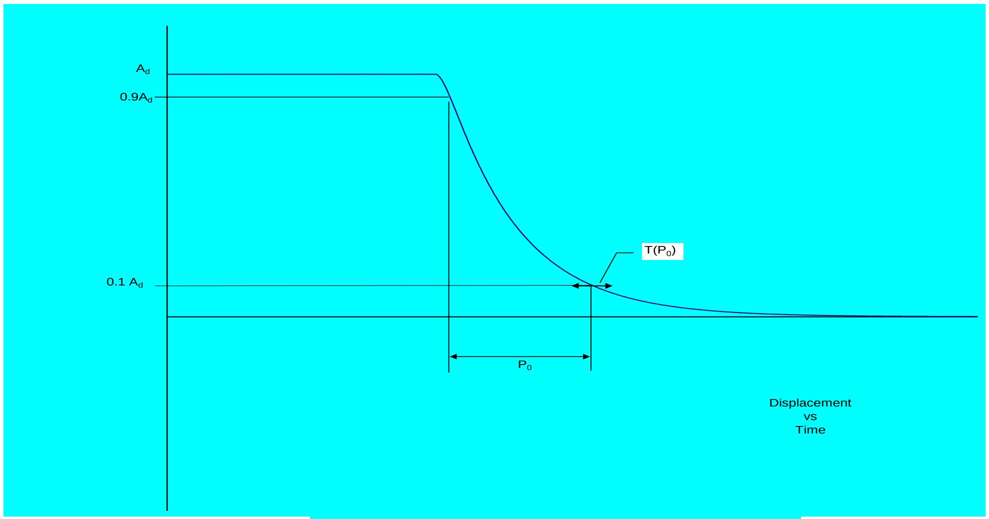


Figure 4: Critically damped step response

The following tolerance applies only to the overdamped and critically damped systems (see Figure 4 above for an illustration of the reference measurement):

$T(P_0)$ ± 10 % of P_0 or ± 0.05 s.

(d) Alternate method for control dynamics evaluation of irreversible flight controls

One aeroplane manufacturer has proposed, and its competent authority has accepted, an alternate means for dealing with control dynamics. The method applies to aeroplanes with hydraulically powered flight controls and artificial feel systems. Instead of free response measurements, the system would be validated by measurements of control force and rate of movement.

These tests should be conducted under typical taxi, take-off, cruise and landing conditions. For each axis of pitch, roll and yaw, the control should be forced to its maximum extreme position for the following distinct rates:

(1) Static test: slowly move the control such that approximately 100 s are required to achieve a full sweep. A full sweep is defined as the movement of the controller from neutral to the stop, usually aft or right stop, then to the opposite stop, then to the neutral position. Tolerances: see 2.a(1), (2), and (3) of the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105.

(2) Slow dynamic test: achieve a full sweep in approximately 10 s. Tolerance: ± 0.9 daN (2 lb) or ± 10 % on dynamic increment above static test.

(3) Fast dynamic test: achieve a full sweep in approximately 4 s. Tolerance: ± 0.9 daN (2 lb) or ± 10 % on dynamic increment above static test.

Note. Dynamic sweeps may be limited to forces not exceeding 44.5 daN (100 lb).

(e) Alternate reference line evaluation method for control dynamics evaluation

(1) Background

(i) When evaluating a flight control dynamic response, the periods, amplitudes and residual band are defined with respect to a reference line, which is the steady state value of the control. This selection is made since it is assumed that the steady state value is representative of the control's rest position throughout the test. For standard irreversible control systems, this is very often a valid assumption. However, in the case of reversible control systems, for example, aerodynamic forces on the control surfaces influence the instantaneous rest position of the control. During the dynamic test, the control's rest position will vary in response to the variance of the flight conditions. In such a case, the instantaneous rest position and steady state value at the end of the test are not equivalent. When the tolerances are applied to the entire dynamic response based on the steady state value, they may become incorrect and lead to problems evaluating the cases.

(ii) In such cases, an alternate reference line may be used, which attempts to better approximate the true rest position of the control throughout a step response. That reference line is obtained as described in Section (2) 'Alternate reference line' below.

(iii) The rest position is defined as the position where the control would eventually settle if no pilot forces were applied to it (left free). This position may or may not be affected by the aerodynamic conditions, the aeroplane configuration and the acceleration it is subjected to. It will depend on the type of flight control system in the aeroplane. Typically, reversible control systems will be affected while irreversible systems will not. The instantaneous rest position is defined as the theoretical rest position at a particular point in time and at the same conditions at that moment.

(2) Alternate reference line

(i) On the control position curve, identify median points, defined as points on the control position curve located equidistantly between two consecutive peaks, measured vertically (see Figure 5). The last median point is the first point where the dynamic portion of the response has ended rather than the mid-point between the last peak and the end of the dynamic portion.

(ii) Join the median points to produce the 'line of medians'. Then, identify reference points, defined as the intersection of a vertical line passing through a position peak and the line of medians (see Figure 6).

(iii) The first reference point is the last control position before the start of the excitation. When this part of the data is not available, project the first available reference point horizontally to time zero. The last reference point is simply the last median point.

(iv) Link all the reference points to obtain the alternate reference line (see Figure 6), and append the final non-dynamic portion to it.

(3) Tolerances

The final alternate reference line (see Figure 7) may be used to calculate the conventional tolerances described in 2.a(1), (2), and (3) of the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105. Note that the residual band T(Ad) should be at a distance of ± 5 % per cent of Ad or ± 0.5 % of the total control travel (stop to stop) from the alternate reference line. Its shape will therefore follow the alternate reference line.

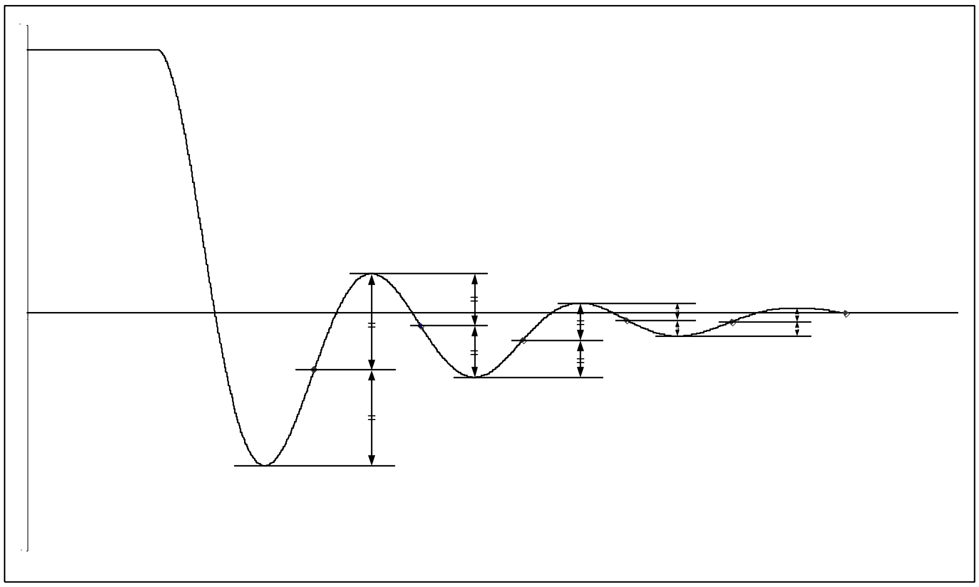


Figure 5: Locating median points

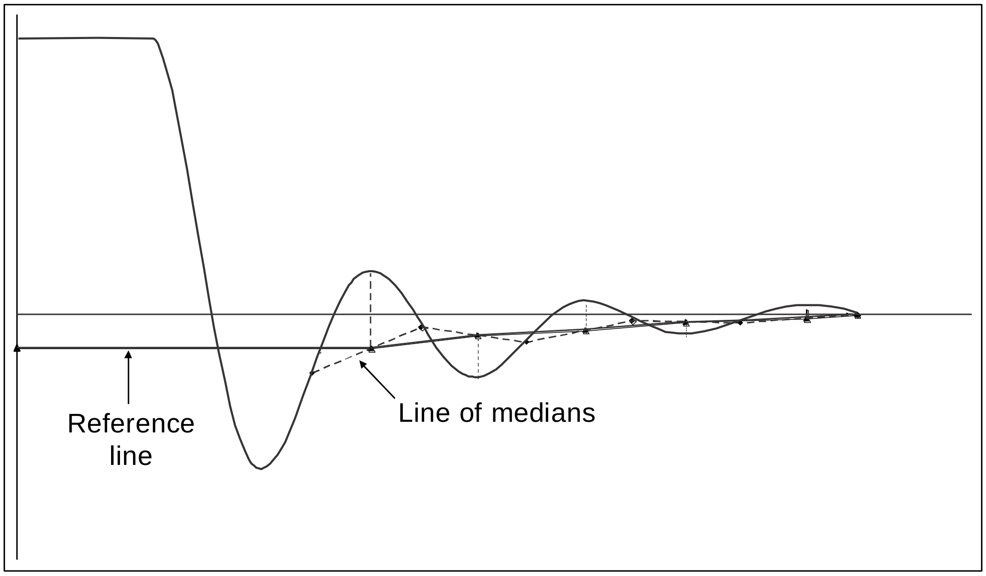


Figure 6: Producing the alternate reference line

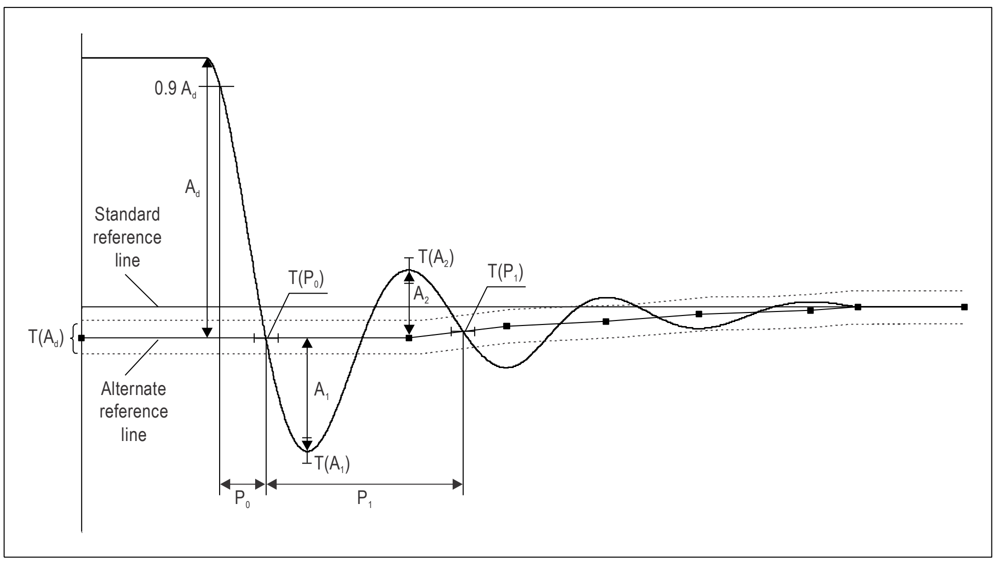


Figure 7: Tolerances applied using the alternate reference line

(f) The competent authority should consider alternative means such as the ones 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 competent authority find that alternative methods do not result in satisfactory performance, then more conventionally accepted methods should be used.

CS FSTD(A).QTG.220 Ground effect

This CS provides standards for the definition of ground effect tests parameters.

(a) For an 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 to validate the aerodynamic ground effect characteristics.

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

(b) Acceptable tests for validation of ground effect include the following:

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

(2) Shallow approach landing: this should be performed at a glide slope of approximately one degree with negligible pilot activity until flare.

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

(c) 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. 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.

CS FSTD(A).QTG.230 Motion system

This CS provides general standards for the assessment of motion systems.

(a) General

(1) 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.

(2) The objective validation tests presented in this CS are intended to qualify the FSTD motion cueing system from a mechanical performance standpoint and a motion cueing fidelity perspective.

(b) Motion system checks

The intent of tests as described in the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105, points 3.a. frequency response, 3.b. 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.

(c) Motion cueing fidelity — frequency-domain criterion

Unlike other motion tests, such as the motion system frequency response, that concentrate on the mechanical performance of the motion system hardware alone, the purpose of this test is to objectively measure the frequency response of the complete motion cueing system for specified DOF relationships.

The motions experienced by the pilot are highly dependent on the motion cueing algorithm and its implementation in the FSTD. This test quantifies the response of the motion cueing system from the output of the flight model to the motion platform response.

Refer to CS FSTD(A).QTG.235 Frequency domain motion cueing system performance test.

(d) 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 test allows 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.

(1) Conditions:

(i) one test case on ground: to be determined by the operator; and

(ii) one test case in flight: to be determined by the operator.

(2) Input: the inputs should be such that both rotational accelerations/rates and linear accelerations are inserted before the transfer from aeroplane CoG to pilot reference point with a minimum amplitude of 5deg/s/s, 10deg/s and 0.3g respectively to provide adequate analysis of the output.

(3) Recommended output:

(i) actual platform linear accelerations: the output will comprise accelerations due to both the linear and rotational motion acceleration; and

(ii) motion actuators position.

(e) Motion vibrations

(1) 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.

(2) 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 the 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 grms2/Hz would describe a heavy buffet. On the other hand, a 1x10-6 grms2/Hz buffet is barely 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.).

CS FSTD(A).QTG.235 Frequency domain motion cueing system performance test

This CS provides standards for frequency domain motion cueing system performance test.

(a) Background

(1) The objective of this CS is to define the objective test which should be used to ensure motion cueing of FSTDs is consistently delivered in an acceptable manner.

(2) The purpose of this test is to objectively measure the frequency response of the complete motion cueing system for specified DOF relationships. Other motion tests, such as the motion system frequency response, concentrate on the mechanical performance of the motion system hardware alone. The motions experienced by the pilot are highly dependent on the motion cueing algorithm and its implementation in the FSTD. This test quantifies the response of the motion cueing system from the output of the flight model to the motion platform response.

(3) The characteristics of the motion cueing system have a direct impact on the perception and control exercised by the pilot in the FSTD, especially during manual flying. The pilot's appreciation of the FSTD fidelity depends considerably on the perceived 'feel' of the aeroplane being simulated, and this feel is influenced by the motion cueing system, among others. The first element in the motion cueing system is the motion drive algorithm (MDA), a set of control blocks that transform the outputs from the flight model to motion platform commands. A block diagram of the basic scheme of an MDA is shown in Figure 1.

(4) In Figure 1, the HP filter and LP filter indicate high-pass and low-pass filters, respectively. The scaling factors, f-scale and ω-scale are chosen to attenuate the input signals in such a way that the motion platform remains within its mechanical limits.

(5) In order for the FSTD to provide a feel that is representative of the aeroplane, the MDA parameters are tuned during acceptance by the evaluation pilot under different simulated flight conditions. Usually, the evaluation pilot's subjective feel is used to tune the motion cueing system. This, however, does not lead to a consistently reliable and reproducible tuning of the motion cueing system — not only because of variability in preferences across pilots but also variability of feel for the same pilot over different days.

(6) Invariably, compromises need to be made in order to provide motion cues that feel reasonable, while keeping the motion platform within its fixed boundaries. The gains are therefore attenuated throughout the frequency range. In this sense, the motion system includes the following:

(i) the motion cueing algorithm;

(ii) the motion platform actuator extension transformation and control laws;

(iii) the motion platform hardware that reacts to the transformed aeroplane motion commands; and

(iv) the digital time delay embedded in the above processes.

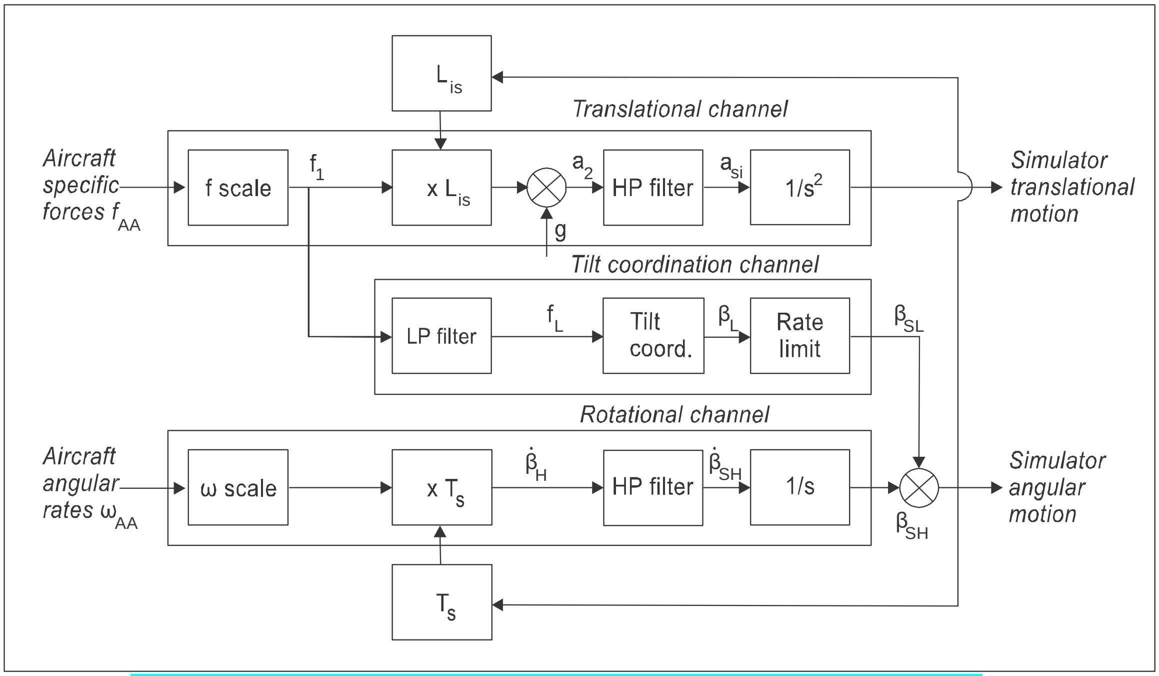


Figure 1: Basic scheme of a motion cueing algorithm (from Reid-Nahon)

(7) Analogue processes have a modulus and a phase which includes the analogue delays. When these analogue processes are simulated digitally, an additional digital time delay is introduced.

(8) All of the above influence the pilot's perception of the simulated motion. In order to compare and evaluate motion systems in a more rigorous manner, an objective motion cueing test (OMCT) is described herein.

(9) For this test, it is important that the 'reference' signals are defined at the location of the pilot F_{PA} in the aeroplane, and not at the aeroplane CoG. It is important because this is what the pilot feels when in their seat. The FSTD response is measured at the pilot position F_{PS} in the FSTD. The response at F_{PS} should be compared with the signal at F_{PA}. This provides information on the transformation of the aeroplane motions to FSTD motions as perceived by the pilot and is shown in the signal diagram of Figure 2. The measured frequency response of the motion cueing system describes the relation between the motion platform responses measured at ❶ compared to the input at ❷, with the 'switch' in Figure 2 in the down position. The signals generated by the OMCT signal generator are described below.

Note. The relevant frames of reference are described in paragraph (h).4.

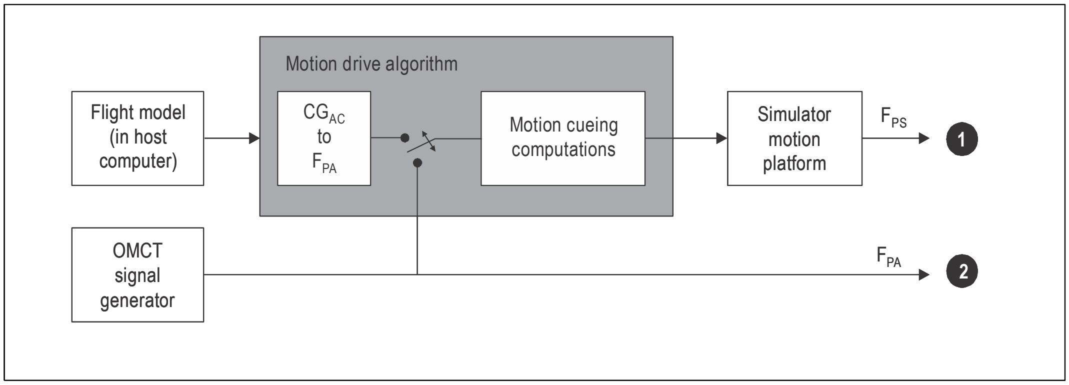


Figure 2: Transformation from simulated aeroplane flight modeloutput to motion platform response

(10) The MDA is defined here as the set of processes needed to transform the F_{PA} motions to FSTD motion platform response F_{PS}. It includes the motion cueing algorithm as applied in the operational use of the training device, including all special effects and buffet computations, actuator inverse transformations and the control laws needed to command the closed-loop motions of the platform. This OMCT considers all these aspects as a whole in order to capture the transport delays introduced by these processes and any delays in the related computer equipment used in the motion system. In some cases, the MDA may be integrated in the host computer, and in others it may be part of the motion control computer.

(11) The FSTD motion platform is defined as the mechanical hardware used to generate the motions.

(12) The criterion on which the OMCT is based states that, over the finite frequency range important for manual control, the modulus of the total system should be high (close to 1) and the phase should be small (close to zero) for the direct transformation and some of the cross-coupling relations, in order to simulate the aeroplane motions as realistically as possible. Hence, the OMCT is set up to evaluate the modulus and phase of the FSTD over the defined frequency range against this criterion.

(13) The ideal FSTD would provide rotations and translations as they would occur in the aeroplane. However, due to the limitations of the motion platform, this is physically not possible. As a result, FSTD translations and rotations are used in a mixed manner to create the effect of both aeroplane rotations and translations. From the motion stimulation and pilot perception point of view, the following frequency responses have been defined as being of direct importance for the OMCT:

(i) FSTD rotational response due to aeroplane pure rotational manoeuvres;

(ii) FSTD specific force response due to aeroplane pure translational manoeuvres;

(iii) FSTD rotational accelerations due to aeroplane pure translational manoeuvres; and

(iv) FSTD translational response due to aeroplane pure rotational manoeuvres.

(14) The first two relations are of direct importance for the correct simulation of motions. In the frequency range of importance to manual flying, these require a high gain with respect to the aeroplane motions, and a small phase distortion. The other two relations ((13)(iii) and (13)(iv) above) provide information about the cross-coupling of the FSTD motion response and may be used to create the illusion of the aeroplane environment.

(b) Objective motion cueing test (OMCT) procedure

(1) The OMCT is to be conducted in up to two configurations separately, representing the motion cueing algorithm settings on the ground, and again in flight. In the unlikely event that these settings are the same between ground and flight on the FSTD in question, a single set of tests is acceptable.

(2) *Measurement frequencies.* The purpose of these tests is to determine the frequency response of the complete motion cueing system for the four relations described above. For these measurements, the frequencies of the input signals are given in Table 1.

Note. In Table 1, the frequency given in Hertz is that corresponding to the frequency in rad/s and is only shown for reference.

Input signal number	**Frequency [rad/s]**	**Frequency [Hz]**	**Modulus M [non-dimensional]**	**Phase ϕ [°]**
1	0.100	0.0159 Hz		
2	0.158	0.0251 Hz		
3	0.251	0.0399 Hz		
4	0.398	0.0633 Hz		
5	0.631	0.1004 Hz		
6	1.000	0.1591 Hz		
7	1.585	0.251 Hz		
8	2.512	0.399 Hz		
9	3.981	0.633 Hz		
10	6.310	1.004 Hz		
11	10.000	1.591 Hz		
12	15.849	2.515 Hz		

Table 1: Input test signal frequencies and required modulus and phase measurements

(i) The relationship between the frequency and corresponding modulus M and the corresponding phase ϕ defines the system frequency response. The OMCT requires that for each DOF, measurements at 12 discrete frequencies are taken. It should be noted that as more experience is gained with this test for a specific application, the exact number of discrete frequencies required may change.

(ii) During the OMCT, for the measurements required, the individual DOF are excited independently for pitch, roll and yaw and modified inputs are given for the surge, sway and heave (described below). For each discrete input frequency defined in Table 1, the measured relation in modulus and phase should be shown. This can be done manually (by measuring amplitude and phase on the resulting plots as shown in Figure 3) or by using appropriate digital methods.

(iii) Whereas Table 1 describes the frequencies at which these measurements are to be performed, combinations of sinusoidal inputs may be used instead in order to reduce the testing time. If such a method is used, care should be taken to obtain the correct results.

(iv) Depending on the sampling frequency of the input sum of sinusoids and the output, a total run length of the input signal of 200 to 300 seconds will be needed.

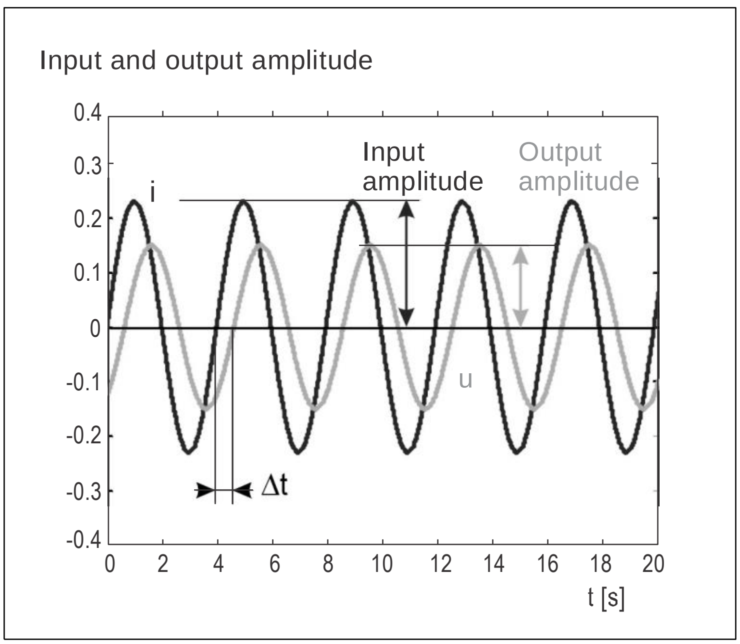


Figure 3: General definition of amplitudes of an output signal *u* and input signal *i* and time shift *Δt* between *u* and *i*.

(v) The modulus M and phase ϕ are defined as:

$M(\omega)$ = amplitude of output $u(\omega)$/amplitude of input $i(\omega)$

$\phi(\omega) = \Delta t\, \omega\, 360 / 2\pi$ [°]

Note. A description of symbols and notations is provided in paragraph (h).

(c) Input amplitudes

(1) A key goal of the MDA is to generate motion responses while maintaining the platform within its mechanical limits. In order to test the motion cueing system in the region important to manual control, the input amplitudes are defined.

(2) The tests applied to the motion cueing system are intended to quantify its response to normal control inputs during manoeuvring (i.e. not aggressive or excessively hard control inputs) with linear response in order to maintain consistency. It is, however, necessary to excite the system in such a manner that the response is measured with a high signal-to-noise ratio and that the possible non-linear elements in the motion cueing system are not overly excited.

(3) In order to carry out these tests, a specific test signal is entered into the motion cueing system using the OMCT signal generator as shown in Figure 2. These test signals stimulate the motion cueing system in a way similar to the aeroplane model output in the FSTD. The test signal represents the aeroplane state variables

$$\left(\varphi_{a/c}, \theta_{a/c}, \text{ and } \psi_{a/c}, f^{x}{}_{a/c}, f^{y}{}_{a/c}, \text{ and } f^{z}{}_{a/c} \right).$$

These variables should correspond to those normally applied in the particular motion cueing system. In other words, if the FSTD manufacturer uses the angular rates instead of attitudes, the corresponding input signals have to be generated.

(i) *Specific force input amplitudes*. In the specific force channels, the input signal is defined by the following equation, using the amplitudes A given in Table 2:

$$f_{a/c}^{x,y,z}(t) = A \sin(\omega t).$$

(ii) *Rotational input amplitudes*. For the rotational inputs, the relations between attitude, angular rate and angular acceleration are given in Table 3, and the corresponding amplitudes in Table 4. These equations are only valid for ω in rad/s. The tests may be carried out with attitude, angular rate or angular acceleration inputs, as long as the inputs are consistent with the MDA implemented in the FSTD.

Frequency signal number	Frequency [rad/s]	Frequency [Hz]	Amplitude A [m/s^2]
1	0.100	0.0159 Hz	1.00
2	0.158	0.0251 Hz	1.00
3	0.251	0.0399 Hz	1.00
4	0.398	0.0633 Hz	1.00
5	0.631	0.1004 Hz	1.00
6	1.000	0.1591 Hz	1.00
7	1.585	0.251 Hz	1.00
8	2.512	0.399 Hz	1.00
9	3.981	0.633 Hz	1.00
10	6.310	1.004 Hz	1.00
11	10.000	1.591 Hz	1.00
12	15.849	2.515 Hz	1.00

Table 2: Specific force input amplitudes

	Aeroplane pitch	Aeroplane roll	Aeroplane yaw
Attitude	$\theta_{a/c}(t) = A \sin(\omega t)$	$\varphi_{a/c}(t) = A \sin(\omega t)$	$\psi_{a/c}(t) = A \sin(\omega t)$
Angular rate	$q_{a/c}(t) = A\omega \cos(\omega t)$	$p_{a/c}(t) = A\omega \cos(\omega t)$	$r_{a/c}(t) = A\omega \cos(\omega t)$
Angular acceleration	$\dot{q}_{a/c}(t) = -A\omega^2 \sin(\omega t)$	$\dot{p}_{a/c}(t) = -A\omega^2 \sin(\omega t)$	$\dot{r}_{a/c}(t) = -A\omega^2 \sin(\omega t)$

Table 3: Rotational input amplitudes

Frequency signal number	Frequency [rad/s]	Frequency [Hz]	Attitude Amplitude A [°]	Angular rate amplitude A ω [°/s]	Angular acceleration amplitude A ω^2 [°/s^2]
1	0.100	0.0159 Hz	6.000	0.600	0.060
2	0.158	0.0251 Hz	6.000	0.948	0.150
3	0.251	0.0399 Hz	3.984	1.000	0.251
4	0.398	0.0633 Hz	2.513	1.000	0.398
5	0.631	0.1004 Hz	1.585	1.000	0.631
6	1.000	0.1591 Hz	1.000	1.000	1.000
7	1.585	0.251 Hz	0.631	1.000	1.585
8	2.512	0.399 Hz	0.398	1.000	2.512
9	3.981	0.633 Hz	0.251	1.000	3.981
10	6.310	1.004 Hz	0.158	1.000	6.310
11	10.000	1.591 Hz	0.100	1.000	10.000

Frequency signal number	Frequency [rad/s]	Frequency [Hz]	Attitude Amplitude A [°]	Angular rate amplitude A ω [°/s]	Angular acceleration amplitude A ω^2 [°/s^2]
12	15.849	2.515 Hz	0.040	0.631	10.000

Table 4: Guidelines for electronic qualification test guide

(d) OMCT matrix

The OMCT requires the frequency response to be measured for the motion cueing system from the pilot reference position in the aeroplane F_{PA} to the pilot reference position in the FSTD F_{PS} for the transformations defined in Table 5. Six independent tests (one for each aeroplane input signal) should be performed. Tests 1 and 2, tests 3 and 4, tests 6 and 7, and tests 8 and 9 are to be conducted with one input signal while measuring two output responses, simultaneously. The reason for this is to measure both the direct responses and cross-coupling responses in one test.

(e) OMCT description

(1) The frequency responses describe the relations between aeroplane motions and FSTD motions as defined in Table 5. The relations are explained below per individual test.

Test number	Test description	Dimension frequency response
1	FSTD pitch response to aeroplane pitch input.	No dimension
2	FSTD surge acceleration response due to aeroplane pitch acceleration input.	[m/°]
3	FSTD roll response to aeroplane roll input.	No dimension
4	FSTD sway specific force response due to aeroplane roll acceleration input.	[m/°]
5	FSTD yaw response to aeroplane yaw input.	No dimension
6	FSTD surge response to aeroplane surge input.	No dimension
7	FSTD pitch response to aeroplane surge specific force input.	[° s^2/m]
8	FSTD sway response to aeroplane sway input	No dimension
9	FSTD roll response to aeroplane sway specific force input.	[° s^2/m]
10	FSTD heave response to aeroplane heave input.	No dimension

(2) Tests 1, 3, 5, 6, 8 and 10 show the direct transfer relations, while tests 2, 4, 7 and 9 show the cross-coupling relations.

	FSTD response output					
Aeroplane input signal	**Pitch**	**Roll**	**Yaw**	**Surge**	**Sway**	**Heave**
Pitch	1			2		
Roll		3			4	
Yaw			5			
Surge	7			6		
Sway		9			8	

Heave						10

Table 5: Test matrix with test numbers

(f) Presentation of results

(1) The results should be presented for each of the OMCTs defined in Table 5, and at each frequency defined in Table 1, in terms of the modulus and the phase. Ten tables should be presented as described in paragraph (e) above. The results should also be plotted for each component in the test matrix, in bode plots with the modulus and the phase along the vertical axis and the frequency in rad/s along the horizontal axis (see Figure 4). The modulus and phase tolerance boundaries for all 10 tests are presented in Tables 6 to 15. These tolerance boundaries were derived from the motion cueing systems of eight FSTDs from several of the leading FSTD manufacturers and the consideration in (2) below.

(2) As these tests show the additional modulus and phase introduced by the FSTD motion cueing system, the criterion on which the OMCT is based stipulates that it is important to achieve a relatively high modulus and a relatively low phase for tests 1, 3, 5, 6, 7, 8, 9 and 10. Tests 2 and 4 define undesired motions and should have relatively low moduli. Note that when the modulus is low, phase errors are correspondingly less significant.

(3) Regions of acceptable fidelity are given in Tables 6 to 15 for the in-flight conditions as maximum and minimum allowable modulus and phase of the frequency response. The motion cueing systems should lie within the maximum and minimum fidelity tolerance boundaries or, alternatively, a rationale should be provided describing any differences and justification for their acceptability.

(4) Tolerance tables for on-ground conditions have not yet been determined and will be provided in future revisions of this document.

(5) From the above description of the OMCT, it is clear that the results describe the motion cueing system dynamic characteristics between FPA and FPS in the frequency domain. For correct simulation of the aeroplane motions at the pilot position in the aeroplane (which is the input to the motion cueing system), it is important that the calculation of the specific forces at pilot reference position FPA is performed correctly.

(g) Motion cueing criteria

(1) The motion cueing criteria are defined in the frequency domain by indicating areas for fidelity and low fidelity. The boundaries are based on the notion that preferably the motion cueing has a high gain and small phase to present motion cues to the pilot as close as possible to those in the real aeroplane. This is, however, not always practical. Therefore, a practical approach has been used based on the statistical results of reliable OMCT measurements of eight Level D or ICAO Doc 9625 Type VII FSTDs. The boundaries are based on the average behaviour ± 2 times the standard deviations for each test

defining the boundaries for high-fidelity and low-fidelity areas (see Figure 5 where the high-fidelity area is labelled 'fidelity'). The boundaries for the phase angles of Tests 2 and 4 may be considered as an indication for possible errors in the frequency responses but have no significant meaning for the motion cueing where the modulus for these tests is already small.

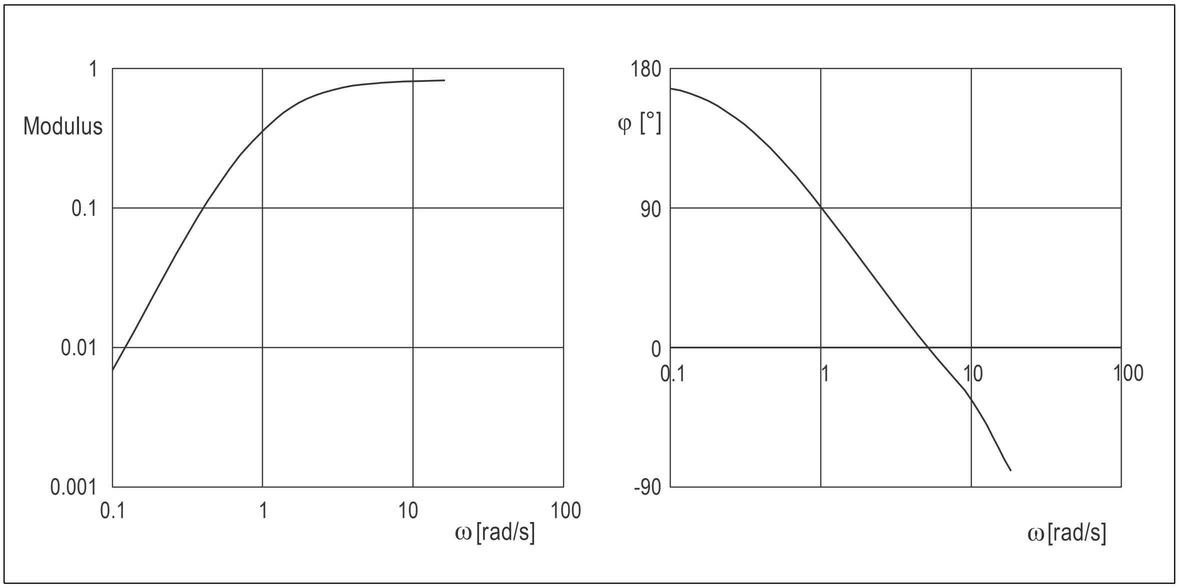


Figure 4: Example of bode plots for the frequency response of a test of the motion cueing system

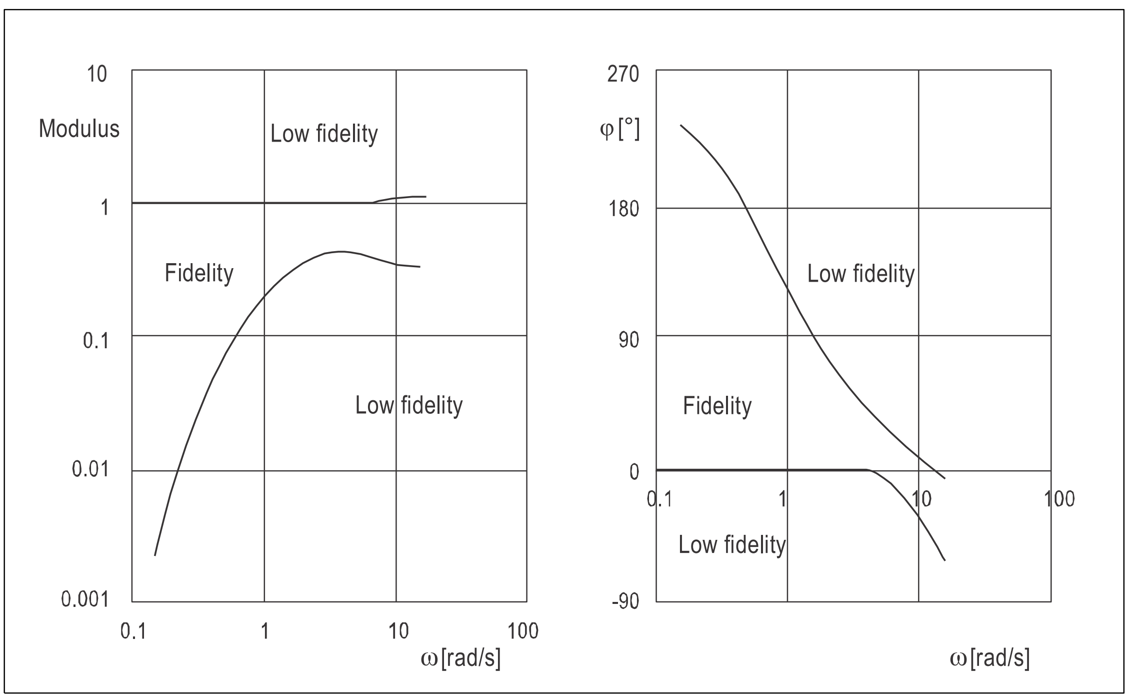


Figure 5: Example of bode plots with the boundaries for the OMCT modulus and phase for fidelity

(2) In Tables 6 to 15, the boundaries for the modulus and phase for each test are presented with high fidelity between the values in the columns 'maximum' and 'minimum' and low fidelity outside the values in these columns.

Frequency [rad/s]	Modulus		Phase [°]	
	Maximum	Minimum	Maximum	Minimum
0.1000	1.0000	0.5830	2.124	-7.061
0.1585	1.0000	0.5827	1.602	-9.685
0.2512	1.0000	0.5797	3.076	-14.185
0.3981	1.0000	0.5435	6.375	-18.286
0.6310	1.0000	0.4803	13.359	-19.125
1.0000	1.0000	0.4408	18.153	-14.888
1.5850	1.0755	0.4044	18.200	-13.063
2.5120	1.1653	0.3805	18.300	-23.504
3.9810	1.1761	0.3481	18.339	-33.079
6.3100	1.2282	0.3110	16.701	-37.583
10.0000	1.2972	0.2607	8.964	-48.343
15.8490	1.2974	0.2526	-3.000	-70.541

Table 6: The boundaries for fidelity for the modulus and phase of the frequency response for test 1

Frequency [rad/s]	Modulus [m/°]		Phase [°]	
	Maximum	Minimum	Maximum	Minimum
0.1000	0.050	0.000	180.000	-90.000
0.1585	0.050	0.000	153.181	-116.819
0.2512	0.050	0.000	126.044	-143.956
0.3981	0.050	0.000	99.016	-170.984
0.6310	0.047	0.000	71.996	-198.004
1.0000	0.038	0.000	45.000	-225.000
1.5850	0.027	0.000	18.181	-251.819
2.5120	0.021	0.000	-8.956	-278.956
3.9810	0.021	0.000	-35.984	-305.984
6.3100	0.021	0.000	-63.004	-333.004
10.0000	0.021	0.000	-90.000	-360.000
15.8490	0.021	0.000	-116.819	-386.819

Table 7: The boundaries for fidelity for the modulus and phase of the frequency response for test 2

Frequency [rad/s]	**Modulus**		**Phase [°]**	
	Maximum	**Minimum**	**Maximum**	**Minimum**
0.1000	1.000			
0.1585	1.000	0.002	238.809	0.000
0.2512	1.000	0.012	218.808	0.000
0.3981	1.000	0.042	193.142	0.000
0.6310	1.000	0.104	160.237	0.000
1.0000	1.000	0.199	123.919	0.000
1.5850	1.000	0.307	91.470	0.000
2.5120	1.000	0.398	65.983	0.000
3.9810	1.000	0.426	44.115	0.000
6.3100	1.007	0.394	25.551	-11.747
10.0000	1.104	0.358	10.422	-32.346
15.8490	1.132	0.344	-4.276	-61.569

Table 8: The boundaries for fidelity for the modulus and phase of the frequency response for test 3

Frequency [rad/s]	Modulus [m/°]		Phase [°]	
	Maximum	Minimum	Maximum	Minimum
0.1000	0.1800	0.0001	290.00	70.00
0.1585	0.1800	0.0001	263.00	44.00
0.2512	0.1800	0.0001	236.00	18.00
0.3981	0.1800	0.0001	209.00	-8.00
0.6310	0.1800	0.0001	182.00	-34.00
1.0000	0.0895	0.0001	155.00	-60.00
1.5850	0.0447	0.0001	128.00	-86.00
2.5120	0.0221	0.0001	101.00	-112.00
3.9810	0.0110	0.0001	74.00	-138.00
6.3100	0.0110	0.0001	47.00	-164.00
10.0000	0.0110	0.0001	20.00	-190.00
15.8490	0.0110	0.0001	-7.00	-216.00

Table 9: The boundaries for fidelity for the modulus and phase of the frequency response for test 4

Frequency [rad/s]	Modulus		Phase [°]	
	Maximum	Minimum	Maximum	Minimum
0.1000	1.0000			
0.1585	1.0000	0.0000	205.571	0.000
0.2512	1.0000	0.0002	184.672	0.000
0.3981	1.0000	0.0020	162.452	0.000
0.6310	1.0000	0.0100	137.846	0.000
1.0000	1.0000	0.0358	111.264	0.000
1.5850	1.0000	0.1574	84.075	0.000
2.5120	1.0000	0.2748	57.893	0.000
3.9810	1.0000	0.3434	34.559	-3.155
6.3100	1.0000	0.3672	15.671	-17.260
10.0000	1.0000	0.3819	-0.257	-35.691
15.8490	1.0000	0.3321	-21.476	-61.278

Table 10: The boundaries for fidelity for the modulus and phase of the frequency response for test 5

Frequency [rad/s]	Modulus		Phase [°]	
	Maximum	Minimum	Maximum	Minimum
0.1000	1.0000	0.4983	0.000	-6.728
0.1585	1.0000	0.5571	0.000	-9.993
0.2512	1.0000	0.5464	0.000	-16.133
0.3981	1.0000	0.4905	0.000	-33.732
0.6310	1.0000	0.3581	2.116	-62.645
1.0000	1.0000	0.1000	6.427	-97.015
1.5850	1.0000	0.1000	88.567	-189.130
2.5120	1.0000	0.1294	172.898	-155.592
3.9810	1.0000	0.1626	135.606	-87.596
6.3100	1.0000	0.1609	86.135	-86.752
10.0000	1.0000	0.1206	63.372	-110.460
15.8490	1.1115	0.0564	53.757	-151.068

Table 11: The boundaries for fidelity for the modulus and phase of the frequency response for test 6

Frequency [rad/s]	Modulus [°.s^2/m]		Phase [°]	
	Maximum	Minimum	Maximum	Minimum
0.1000	5.721	2.894	-1.687	-7.480
0.1585	5.715	3.241	-1.921	-9.759
0.2512	5.698	3.160	-3.247	-15.377
0.3981	5.628	2.846	-1.995	-32.297
0.6310	5.848	2.016	0.779	-56.854
1.0000	5.662	1.200	-7.696	-78.855
1.5850	5.103	0.411	-26.388	-114.064
2.5120	4.042	0.143	-39.054	-155.006
3.9810	2.903	0.047	-70.614	-176.185
6.3100	1.693	0.015	-113.010	-193.390
10.0000	0.832	0.005	-154.536	-208.439
15.8490	0.370	0.002	-184.930	-238.245

Table12: The boundaries for fidelity for the modulus and phase of the frequency response for test 7

Frequency [rad/s]	Modulus		Phase [°]	
	Maximum	Minimum	Maximum	Minimum
0.1000	1.0000	0.3103	0.000	-8.465
0.1585	1.0961	0.3355	0.000	-12.366
0.2512	1.0979	0.3144	0.000	-19.548
0.3981	1.0988	0.2631	0.000	-30.681
0.6310	1.0882	0.1724	0.000	-48.655
1.0000	1.0532	0.0400	27.399	-83.909
1.5850	1.0000	0.0627	102.943	-148.567
2.5120	1.0000	0.1200	135.772	-150.148
3.9810	1.0000	0.3247	117.522	-99.978
6.3100	1.0000	0.4448	62.714	-51.655
10.0000	1.0000	0.3429	42.305	-79.292
15.8490	1.0368	0.1885	30.545	-122.581

Table 13: The boundaries for fidelity for the modulus and phase of the frequency response for test 8

Frequency [rad/s]	Modulus [°.s^2/m]		Phase [°]	
	Maximum	Minimum	Maximum	Minimum
0.1000	6.279	1.993	178.49	172.43
0.1585	6.279	2.105	179.91	167.21
0.2512	6.279	2.049	179.57	160.23
0.3981	6.269	1.925	178.84	149.61
0.6310	6.265	1.630	177.62	133.20
1.0000	6.263	1.043	174.32	110.65
1.5850	5.601	0.486	163.13	67.11
2.5120	4.593	0.204	152.69	22.48
3.9810	2.954	0.081	108.60	0.62
6.3100	1.715	0.032	70.73	-16.13
10.0000	0.899	0.013	30.13	-27.50
15.8490	0.414	0.005	-1.96	-53.85

Table 14: The boundaries for fidelity for the modulus and phase of the frequency response for test 9

Frequency [rad/s]	Modulus		Phase [°]	
	Maximum	Minimum	Maximum	Minimum
0.1000	1.0000			0.000
0.1585	1.0000	0.0001	280.382	0.000
0.2512	1.0000	0.0003	260.530	0.000
0.3981	1.0000	0.0013	238.435	0.000
0.6310	1.0000	0.0041	213.109	0.000
1.0000	1.0000	0.0111	185.979	0.000
1.5850	1.0000	0.0246	154.825	0.000
2.5120	1.0000	0.0447	123.413	0.000
3.9810	1.0000	0.0755	94.706	0.000
6.3100	1.0000	0.1301	68.148	0.000
10.0000	1.0000	0.2043	40.922	-21.483
15.8490	1.0000	0.2867	10.539	-50.328

Table 15: The boundaries for fidelity for the modulus and phase of the frequency response for test 10

(4) Notations and frames of reference

(1) *Notations* *Unit*

θ	pitch angle	[°]
φ	roll angle	[°]
ψ	yaw angle	[°]
ω	frequency	[rad/s]
Φ	phase angle	[°]
A	amplitude	
M	Modulus	
a	linear acceleration	[m/s²]
f	specific force	[m/s²]
g	gravity	[m/s²]
I	input signal	
p	roll rate	[°/s]
q	pitch rate	[°/s]
r	yaw rate	[°/s]
u	output signal (or response)	
t	time	[s]
Δt	measured phase delay	[s]

(2) *Subscript indices*

A	aeroplane or aircraft
a/c	aircraft
S	simulator or FSTD

PA aeroplane pilot
PS FSTD pilot

(3) *Superscript indices*

x, y, z along the X, Y, and Z axis, respectively.

(4) *Frames of reference*

In order to ensure that the results are consistent between FSTDs, the following frames of reference are defined.

Frame F_D
Reference frame F_D is located with its origin at the centre of the motion measurement system that may be used in these tests. The x-axis points forward, and the z-axis points downward. The x-y plane is parallel to the upper FSTD frame which will be assumed to be parallel to the floor of the cockpit. Note that F_D is not explicitly shown in Figure 6.

Frame F_I
The inertial reference frame F_I is fixed to the ground with the z-direction aligned with the gravity vector g. This frame is often used in the MDA.

Frame F_S
The FSTD reference frame F_S has its origin at a reference point selected to suit the manufacturer's MDA. It is attached to the FSTD cab and is parallel to frame F_D. Its origin may be coincident with $\boldsymbol{F_D}$.

Frame F_A
The aeroplane reference frame F_A has its origin at the aeroplane CoG. Frame F_A has the same orientation with respect to the flight deck as the FSTD frame F_S.

Frame F_{PS}
This is a reference frame attached to the FSTD in the plane of symmetry of the cab, at a height approximately 35 cm below eye height. The x-axis points forward, and the z-axis points downward. F_{PS} is parallel to F_D.

Frame F_{PA}
This is the same as F_{PS}, but for the aeroplane pilots.

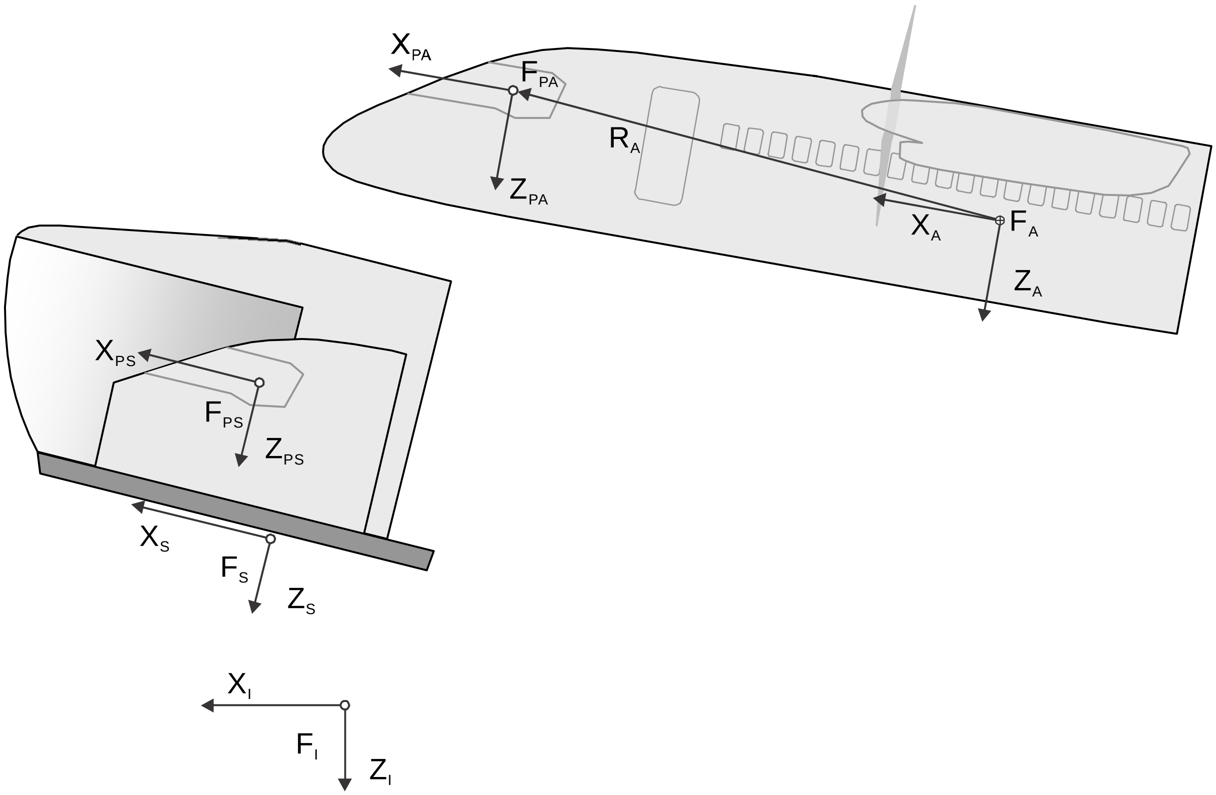


Figure 6: Aeroplane and FSTD frames of reference relevant to MDAs.

CS FSTD(A).QTG.240 Visual system

This CS provides general standards for the assessment of visual systems.

(a) Visual display system

(1) Contrast ratio (daylight systems). This 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 five degrees per square with a white square in the centre of each channel. Measurement should be made on the centre bright square for each channel using a one degree spot photometer. Measure any adjacent dark squares. The contrast ratio is the bright square value divided by the dark square value. Lightpoint contrast ratio is measured when lightpoint modulation is just discernible compared to the adjacent background. See CS FSTD(A).QTG.105 4.b(3) and CS FSTD(A).QTG.105 4.b(7).

(2) Highlight brightness test (daylight systems). This should be demonstrated by maintaining the full test pattern described above, superimposing a highlight on the centre white square of each channel and measuring the brightness using the one degree spot photometer. Lightpoints are not acceptable. Use of calligraphic capabilities to enhance raster brightness is acceptable. See CS FSTD(A).QTG.105 4.b(4).

(3) 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 SoC. See CS FSTD(A).QTG.105 4.b(5).

(4) 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 CS FSTD(A).QTG.105 4.b(6).

(5) Lightpoint size (twilight and night systems) should be of sufficient resolution so as to enable achievement of visual feature recognition tests according to CS FSTD(A).QTG.105 4.b(6).

(b) Visual ground segment

(1) 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.

(2) The QTG should indicate the source of data, i.e. airport and runway used, ILS G/S antenna location (airport and aeroplane), pilot eye reference point, flight deck cut-off angle, etc., used to make accurate visual ground segment (VGS) scene content calculations. See Figure 8.

(3) 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 that aeroplane attitude is achieved. Flying the approach manually or with an installed autopilot should also produce acceptable results.

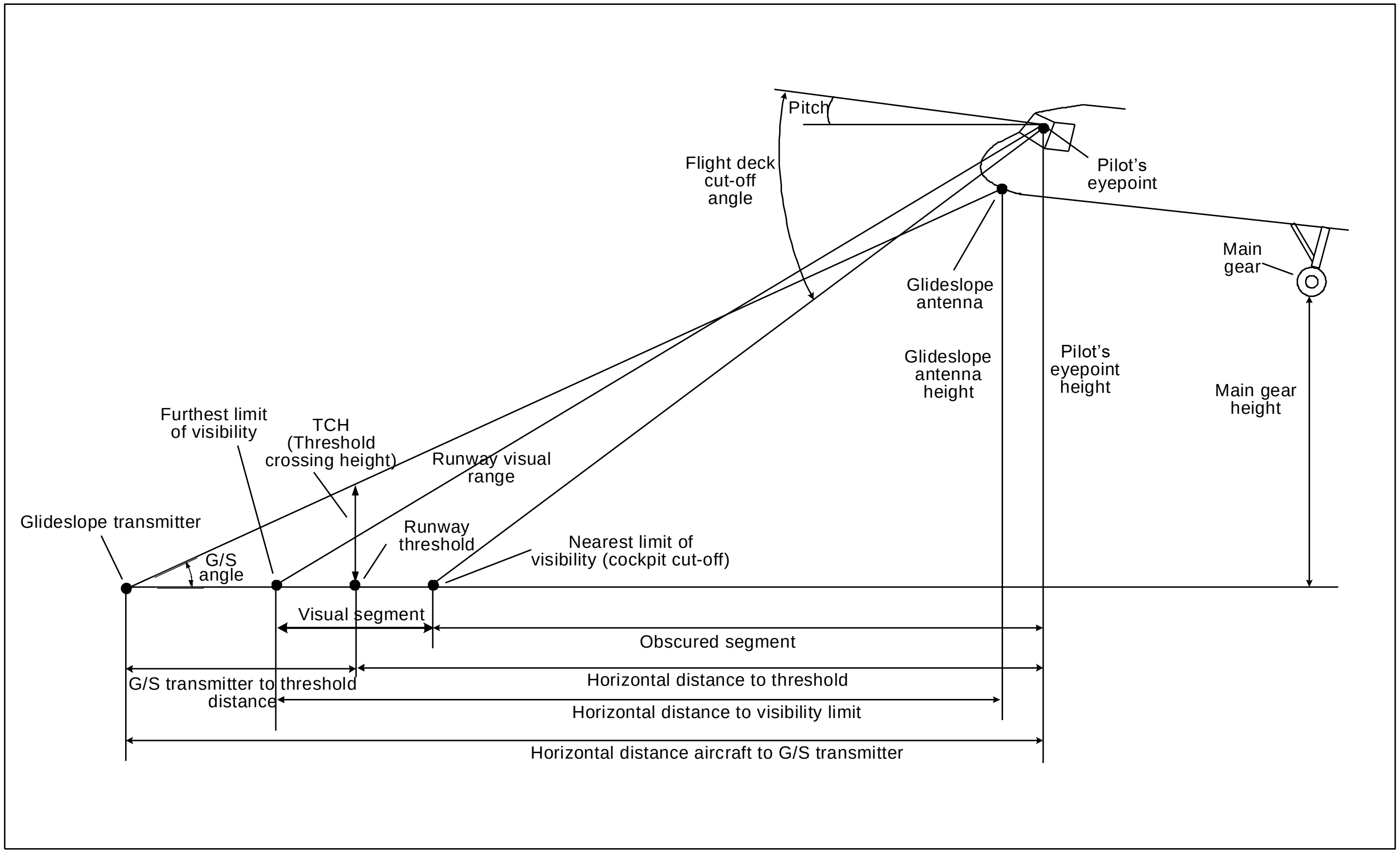


Figure 8: VGS scene content calculations

(c) Image geometry

The geometry of the final image as displayed to each pilot should meet the criteria defined. This assumes that the individual optical components have been tested to demonstrate a performance that is adequate to achieve this end result.

(1) Image position. See test 4.a.2.a.1.

(i) When measured from the pilot's and co-pilot's eyepoint, the centre of the image should be positioned horizontally between 0 degrees and 2 degrees inboard and within ±0.25 degree vertically relative to the FSTD centreline taking into account any designed vertical offset.

(ii) The differential between the measurements of horizontal position between each eyepoint should not exceed 1 degree.

Note. The tolerances are based on eye spacings of up to ±53.3 cm (±21 inch). Greater eye spacings should be accompanied by an explanation of any additional tolerance required.

(2) Image absolute geometry. See test 4.a.2.a.2.

The absolute geometry of any point on the image should not exceed 3 degrees from the theoretical position. This tolerance applies to the central 200 degrees by 40 degrees. For larger fields of view, there should be no distracting discontinuities outside this area.

(3) Image relative geometry. See test 4.a.2.a.3.

(i) The relative geometry check is intended to test the displayed image to demonstrate that there are no significant changes in image size over a small angle of view. With high-detail visual systems, the eye can be a very powerful comparator to discern changes in geometric size. If there are large changes in image magnification over a small area of the picture, the image can appear to 'swim' as it moves across the mirror.

(ii) The typical Mylar-based mirror system will naturally tend to form a 'bathtub' shape. This can cause magnification or 'rush' effects at the bottom and top of the image. These can be particularly distracting in the lower half of the mirror when in the final approach phase and hence should be minimised. The tolerances are designed to try to keep these effects to an acceptable level while accepting that the technology is limited in its ability to produce a perfect spherical shape.

(iii) The 200˚× 40˚ FOV is divided up into three zones to set tolerances for relative geometry as shown in Figure 9.

(iv) Testing of the relative geometry should proceed as follows:

(A) from the pilot's eye position, measure every visible 5-degree point on the vertical lines and horizontal lines. Also, at -90, -60, -30, 0 and +15 degrees in azimuth, measure all visible 1-degree points from the -10˚point to the lowest visible point;

Note. Not all points depicted on the pattern are measured, but they may be measured if observation suggests a problem.

(B) from the co-pilot's eye position, measure every visible 5 degree point on the vertical lines and horizontal lines. Also, at +90, +60, +30, 0 and -15 degrees in azimuth, measure all visible 1-degree points from the -10˚point to the lowest visible point;

Note. Not all points depicted on the pattern are measured, but they may be measured if observation suggests a problem.

(C) the relative spacing of points should not exceed the following tolerances when comparing the gap between one pair of dots with the gap between an adjacent pair:

Zone 1 < 0.075 degree/degree;

Zone 2 < 0.15 degree/degree;

Zone 3 < 0.2 degree/degree;

(D) here, as 5-degree gaps are being measured, the tolerances should be multiplied by 5, e.g. one 5-degree gap should not be more than (5*0.075) = 0.375 degree more or less than the adjacent gap when in zone 1; and

(E) for larger fields of view, there should be no distracting discontinuities outside this area.

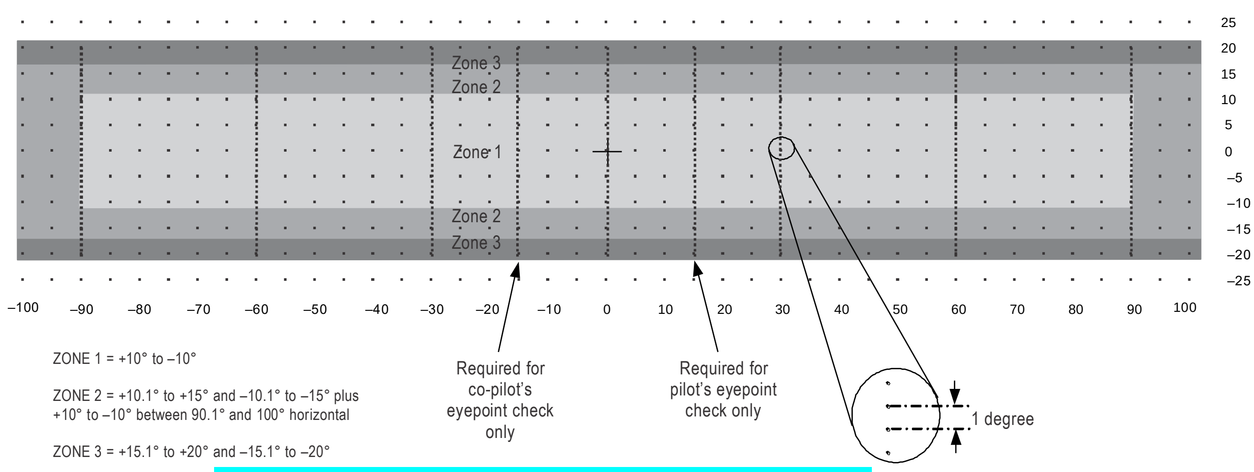


Figure 9: Relative geometry test pattern showing zones

(v) For recurrent testing, the use of an optical checking device is encouraged. This device should typically consist of a handheld go/no go gauge to check that the relative positioning is maintained.

(d) Laser speckle contrast ratio (laser projection system)

The objective measure of speckle contrast that is described in the following subparagraphs considers the grainy structure of speckle and concentrates on the variations of brightness inherently introduced by speckle. Speckle contrast is quite commonly measured in many applications. However, speckle contrast does not take into account the size of the grains, i.e. the spatial wavelength of the speckle pattern.

(1) Definition of speckle contrast ratio

(i) Due to its noisy character, one adequate measure to quantify speckle is the root mean square (RMS) deviation derived from statistical theory: in a random distribution, the RMS deviation quantifies the amount of variation from the mean value.

(ii) When applied to the intensity profile of an illuminated surface, the speckle contrast C is the RMS deviation normalised to the mean value.

(iii) Given the intensity profile I(x, y) in the considered field of view, the speckle contrast C can be defined as:

$$C = \frac{\sqrt{\langle I^2 \rangle - \langle I \rangle^2}}{\langle I \rangle},$$

where the average operator < > operating on a profile I(x, y) is defined as:

$$\langle I \rangle := \frac{1}{A} \cdot \int_{FOV} I(x,y)dA$$

Hence:

$$C = \frac{\sqrt{A \cdot \int_{FOV} (I(x,y))^2 dA - \left(\int_{FOV} I(x,y)dA \right)^2}}{\int_{FOV} I(x,y)dA}$$

(2) Speckle measurement

(i) The intensity profile I(x, y) can be measured with a charge-coupled device (CCD) camera. The set-up of the measurement (selection of lenses and CCD array) ensures that the granularity of the speckle can easily be resolved; hence, the granularity on the CCD chip should therefore be larger than the pixel size.

(ii) With the discrete nature of the CCD chip, I(x, y) translates into an array Im,n, while

$$\frac{1}{A} \cdot \int_{FOV} I(x,y)dA$$

$$\frac{1}{m \cdot n} \cdot \sum_{FOV} I_{m,n}$$

translates into:

Therefore,

$$C = \frac{\sqrt{m \cdot n \cdot \sum_{FOV} I_{m,n}^2 - \left(\sum_{FOV} I_{m,n}\right)^2}}{\sum_{FOV} I_{m,n}}$$

where:

Symbol or Notation	Description	Units
Σ	Summation operator	N/A
A	Area	Arbitrary units
C	Speckle contrast	Per cent
FOV	Field of view	Degrees
I	Intensity	Arbitrary units
m	Number of pixel rows within FOV	N/A
n	Number of pixel columns within FOV	N/A

(iii) Since the definition of C is also sensitive to the profile's low-frequency variations across the FOV, either the illumination together with the reflectivity of the screen should be homogeneous, or the measured intensity profile should be corrected for these variations. This can be accomplished by applying a suitable high-pass filter; for example, by evaluating on sufficiently small FOVs in which low-frequency variations are negligible.

(iv) To take into account the subjective nature of speckle, the f-number (or f# which is sometimes called the focal ratio expressing the diameter of the entrance pupil D divided by the focal length f, i.e. D/f) of the lens should be used as close as possible to that of the human eye. The recommended f# is 1/16.

(3) Speckle tolerance (see test 4.a.11)

If the speckle contrast is more than 10 %, the image begins to appear disturbed. The distractive modulation as an overlay of the image reduces the perceptibility of the projected image and then degrades the perceived resolution. With a speckle contrast below 10 %, the resolution and focus are not affected.

(e) Solid-state illuminators

(1) Projectors using solid-state illuminators, such as LEDs or lasers, exhibit improved lifetimes over those illuminated by lamps. However, current LED and laser illuminators lose this lifetime improvement when required to achieve 30 cd/m2 (8.8 ft-lamberts) light-point intensity. This limitation is considered acceptable when measured against the benefits of solid-state illuminators. Such devices should therefore only be required to achieve 20 cd/m2 (5.8 ft-lamberts) light-point brightness.

(2) As soon as technology allows, solid-state illuminators to achieve the full 8.8 ft-lamberts that capability should be employed. This is further emphasised by current advances in solid-state illuminators which show that this waiver for the limitation will soon be unnecessary.

CS FSTD(A).QTG.245 Visual display systems

This CS provides standards for the assessment of visual display systems.

(a) Introduction

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

(b) Basic principles of an FSTD collimated display

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

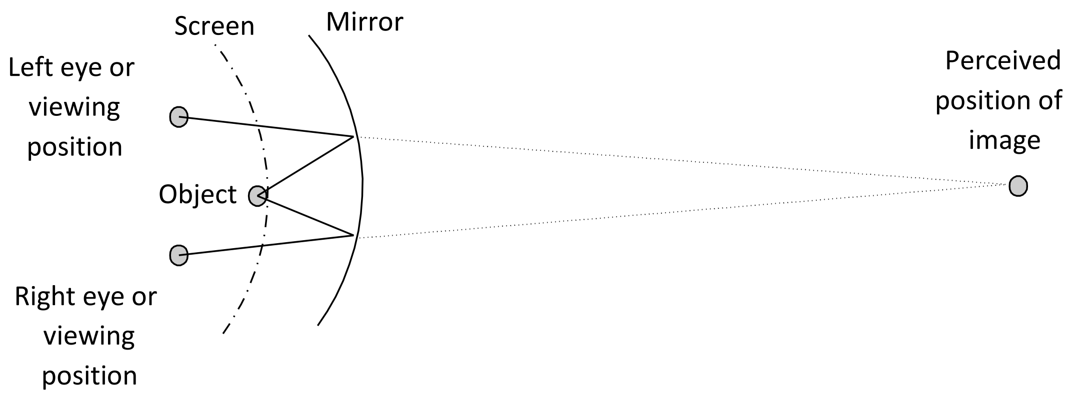


Figure 1: Collimated display

(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.

(4) While the horizontal field of view (FOV) of a collimated display can be extended to approximately 210-220°, the vertical FOV has normally been limited to about 40° - 45°. These limitations result from trade-offs in optical quality as well as interference between the display components and cockpit structures, but were sufficient to meet FSTD regulatory approval for fixed wing and rotary wing FSTDs. Recently more designs have been introduced with vertical FOVs of up to 60° for helicopter applications.

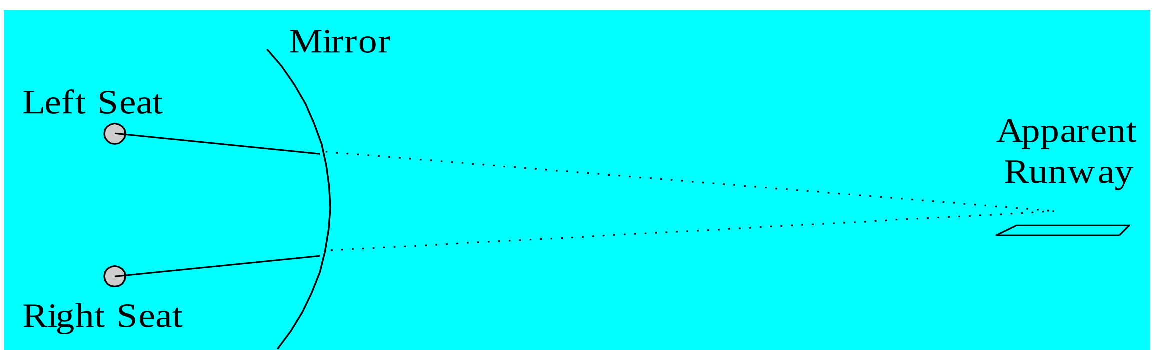


Figure 2: Runway view in a collimated display

(c) Basic principles of an FSTD dome display

(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 aeroplane. To the left seat viewer, however, the runway appears to be somewhat to the right of the aeroplane. As the aeroplane is still moving towards the runway, the perceived velocity vector should be directed towards the runway and this should be interpreted as the aeroplane having some yaw offset.

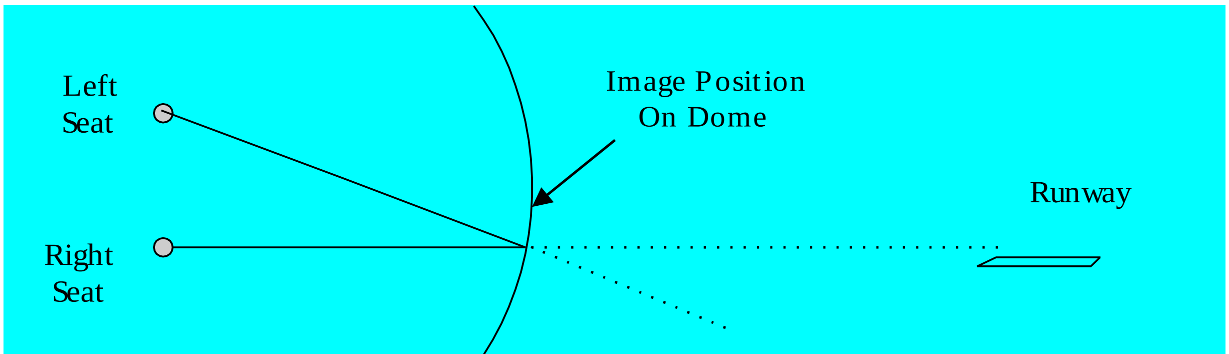


Figure 3: Runway view in a dome display

(2) The situation is substantially different for near field objects such as those that 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.

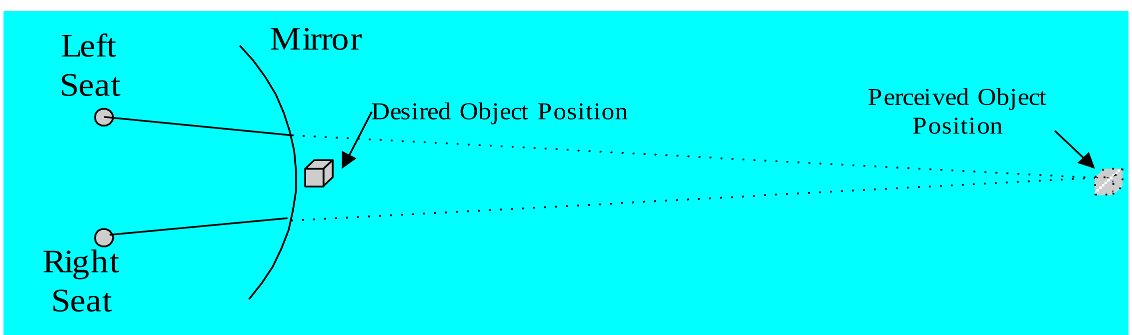


Figure 4: Near field object in a collimated display

(3) 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° is possible and can be exceeded.

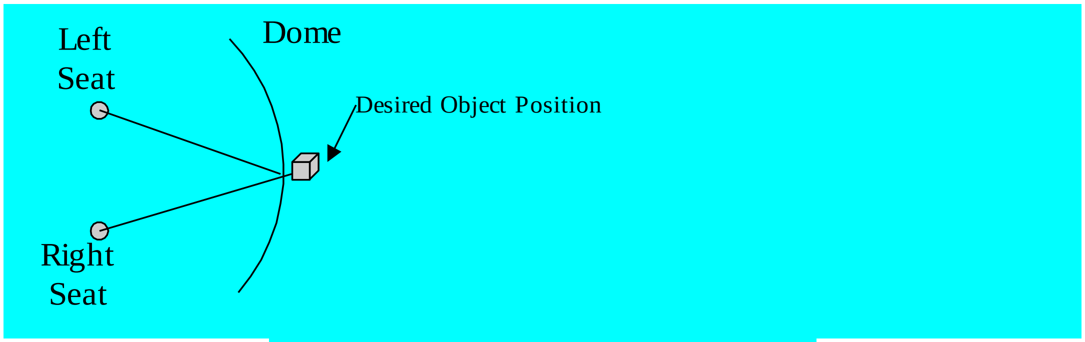


Figure 5: Near field object in a dome display

(d) Additional display considerations

(1) While the situations described above are for discrete viewing positions, the same arguments can be extended to moving eye points such as those that are produced by the viewer moving their 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 provide accurate parallax cues for distant objects, but increasingly inaccurate cues for near field objects. The situation is reversed for dome displays.

(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.

(e) Training implications

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 an 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.

CS FSTD(A).QTG.250 Sound system

This CS provides general standards for the assessment of visual systems.

(a) 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 organisation operating FSTDs should carefully evaluate background noises in the location being considered. To demonstrate compliance with the sound requirements, the objectives or validation tests have been selected to provide a representative sample of normal static conditions typical of those experienced by a pilot.

(b) Alternate engine fits

For FSTDs with multiple propulsion configurations, any condition listed in the table of FTSD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105 that is identified by the data provider as significantly different due to a change in engine model, should be presented for evaluation as part of the QTG.

(c) Data and data collection system

(1) Information provided to the FSTD manufacturer should comply with the document entitled 'Flight Simulation Training Device Design & Performance Data Requirements, ARINC 450' as amended. This information should contain calibration and frequency response data.

(2) The system used to perform the tests listed in 5., within the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105, should comply with the following standards:

(i) For sound feature fidelity level R and S (1/3-octave measurements):

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

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

(ii) For sound feature fidelity level G (overall SPL measurements):

IEC 61672, IEC 60651, or ANSI S1.4 - Sound level meters, time-weighting, class/type 2 or better. Equipment not meeting the IEC or ANSI standards, such as a smartphone with a 'decibel meter' application or a computer with an external microphone, may be acceptable provided they can achieve repeatable measurements within the validation test tolerances.

(d) Headsets

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

(e) Playback equipment

Recordings of the QTG conditions according to the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105, should be provided during initial evaluations.

(f) Background noise

(1) 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.

(2) The acceptability of the background noise levels is dependent upon the normal sound levels in the aeroplane or class of aeroplane being represented. Background noise levels that fall below the lines defined by the following points, may be acceptable (refer to Figure 10 below):

(i) 70 dB at 50 Hz;

(ii) 55 dB at 1 000 Hz;

(iii) 30 dB at 16 kHz.

These limits are for unweighted 1/3-octave band sound levels. Meeting these limits for background noise does not ensure an acceptable FSTD. Aeroplane sounds which fall below this limit require careful review and may require lower limits on the background noise.

(3) The background noise measurement may be rerun at the recurrent evaluation as stated in (h) 'Initial and recurrent evaluations'. The tolerances to be applied are that recurrent 1/3-octave band amplitudes cannot exceed $\pm$ 3 dB when compared to the initial results.

(g) Frequency response

For sound feature fidelity level R and S, frequency response plots for each channel should be provided at initial evaluation. These plots may be rerun at the recurrent evaluation as per (h) 'Initial and recurrent evaluations'. The tolerances to be applied are as follows:

(1) recurrent 1/3-octave band amplitudes cannot exceed $\pm$ 5 dB for three consecutive bands when compared to the initial results; and

(2) the average of the sum of the absolute differences between initial and recurrent results cannot exceed $\pm$ 2 dB (refer table 1 below).

(h) 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.

(i) 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:

(1) variation of data between tail numbers;

(2) frequency response of microphones;

(3) repeatability of the measurements; and

(4) extraneous sounds during recordings.

Fi

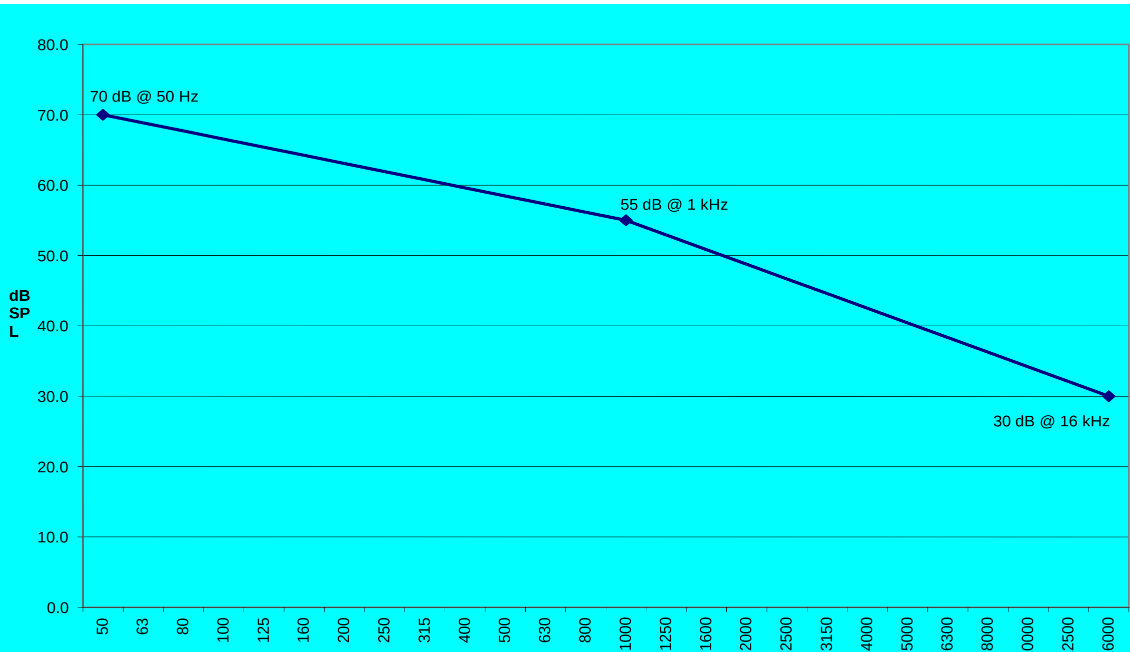


Figure 10: 1/3-octave band frequency (Hz)

Band Centre Freq.	Initial Results (dBSPL)	Recurrent Results (dBSPL)	Absolute Difference
50	75.0	73.8	1.2
63	75.9	75.6	0.3
80	77.1	76.5	0.6
100	78.0	78.3	0.3
125	81.9	81.3	0.6
160	79.8	80.1	0.3
200	83.1	84.9	1.8
250	78.6	78.9	0.3
315	79.5	78.3	1.2
400	80.1	79.5	0.6
500	80.7	79.8	0.9
630	81.9	80.4	1.5
800	73.2	74.1	0.9
1000	79.2	80.1	0.9
1250	80.7	82.8	2.1
1600	81.6	78.6	3.0
2000	76.2	74.4	1.8
2500	79.5	80.7	1.2
3150	80.1	77.1	3.0
4000	78.9	78.6	0.3
5000	80.1	77.1	3.0
6300	80.7	80.4	0.3
8000	84.3	85.5	1.2
10000	81.3	79.8	1.5
12500	80.7	80.1	0.6
16000	71.1	71.1	0.0
		Average	1.1

Table 1: Example of recurrent frequency response test tolerance

CS FSTD(A).QTG.260 Transport delay and latency testing methods

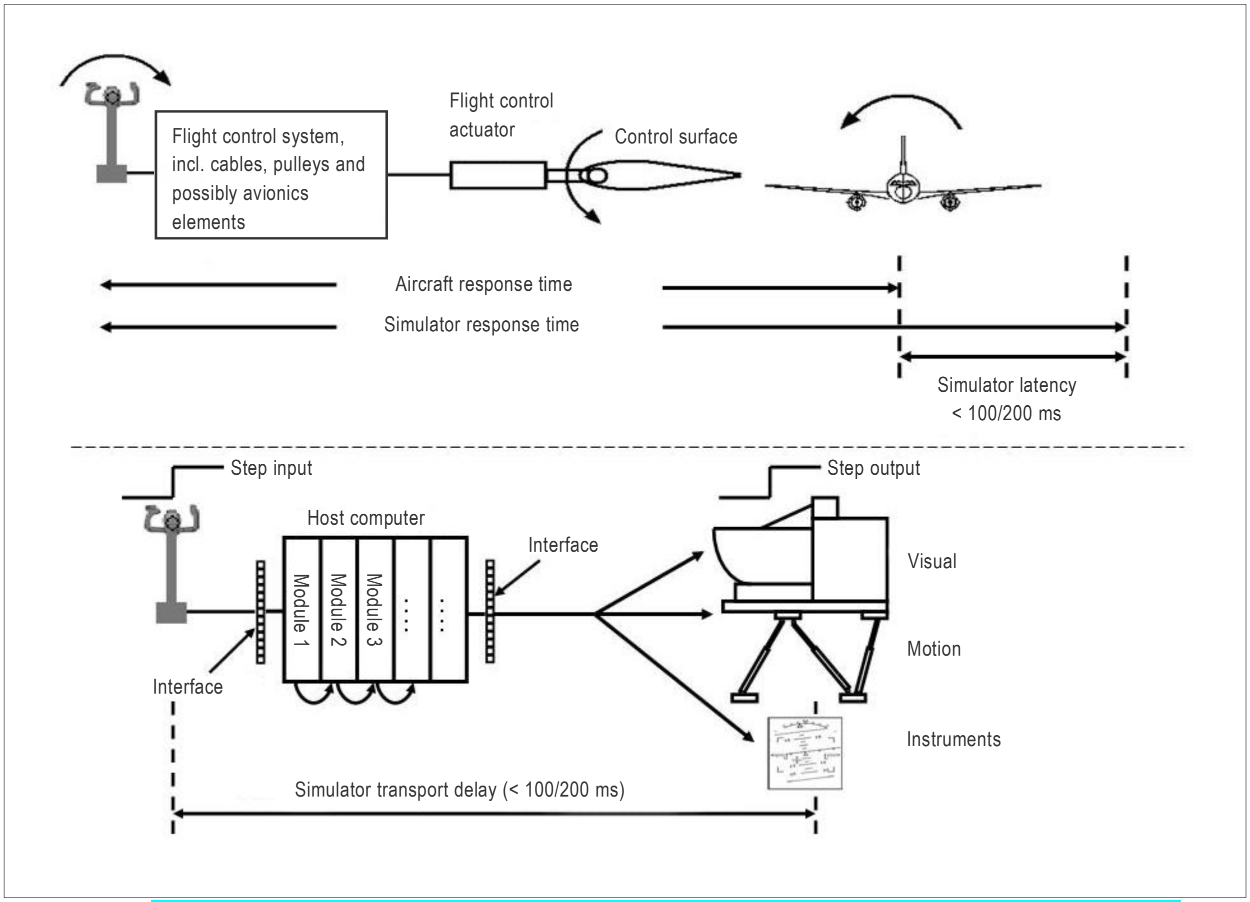
This CS provides standards for transport delay and latency testing methods.

(a) Background

(1) The purpose of this CS is to provide the methods for conducting transport delay and latency tests.

(2) The transport delay test has become the primary method for determining the delay introduced into the FSTD due to the time taken for the computations through the FSTD controls, host, motion and visual computer modules. The transport delay test is not dependent upon flight test data but may require avionics computer and instrument data from the data provider for some cases described below.

(3) The latency test is a second method that remains acceptable as an alternate means of



compliance. Figure 1 presents the principles of transport delay and latency testing.

Figure 1: Transport delay and latency testing

(b) Transport delay

(1) The purpose of this paragraph (b) is to demonstrate how to determine the introduced transport delay through the FSTD system such that it does not exceed a specific duration. It is not the intention of the transport delay test to arrive at a comparison with the aeroplane but rather to demonstrate acceptable performance of the simulation at initial qualification, and then to be used as a non-regression test for the software architecture at each recurrent evaluation. The transport delay needs to be measured 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 shown to be no more than the tolerances required in the validation test tables. (For latency testing methods, see (c) 'Latency test methods').

(2) In all cases, the simulation will have been demonstrated to be dynamically equivalent to the aeroplane or class of aeroplane in terms of response by the many dynamic tests in

the QTG as well as the subjective handling tests, both for short-term and long-term modes. It is, therefore, only necessary to measure the maximum increased time added by the various interfaces and computing elements in the FSTD that are not present in the aeroplane. To do this, a signal is processed through the entire system from the input to the first interface from the control column or stick, through each subsequent computing element or interface and back out to the physical feedback to the pilot, via the motion system, visual system or cockpit instruments. To make this signal more traceable, a handshaking method may be used from element to element such that a clear leading edge is visible at any point through the system. However, it should be noted that the signal needs to be passed through each element of the software and hardware architectures and that the simulation should be running in its normal mode with all software elements active. This is to ensure that the test may be rerun at subsequent re-qualifications to check that software modifications have not modified the overall path length. A full description of the method chosen and the path of the signal, as well as the input and recording points, should be provided.

(3) The test result analysis requires only that the input and output signals be measured to be separated by no more than 100/200 ms for the motion and instruments and 120/200 ms for the visual system, according to the FCS of the FSTD. The point of movement will be very simple to determine since both input and output signals will have clear leading edges.

(4) Figure 2 illustrates the total transport delay for a non-computer-controlled aeroplane, or the classic transport delay test. Since there are no aeroplane-induced delays for this case, the total transport delay is equivalent to the introduced delay.

(5) Computer-controlled aeroplane

For FSTDs of aeroplanes with electronic elements in the path between input from the pilot and resulting output, the measured transport delay will include elements of the aeroplane itself. These may include flight control systems avionics or display systems. Since the intention of the transport delay test is to measure only the time specific to the FSTD and not that of the aeroplane, the test result time should be offset by the throughput time of the avionics elements. This throughput time should be based on data from the manufacturer of the aeroplane or avionics. Alternatively, the aeroplane equipment may be bypassed, provided that the signal path is maintained in terms of FSTD interfaces. A schematic diagram should be provided to present that part of the aeroplane equipment being considered in this manner, and the way in which the signal path has been treated to be representative of all the simulation elements (see Figure 3).

(i) For FSTDs on which the avionics elements in question are replaced by re-hosted, re-targeted or other similar solutions, it is still necessary to offset the test result by the equivalent time of the aeroplane elements. However, the schematic diagram should in this case demonstrate the equivalence of the simulated avionics to the real avionics in terms of architecture. It is the responsibility of the developer of the re-hosted, re-targeted, or other similar solution to establish the equivalence of the simulated element to the aeroplane element being replaced.

(ii) For cases of computer-controlled aeroplanes, where it can be established that the data path to the instrumentation in the aeroplane is subject to computer and data bus asynchronism, uncertainty or 'jitter' of a similar order of magnitude to the transport delay allowance, an SoC will suffice in place of an actual test. This optional SoC should establish the equivalence of the simulated solution to that of the aeroplane and provide a rationale regarding the statistical uncertainty. In this case, the need for the objective test 6.a.1 for pitch, roll and yaw may be waived.

(6) 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.

(7) 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'. FSTDs may 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 this data will not be processed before the start of the new iteration. For an FSTD running at 60 Hz, a worst-case difference of 16,67 ms can be expected. Where multiple parallel processors or priority-based execution systems are used, the scatter may be greater. 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.

(8) When offsetting the measured results by the throughput time of the avionics elements, it is also necessary to recognise that digital equipment will normally give a range of response times dependent upon the synchronisation of the control input with the internal equipment frame time. The aeroplane or avionics manufacturer should quantify the range of results that should be expected by providing minimum and maximum response times, as well as an indication of the statistical spread in this range. It may be necessary to run the test several times on the FSTD to demonstrate the correctness of the avionics simulation in these conditions.

(9) The transport delay test should account for daylight, twilight (dusk, dawn) and night modes (as applicable) of operation of the visual system. The tolerance is as required in the validation test tables and motion response should occur before the end of the first video scan containing new information. Where it can be demonstrated that the visual system operates at the same execution rate for both day and night modes, a single test in each axis is sufficient.

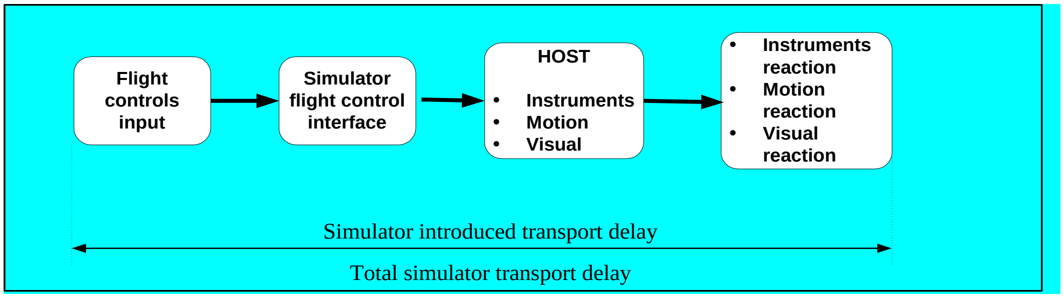


Figure 2: Transport delay for simulation of a classic non-computer-controlled aeroplane

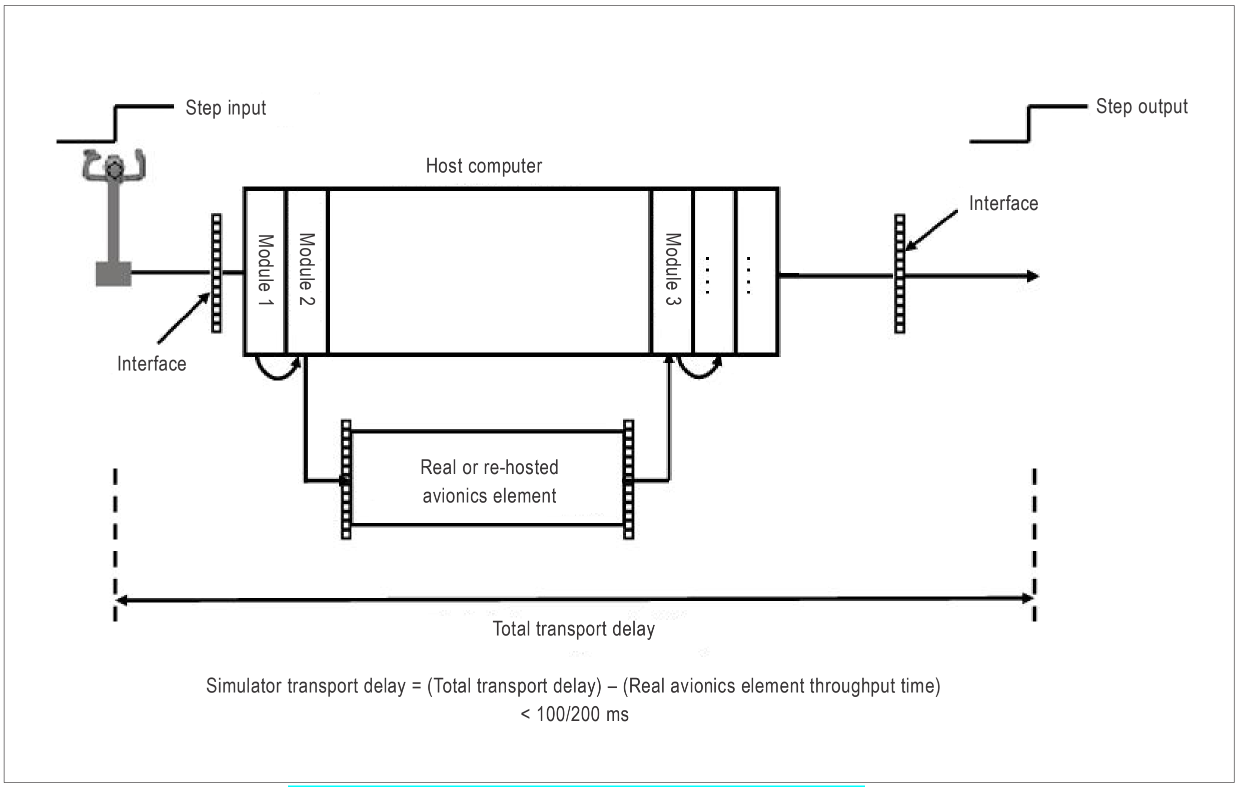


Figure 3: Transport delay with avionics elements

(c) Latency test methods

(1) The purpose of this paragraph (c) is to provide guidance on how FSTD latency tests should be conducted and how measurements should be taken. The description below is for the classic non-computer-controlled aeroplane.

(2) Nine latency tests are required. Tests are required in roll, pitch and yaw axes for the take-off, cruise and approach or landing configurations. The tolerances employed are the same as those specified for the transport delay tests. Flight test data is required to support these tests.

(3) 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 approach or landing configuration for abrupt pilot control inputs in all three rotational axes. The intent is to verify that the FSTD system response time beyond the aeroplane response time (as per the validation data) does not exceed the tolerances required in the validation test tables and that the motion and visual cues relate to actual aeroplane responses. To determine the aeroplane response time, acceleration in the appropriate corresponding rotational axis is preferred.

(4) Because the test tolerance is a small time value measured in ms, it is essential that aeroplane and FSTD responses be measured accurately to enable a meaningful test result.

(5) Aeroplane response time

(i) This test is a timing check of the motion, visual system and cockpit instruments to check the computational delay of the FSTD computer architecture. As aeroplane data is employed as the benchmark, it is necessary to establish the aeroplane response time for each test case to enable the FSTD response time to be isolated.

(ii) It is difficult to establish when the aeroplane will have first moved as the result of the pilot control input in the selected axis, as the control input is unlikely to have been a step input. In order to establish a clear methodology for determining the initial aeroplane movement for the purpose of this test, it has been necessary to define the initial movement as the point when the angular acceleration in the appropriate axis reaches 10 % of the maximum angular acceleration experienced. The elapsed time between the pilot control input and the aeroplane reaching 10 % of its maximum acceleration in ms should be used as the aeroplane response time.

(6) FSTD response time — motion system

The FSTD response time for motion will be the elapsed time in ms between the pilot control input and the first discernible motion movement recorded by the accelerometers mounted on the motion platform. The latency for the motion system will be the FSTD response time (motion system) minus the aeroplane response time in ms. This time is subject to the test tolerance.

(7) FSTD response time — visual system

The FSTD response time for visual system will be the elapsed time in ms between the pilot control input and the first discernible visual change measured as appropriate for the visual system. The latency for the visual system will be the FSTD response time (visual system) minus the aeroplane response time in ms. This time is subject to the test tolerance.

Note. Visual system response time is measured to the beginning of the frame in which a change occurs.

(8) FSTD response time — cockpit instrument

The FSTD response time for cockpit instrument will be the elapsed time in ms between the pilot control input and the first discernible change measured as appropriate on the selected cockpit instrument. The latency for the cockpit instrument will be the FSTD response time (cockpit instrument) minus the aeroplane response time in ms. This time is subject to the test tolerance.

(9) Computer-controlled aeroplanes and other special cases

Procedures already provided above for the transport delay tests for computer-controlled aeroplanes and other special cases can be applied to the latency tests.

CS FSTD(A).QTG.400 Validation data roadmap

This CS provides standards for validation data roadmaps.

(a) General

(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 provider 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 certified prior to 1992, and for requests for qualification of alternate engine or avionics fits (see Appendices 3 and 4 to this CS). A VDR should be submitted to the competent authority as early as possible in the planning stages for any FSTD planned for qualification to the standards contained herein. The respective Member State's civil aviation authority is the final authority to approve the data to be used as validation material for the QTG.

(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 this 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 is 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).

(3) Table 1 depicts a generic VDR matrix identifying sources of validation data. Only the first page of the full matrix is shown and some test conditions were deleted for brevity. The first column refers to validation tests in CS FSTD(A).QTG.105 or to tests in the ARINC 450 document 'Flight Simulation Training Device Design and Performance Data Requirements'.

(4) Relevant regulatory material should be consulted and all applicable tests addressed in the actual VDR document submitted. Validation sources, validation data documents, and comments provided herein are for reference only. The actual data sources and documents will be dependent upon the particular airframe/engine combination under consideration. The following set of guidelines should be used when applying this example to a specific VDR document:

(i) Include CCA mode column if applicable.

(ii) Include column for each validation source (e.g. each flight test airframe/engine combination and the simulation configuration).

(iii) Include column for each document being referenced as a source of validation data. The term 'integrated' in the document title indicates that test conditions contained in these documents conform to the definition of 'integrated testing' as described in the glossary.

(iv) Data type numbering should align with the hierarchy of preferences outlined in CS FSTD(A).QTG.410 (a).5

(5) Tables 2 and 3 provide examples of another presentation of VDR matrices identifying sources of validation data for an abbreviated list of tests along with detailed information for a typical test case. A complete matrix should address all test conditions. A complete set of detailed information pages for tests quoted in the matrix would be provided with this particular presentation.

(6) Additionally, two examples of 'rationale pages' are presented in Appendix F to the ARINC 450 document 'Flight Simulation Training Device Design & Performance Data Requirements'. 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 competent authority for obtaining deviations from QTG validation requirements.

Table 1: Validation Data Roadmap

ICAO/ IATA#	Test description	CCA mode *N — Normal law, D — Direct law*	Validation source				Validation document						Validation source category	Rationales *R — Rationale page attached*	Comments *(This VDR is for aeroplane 2 with DEF-74 engines)*
			Aeroplane 1 flight test data	Aeroplane 2 flight test data	Engineering simulation data *(Aeroplane 2 with DEF-74 engines)*	Aerodynamics POM	Flight controls POM	Ground handling POM	Propulsion POM	Integrated POM	Aeroplane 2 Integrated validation data	Aeroplane 2 Validation data roadmap (integrated)			
1.a (1)	Minimum radius turn.	N		2				NE					FT		
1.a (2)	Rate of turn versus nosewheel steering angle (2 speeds).	N			3						D73		ES		
1.b (1)	Ground acceleration time and distance.	N			3							D74	ES		Data is included in normal take-off (1.b (4)).
1.b (2)	Minimum control speed, ground (V_{mcg}).	N		1		d74				D74			FT		
1.b (3)	Minimum unstick speed (V_{mu}).	N			3							D74	ES		
1.b (4)	Normal take-off.	N	2		3	c78						D74	ES	R	
1.b (5)	Critical engine failure on take-off.	N		1		D74							FT		
1.b (6)	Crosswind take-off.	N		1		D74							FT		
1.b (7)	Rejected take-off.	N		1	3	D74						D74	FT/ES	R	Test procedure anomaly; see rationale.
1.b (8)	Dynamic engine failure after take-off.	N		1		d74				D74			FT		
1.c (1)	Normal climb all engines operating.	N,D	2		3	d73						D74	ES	R	FT data flown in direct mode; see rationale.
1.c (2)	One-engine-inoperative 2nd segment climb.	N		1		D74							FT		AFM data available for reference.
1.c (3)	One-engine-inoperative en-route climb.	N			3							D74	ES		
1.c (4)	One-engine-inoperative approach climb.	N			3							D74	ES		Run with and without icing accountability.
1.d (1)	Level flight acceleration.	N	2		3	C78						D74	FT/ES	R	FSTD manufacturer to evaluate use of FT in QTG.
1.d (2)	Level flight deceleration.	N	2		3	C78						D74	FT/ES	R	FSTD manufacturer to evaluate use of FT in QTG.
1.d (3)	Cruise performance.	N			3							D74	ES		
1.d (4)	Idle descent.	N			3						D73		ES		
1.d (5)	Emergency descent.	N			3						D73		ES		
1.e (1)	Deceleration time and distance (wheel brakes).	N		2		D73							FT		
1.e (2)	Deceleration time and distance (reverse thrust).	N	2		3	d73						D74	ES		
1.e (3)	Stopping distance, wheel brakes, wet runway.	N	2		3	D73					d73		FT		
1.e (4)	Stopping distance, wheel brakes, icy	N	2		3	D73					d73		FT		

ICAO/ IATA#	Test description	CCA mode N — Normal law, D — Direct law	Validation source: Aeroplane 1 flight test data	Aeroplane 2 flight test data	Engineering simulation data (Aeroplane 2 with DEF-74 engines)	Aerodynamics POM	Validation document: Flight controls POM	Ground handling POM	Propulsion POM	Integrated POM	Aeroplane 2 Integrated validation data	Aeroplane 2 Validation data roadmap (integrated)	Validation source category	Rationales R — Rationale page attached	Comments (This VDR is for aeroplane 2 with DEF-74 engines)
	runway.														
3.3.3.7	Brake fade (hot brakes). IATA reference 3.3.3.7-1.				3						D73		ES		

Validation source — DATA type key:
1. Flight test data — exact configuration.
2. Flight test data — similar configuration.
3. Engineering simulation data
4. Aeroplane flight manual data

Shading key:		***Type case key:***
(dark shading)	Recommended data.	UPPER CASE: Preferred data
(light shading)	Data options available.	lower case: Reference or secondary data
(no shading)	Reference data only.	

Validation document — Engine type/rating key:
C78 — Engine type: CEF-78, thrust rating: 78 kN.
D73 — Engine type: DEF-73, thrust rating: 73 kN.
D74 — Engine type: DEF-74, thrust rating: 74 kN.
NE — Independent of engine model or no engine model used.

Validation source category:	
FT	Flight test data recommended for QTG. Engineering simulation data may be provided for reference and checkout purposes.
FT/ES	Flight test data is provided as a potential validation data source, with engineering simulation data provided as a supplementary resource if required.
ES	Engineering simulation data recommended for QTG, with flight test data provided as available for reference purposes.

Table 2: Recommended Qualification Test Guide — 1

QTG	Test description		Validation source															
	A = Engine 1: xx kN. B = Engine 2: xx kN. D: *Direct law.* N: *Normal law.* Alt: *Alternate law or system alternate conditions (e.g. hydraulics off).*	**CCA mode**	Aeroplane flight test	Proof of match (POM)	Engineering simulator test	AFM data	QTG — Natural/computer controlled aeroplane Doc. xxxx Common tests	QTG — Natural/computer controlled aeroplane Doc. xxxx A3xx-xxx — Engine specific tests	Performance test cases for FSTD Doc. xxxx	Autopilot tests Doc. xxxx	Engine tests for FSTD qualification Doc. xxxx	Static control and dynamic control checks Doc. xxxx	Brake static and dynamic control checks Doc. xxxx	Common sound QTG: xxxx	Engine specific sound QTG: xxxx	Common vibration QTG: xxxx	Engine specific vibration QTG: xxxx	Long range flight controls latency tests Doc. xxxx
1.a (1)	Minimum radius turn.	N	B				X											
1.a (2)1	Rate of turn versus nosewheel steering angle — Speed 1.	D	A	A			X											
1.a (2)2	Rate of turn versus nosewheel steering angle — Speed 2.	D	A	A			X											
1.b (1)	Ground acceleration time and distance.	N	B	B				X										
1.b (2)	Minimum control speed, ground (V_{mcg}).	D			B			X										
1.b (3)	Minimum unstick speed (V_{mu}).	D	A	B			X											
1.b (4)1	Normal take-off — max weight — aft CoG.	N	B	B				X										
1.b (4)2	Normal take-off — light weight — mid CoG.	N	B	B				X										
1.b (5)	Critical engine failure on take-off — normal mode	N	B	B				X										
1.b (6)	Crosswind take-off.	N	C	C			X											
1.b (7)1	Rejected take-off — pedal braking.	D	A	A				X										
1.b (7)2	Rejected take-off — autobrake.	N	B	B				X										
1.b (8)1	Dynamic engine failure after take-off, non-normal mode.	D	B	B				X										
1.b (8)2	Dynamic engine failure after take-off, normal mode.	N	B	B				X										
1.c (1)	Normal climb all engines operating.	N		A		A			X									
1.c (2)	One-engine-inoperative 2nd segment climb.	N		A		A			X									
1.c (3)	One-engine-inoperative en-route climb.	N		A		A			X									
1.c (4)	One-engine-inoperative approach climb.	N		A		A			X									
1.d (1)	Level flight acceleration.	N	A	B				X										
1.d (2)	Level flight deceleration.	N	A	B				X										

1.d (3)	Cruise performance.	N		A		A			X									
1.d (4)	Idle descent.	N	A							X								
1.d (5)	Emergency descent.	N	A							X								

Table 3: Recommended Qualification Test Guide — 2

1. PERFORMANCE	**1.a TAXI**	**1.a (2) Rate of turn versus nosewheel steering angle (NWA)**	**Conditions: Ground**

A — Requirements

Document: ICAO Doc 9625 — *Manual of Criteria for the Qualification of Flight Simulation Training Devices*, Volume I — *Aeroplanes,* Fourth Edition.

Tolerance: ± 2 °/s or ±10 % of turn rate.

Flight Condition: Ground.

Comments: Plot a minimum of two speeds, greater than minimum turning radius speed, with a spread of at least 5 kt ground speed.

Type:

I	**II**	**III**	**IV**	**V**	**VI**	**VII**
				✓		✓

B — Data Package

Configuration:

#	**Avionics 1**	**FCSC**	**FADEC**	**BSCU**	**Flight test validation data**	**Engineering simulation validation data**	**Proof of match**
1	Std xx	Std xx	Std xx	Std xx	XXXXXX Engine		
2	Std xx	Std xx	Std xx	Std xx			XXXXXX Engine
3							
4							
5							
6							

Rationales:

#	
1	Rationale 1.
2	Rationale 2.
3	
4	

5	
6	

CS FSTD(A).QTG.410 Applicability of CS-FSTD amendments to FSTD data packages for existing aeroplanes

This CS defines the applicability of CS-FSTD amendments to FSTD data packages for existing aeroplanes.

(a) General policy

(1) Except where specifically indicated otherwise in CS FSTD(A).QTG.105, validation data for qualification test guide (QTG) objective tests is expected to be derived from aeroplane flight testing.

(2) Ideally, data packages for all new FSTDs should fully comply with the current standards for qualifying FSTDs.

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

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

(5) Notwithstanding the above discussion, except where other types of data are already acceptable (see, for example, CS FSTD(A).QTG.120 and CS FSTD(A).QTG.125), the preferred source of validation data is flight testing. It is expected that best endeavours will be made by data providers to provide the required flight test data. If any flight test data exists (flown during the certification or any other flight test campaigns) that addresses the requirement, this 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 this flight test data is genuinely not available, alternative sources of data may be acceptable using the following hierarchy of preferences:

First: as defined in flight testing at an alternate but near equivalent condition/configuration.

Second: data from an audited engineering simulation as defined in CS FSTD(A).GEN.005 'Terminology' from an acceptable source (for example, the data meets the guidelines laid out in CS FSTD(A).QTG.120(b), or as used for aeroplane certification.

Third: aeroplane performance data as defined in CS to CS FSTD(A).200 or other approved published sources (e.g. production flight test schedule) for the following tests:

(i) 1.c(1) normal climb, all engines;

(ii) 1.c(2) one-engine-inoperative 2nd segment climb;

(iii) 1.c(3) one-engine-inoperative en-route climb;

(iv) 1.c(4) one-engine-inoperative approach climb for aeroplanes with icing accountability;

(v) 1.e(3) stopping distance, wheel brakes, wet runway, and test; and

(vi) 1.e(4) stopping distance, wheel brakes, icy runway.

Fourth: Where no other data is available, in exceptional circumstances only, the following sources may be acceptable subject to a case-by-case review with the competent authorities concerned taking into consideration the the level of qualification or FCS sought for the FSTD.

(i) unpublished but acceptable sources e.g. calculations, simulations, video or other simple means of flight test analysis or recording; or

(ii) footprint test data from the actual training FSTD requiring qualification validated by subjective assessment by a pilot appointed by the competent authority.

(6) In certain cases, it may make good engineering sense to provide more than one test to support a particular objective test requirement. An example is a minimum control speed (ground) test(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.

(7) For aeroplanes certified prior to the date of issue of the current CS-FSTD (A) Issue 3, an operator may, after reasonable attempts have failed to obtain suitable flight test data, indicate in the MQTG where flight test data is unavailable or unsuitable for a specific test. For each case, where the preferred data are is available, a rationale should be provided laying out the reasons for the non-compliance and justifying the alternate data and or test(s).

(8) These rationales should be clearly recorded within the VDR in accordance with and as defined in CS FSTD(A).QTG.400.

(9) It should be recognised that there may come a time when there is so little compatible flight test data available that new flight testing may be required.

(b) Recommendation concerning the use of footprint tests

(1) Only when all other alternative possible sources of data have been thoroughly sought without success, may a footprint test be acceptable, subject to a case-by-case review with the competent authority concerned taking into consideration the level of qualification or FCS sought for the FSTD.

(2) For additional information concerning acceptability of footprint tests used in tests for qualification submission, refer to GM1 ORA.FSTD.200 Application for FSTD qualification.

CS FSTD(A).QTG.500 Additional/alternate engines or avionics validation data

This CS defines the standards for additional/alternate engines or avionics validation data.

(a) Background

(1) For a new aeroplane type, the majority of flight validation data is collected on the first aeroplane configuration with a 'baseline' engine fit and a 'baseline' avionics configuration which forms the basis of the models and the data pack. This dataset is then used to validate all FSTDs representing that aeroplane type.

(2) 'Primary engine fit' is the FSTD terminology for the primary engine fit for the aeroplane configuration that the organisation operating FSTDs has contractually demanded. The operator may contractually add alternate engine fits. The primary engine fit for a given FSTD will be validated by running the entire QTG for that engine fit. Additional engine fits for that device will only require a subset of the QTG as defined in paragraph (b) of this CS. Note that the organisation operating FSTDs's primary engine fit may not be the airframe manufacturer's baseline.

(3) In the case of FSTDs representing an aeroplane with a different engine fit from the baseline, or with a revised avionics configuration or more than one avionics configuration, additional flight test validation data may be needed.

(4) When a FSTD with multiple engine fits is to be qualified, the QTG should contain test validation data for selected cases where engine differences are expected to be significant.

(5) When an FSTD with alternate avionics configurations is to be qualified, the QTG should contain test validation data for selected cases where the avionics configuration differences are expected to be significant as defined in paragraph (c) of this CS.

(6) The nature of the required complementary validation data (e.g. flight test data, engineering data) should be in accordance with the guidelines prescribed in paragraph

(d) of this CS, except where other data is specifically allowed (see CS FSTD(A).QTG.120 and CS FSTD(A).QTG.125).

(b) QTG standards for the qualification of additional engine fits

(1) The following guidelines apply to FSTDs equipped with multiple engine types or thrust ratings. The primary engine fit for a given FSTD will be validated by running the entire QTG for that engine fit. To validate additional engine types or thrust ratings in that FSTD, a subset of the QTG should be provided. The test conditions (one per test number) in Table 1 of this CS should be included in that subset, as a minimum.

(2) When the additional engine fit is a different type from the primary configuration, all the tests under the additional engine type column in Table 1 of this CS should be provided in the QTG.

(3) In the case where the additional engine type is the same, but the thrust rating exceeds that of the primary configuration (i.e. 'baseline') by 5 % or more, or is significantly less than the primary configuration engine rating (a decrease of 15 % or more), all the tests in the additional engine rating column should be provided in the QTG. Otherwise, it might be acceptable to only provide the throttle calibration data (i.e. commanded power setting parameter versus throttle lever angle), and the engine acceleration and deceleration cases. However, if an aeroplane manufacturer, qualified as a validation data provider under the guidelines of CS FSTD(A).QTG.120 and CS FSTD(A).QTG.125, shows that a thrust increase greater than 5 % will not significantly change the aeroplane's flight characteristics, then flight validation data is not needed.

Table 1: Minimum recommended list of QTG tests for an additional engine configuration

Test Number	**Test description**	**Additional engine type**	**Additional engine rating**
1.b (1), (4)	Ground acceleration time and distance/normal take-off.	X	
1.b (2)	Minimum control speed, ground (V_{mcg}).	X	X
1.b (5)	Critical engine failure on take-off.	X	
1.b (7)	Rejected take-off.	X	
1.b (8)	Dynamic engine failure after take-off.	X	
1.c (1)	Normal climb all engines operating.	X	X
1.c (2)	One-engine-inoperative 2nd segment climb.	X	X
1.d (1)	Level flight acceleration.	X	
1.d (2)	Level flight deceleration.	X	

1.d (3)	Cruise performance.	X	
1.f (1), (2)	Engine acceleration and deceleration.	X	X
2.a (8)	Alignment of cockpit throttle lever versus selected engine parameter (throttle calibration).	X	X
2.c (1)	Power change dynamics.	X	X
2.d (1)	Minimum control speed, air (V_{mca}).	X	X
2.d (5)	Engine-inoperative trim.	X	
2.e (4)	One-engine-inoperative landing.	X	X
2.e (6)	All-engine autopilot go-around.	X	X
2.e (7)	One-engine-inoperative go-around.	X	X
2.e (8)	Directional control with reverse thrust (symmetric).	X	
2.e (9)	Directional control with reverse thrust (asymmetric).	X	
3.f (1)	Thrust effects with brakes set.	X	
5.a (3)	All engines at maximum allowable thrust with brakes set.	X	

(c) QTG standards for the qualification of an alternate avionics configuration

(1) The following requirements apply to FSTDs representing aeroplanes with a revised avionics configuration or more than one avionics configuration.

(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 systems or components 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; controllers for engines; autopilot; braking system; nosewheel steering system; high-lift system; and landing gear system. Related avionics such as stall warning and stability augmentation systems should also be considered. The aeroplane manufacturer should identify, for each avionics system change, the affected QTG tests. The aeroplane manufacturer should identify for each validation test affected by an avionics change what the effect is.

(3) For changes to an avionics system or component that could affect a 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 affecting a different flight phase), the QTG test can be based on validation data from the previously validated avionics configuration. The organisation operating FSTDs should provide a statement from the aeroplane manufacturer clearly stating that this avionics change does not affect the test.

(4) For an avionics change that affects some tests in the QTG, but where no new functionality is added and the impact of the avionics change on the 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 organisation operating FSTDs should provide a rationale from the aeroplane manufacturer explaining the nature of the change and its effect on the aeroplane response.

(5) For an avionics change that significantly affects some tests in the QTG, especially where a new functionality is added, the QTG should be based on validation data from the previously validated avionics configuration and supplemental avionics-specific test data necessary 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. In this situation, the organisation operating FSTDs should coordinate FSTD data requirements in advance with the aeroplane manufacturer and then with the competent authority.

(6) For changes to an avionics system or component that are non-contributory to QTG validation test response, the QTG test can be based on validation data from the previously validated avionics configuration. For such changes, it is not necessary to include a rationale that this avionics change does not affect the test.

(d) Validation data requirement for alternate engine fits and alternate avionics configurations

(1) For tests that are affected by difference in engine type or thrust rating as prescribed in paragraph (b) of this CS, flight test data would be preferred to validate that particular aeroplane-engine configuration or the alternate thrust rating. Table 2 of this CS presents a minimum list of validation tests that should be supported by flight test data.

(2) If certification of the flight characteristics of the aeroplane with a new thrust rating (regardless of thrust rating percentage change) does require certification flight testing with a comprehensive stability and control flight instrumentation package, then the list of tests detailed in Table 2 of this CS, as a minimum, should be supported by flight test data and presented in the QTG (along with additional tests listed in Table 1 of this CS for which other sources of validation data are acceptable). Flight test data, other than throttle calibration and engine acceleration and deceleration data, is not required if the new thrust rating is certified on the aeroplane without need for a comprehensive stability and control flight instrumentation package.

(3) Tests that are significantly affected by a change to the avionics configuration, as described in subparagraph (c)(5) of this CS, should be supported by flight test data.

(4) A matrix or VDR should be provided with the QTG indicating the appropriate validation data source for each test (see CS FSTD(A).QTG.400). The organisation operating FSTDs should coordinate FSTD data requirements pertaining to alternate engines or avionics configurations in advance with the competent authority.

Table 2: Alternate engine validation tests requiring supporting flight test data

<table>
<tr><th>TEST NUMBER</th><th colspan="2">TEST DESCRIPTION</th><th>ALTERNATE ENGINE TYPE</th><th>ALTERNATE THRUST RATING [2]</th></tr>
<tr><td>1.b.1, 4</td><td colspan="2">Ground acceleration time and distance/normal take-off</td><td>X</td><td>X</td></tr>
<tr><td>1.b.2</td><td colspan="2">Minimum control speed, ground (V_{mcg}), if performed for aeroplane certification</td><td>X</td><td>X</td></tr>
<tr><td>1.b.5</td><td>Critical engine failure on take-off</td><td rowspan="2">Either test may be performed.</td><td rowspan="2">X</td><td rowspan="2"></td></tr>
<tr><td>1.b.8</td><td>Dynamic engine failure after take-off</td></tr>
<tr><td>1.b.7</td><td colspan="2">Rejected take-off, if performed for aeroplane certification</td><td>X</td><td></td></tr>
<tr><td>1.d.3</td><td colspan="2">Cruise performance</td><td>X</td><td></td></tr>
<tr><td>1.f.1, 2</td><td colspan="2">Engine acceleration and deceleration</td><td>X</td><td>X</td></tr>
<tr><td>2.a.8</td><td colspan="2">Alignment of cockpit throttle lever versus selected engine parameter (throttle calibration)[1]</td><td>X</td><td>X</td></tr>
<tr><td>2.c.1</td><td colspan="2">Power change dynamics (acceleration)</td><td>X</td><td>X</td></tr>
<tr><td>2.d.1</td><td colspan="2">Minimum control speed, air (V_{mca}) if performed for aeroplane certification</td><td>X</td><td>X</td></tr>
<tr><td>2.d.5</td><td colspan="2">Engine inoperative trim</td><td>X</td><td>X</td></tr>
</table>

[1] Should be provided for all changes in engine type or thrust rating (see (b)(3) above).

[2] See (b)(3) above for a definition of applicable thrust ratings.

Note: This table does not take into consideration additional configuration settings and control laws.

SUBPART D – FUNCTION AND SUBJECTIVE TESTS

CS FSTD(A).FST.001 General

This CS provides standards for function and subjective tests

(a) Accurate replication of aeroplane systems functions should be checked at each flight crew member position. This includes procedures using the operator's approved manuals and aeroplane manufacturer's approved manuals and checklists. Handling qualities, performance, FSTD systems operation as they pertain to the actual aeroplane or class of aeroplane, as well as FSTD cueing (e.g. visual cueing and motion cueing) and other supporting systems (e.g. IOS), should be subjectively assessed. In order to assure that the functions tests are conducted in an efficient and timely manner, operators are encouraged to coordinate with the appropriate competent authority responsible for the evaluation so that any skills, experience or expertise needed by the competent authority in charge of the evaluation team are available.

(b) The necessity of function 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 CS FSTD(A).QTG.100 'Validation tests' 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. As the case is for the FSTD validation tests, the function and subjective tests conducted during the initial evaluation are only a 'spot check' and not a rigorous examination of the quality of the simulation in all areas of flight and systems operation. The organisation operating FSTDs however should have fully completed the acceptance testing of the FSTD with support from the FSTD manufacturer prior to the device being submitted for the initial evaluation to be conducted by the competent authority evaluator(s).

(c) It is important that the function and subjective testing applicability and results from this testing are recorded in the function and subjective tests table included in the QTG at the initial qualification and that they present an accurate reflection of the FSTD's systems, features and capabilities. Not all function and subjective tests may be applicable for the aeroplane type or class that the FSTD represents and this should also be recorded in the completed function and subjective tests list submitted to the competent authority and included in the QTG. The properly completed function and subjective tests applicability and results list is thus a very important document required for review by the competent authority during the initial qualification process to confirm that appropriate acceptance has been completed and the devices capabilities established. This list will form the basis of the procedures or manoeuvres that the competent authority may wish to sample or spot check with the operator during the subjective part of the initial evaluation.

(d) At the request of the organisation operating FSTDs, the FSTD may be assessed for a special aspect of a relevant training programme during the function 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 training programme. Unless directly related to a requirement for the current qualification level or features and fidelity levels pertaining to specific training tasks, the results of such an evaluation would not affect the FSTD's current qualification status.

(e) Functions tests should be run in a logical flight sequence at the same time as performance and handling assessments. This also permits real-time FSTD running for 2 to 3 hours, without repositioning or flight or position freeze, thereby permitting proof of reliability. A useful source of guidance for conducting the function and subjective tests is published in the RAeS 'Aeroplane Flight Simulator Evaluation Handbook, Volume II' as amended.

(f) The FSTD should be assessed to ensure that repositions, resets and freezes support efficient and effective training.

(g) The FSTD should be assessed to ensure that simulated ATC environment supports the specific training tasks envisaged (for example, as needed for MPL/ab initio training) in an efficient and effective manner. Emphasis should be on the approval of those functions that support key training objectives, rather than those that attempt to provide a complete high-fidelity synthetic representation of real-world operations. Since the requirements for simulated ATC environment are intentionally non-prescriptive, the assessment will be largely subjective.

CS FSTD(A).FST.005 Test requirements

This CS defines the test requirements for function and subjective tests.

(a) The ground and flight tests and other checks required for qualification are listed in the table of function and subjective tests as established in CS FSTD(A).FST.105. The table includes manoeuvres and procedures (both conventional and performance-based navigation) to assure that the FSTD functions and performs appropriately for use in pilot training, testing and checking in the manoeuvres and procedures normally required in a training, testing and checking programme.

(b) Some manoeuvres and procedures include pilot techniques and features of advanced technology aeroplanes and innovative training programmes. For example, 'continuous descent final approach technique' and 'high angle of attack manoeuvring' are included to provide an alternative to 'dive and drive final approaches' and 'approach to stall', respectively. For the latter, such an alternative is necessary for aeroplanes employing flight envelope limiting technology.

(c) All systems functions should be assessed for normal and, where appropriate, alternate operations. Normal, abnormal, and emergency procedures associated with a flight phase should be assessed during the evaluation of manoeuvres or events within that flight phase. The effects of the selected malfunctions should be sufficient to correctly exercise the aeroplane-related procedures, normally contained in a quick reference handbook (QRH). Systems are listed separately under 'any flight phase' to assure appropriate attention to systems checks.

(d) When evaluating function 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 CS FSTD(A).QTG.100 'Validation tests' above.

(e) The evaluation of the lower orders of FSTD should be tailored only to the systems and flight conditions which have been simulated. Similarly, many tests should 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.

(f) 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.

CS FSTD(A).FST.105 Table of function and subjective tests

This CS defines the function and subjective tests table.

(a) The function and subjective tests are all executed in an environment where FSTD features are used in a fully integrated manner. The integrated nature of this testing environment therefore prevents these function and subjective tests from being classified as applicable to individual FSTD features and fidelity levels. Each FSTD will have a collection of different features and fidelity levels in its construction (FCS), which precludes the possibility of classifying tests individually using the categories G, R and S. In addition, some of the tests may be worded to apply only to lower levels of devices and thus are N/A for higher levels of devices and vice versa.

(b) For any given FSTD, it is important therefore to establish which of the function and subjective tests are applicable to and supported by the FCS of that FSTD. Consequently, an appropriate function and subjective tests list for the FSTD will have to be defined that covers all possible tests perceived. This establishment of the applicable function and subjective test should be done by annotating the 'Applicability' column in the master table for function and subjective tests. The list should be completed so that the tests are consistent with the FCS declared and with what the FSTD is intended to support.

(c) Having defined the tests that are applicable, it is then important that the operator completes these tests and declares the results of such tests in the 'Result' column of the table along with any pertinent information relevant to that test or manoeuvre or procedure completed. This list of F&S applicability and test results will be reviewed with the relevant competent authority during the initial evaluation process. See GM1 CS FSTD(A).FST.105 Guidance for function and subjective tests, which contains an example and related guidance material.

(d) 'Other' means any other test as applicable to the aeroplane being simulated and as applicable to the FSTD type or FCS but not specifically mentioned.

(e) The complete table is shown below.

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
1	**PREPARATION FOR FLIGHT**		
1.a	Pre-flight: Accomplish a functions check of all switches, indicators, systems, and equipment at all crew members' and instructors' stations and determine that:		
1.a.1	The flight deck design and functions are identical to those of the aeroplane simulated.		
1.a.2	The flight deck design and functions represent those of the simulated class of aeroplane.		
1.a.3	The flight deck design and functions are aeroplane-like and generic but recognisable as within a class of aeroplane.		
2	**SURFACE OPERATIONS (PRE-FLIGHT)**		
2.a	Engine start:		
2.a.1	Normal start		
2.a.2	Alternate start procedures		
2.a.3	Abnormal starts and shutdowns (hot start, hung start, tail pipe fire, etc.)		
2.b	Taxi:		
2.b.1	Pushback/powerback		
2.b.2	Thrust response		
2.b.3	Power lever friction		
2.b.4	Ground handling		
2.b.5	Nosewheel scuffing		
2.b.6	Taxi aids (e.g. taxi camera, moving map)		
2.b.7	Low-visibility taxi route (signage, lighting, markings, etc.)		
2.c	Brake operation-		
2.c.1	Brake operation (normal, automatic and alternate/emergency)		
2.c.2	Brake fade (if applicable)		
2.d	Other		
3	**TAKE-OFF**		
	Note. Only those take-off tests relevant to the type or class of aeroplane being simulated should be selected from the following list, where tests should be made with limiting wind velocities, wind shear and with relevant system failures.		
3.a	Normal:		
3.a.1	Aeroplane/engine parameter relationships including run-up		
3.a.2	Nosewheel and rudder steering		
3.a.3	Crosswind:		
3.a.3.a	Crosswind (maximum demonstrated)		
3.a.3.b	Gusting crosswind		
3.a.4	Special performance:		
3.a.4.a	Reduced V1		
3.a.4.b	Maximum engine de-rate		
3.a.4.c	Soft surface		
3.a.4.d	Short field/short take-off and landing (STOL) operations		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
3.a.4.e.	Obstacle (performance over visual obstacle)		
3.a.5	Low-visibility take-off		
3.a.6	Landing gear, wing flap leading edge device operation		
3.a.7	Contaminated runway operation		
3.a.8	Other		
3.b	Abnormal/emergency:		
3.b.1	Rejected take-off		
3.b.2	Rejected take-off special performance (e.g. reduced V1, max engine de-rate, soft field, short take-off and landing (STOL) operations, etc.)		
3.b.3	Rejected take-off with contaminated runway		
3.b.4	Take-off with a propulsion system malfunction of the most critical engine (allowing an analysis of causes, symptoms, recognition, and the effects on aeroplane performance and handling) at the following points:		
3.b.4.1	Prior to V1 decision speed;		
3.b.4.2	Between V1 and Vr (rotation speed); and		
3.b.4.3	Between Vr and 500 ft above ground level		
3.b.4.4	after gear-up during climb out		
3.b.5	Flight control system failures, reconfiguration modes, manual reversion and associated handling		
3.b.6	Other		
4	**CLIMB**		
4.a	Normal		
4.b	One or more engines inoperative		
4.c	Approach climb in icing (for aeroplanes with icing accountability)		
4.d	Other		
5	**CRUISE**		
5.a	Performance characteristics (speed versus power, configuration, and attitude):		
5.a.1	Straight and level flight		
5.a.2	Change of airspeed		
5.a.3	High-altitude handling		
5.a.4	High-Mach-number handling (Mach tuck, Mach buffet) and recovery (trim change)		
5.a.5	Overspeed warning (in excess of VMO or MMO)		
5.a.6	High-IAS handling		
5.a.7	Other		
5.b	Manoeuvres:		
5.b.1	High angle of attack		
5.b.1.a	High angle of attack, approach-to-stalls, stall warning and stall buffet (take-off, cruise, approach, and landing configuration), including reaction of the autoflight system and stall protection system.		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
5.b.1.b	High angle of attack, approach-to-stalls, stall warning, stall buffet and stall (and g-break, if applicable) (take-off, cruise, approach, and landing configuration), including reaction of the autoflight system and stall protection system.		
5.b.2	Slow flight		
5.b.3	Upset prevention and recovery manoeuvre within the FSTD validation envelope.		
5.b.4	Flight envelope protection (high angle of attack, bank limit, overspeed, etc.)		
5.b.5	Turns with/without speed brake/spoilers deployed		
5.b.6	Normal and standard rate turns		
5.b.7	Steep turns		
5.b.8	Performance turn		
5.b.9	In-flight engine shutdown and restart (assisted and windmill)		
5.b.10	Manoeuvring with one or more engines inoperative, as appropriate		
5.b.11	Specific flight characteristics (e.g. direct lift control)		
5.b.12	Flight control system failures, reconfiguration modes, manual reversion and associated handling		
5.b.13	Gliding to a forced landing		
5.b.14	Visual resolution and FSTD handling and performance for the following:		
5.b.14.a	Terrain accuracy for forced landing area selection		
5.b.14.b	Terrain accuracy for VFR navigation		
5.b.15	Other		
6	**DESCENT**		
6.a	Normal rate		
6.b	Maximum rate/emergency (clean and with speedbrake,etc.)		
6.c	With autopilot		
6.d	Flight control system failures, reconfiguration modes, manual reversion and associated handling		
6.e	Other		
7	**INSTRUMENT APPROACHES OPERATIONS**		
	Note. Only those instrument approach and landing tests relevant to the aeroplane type or class being simulated should be selected from the following list, where tests should be made with limiting wind velocities, wind shear (except for CAT II and CAT III precision approaches) and with relevant system failures.		
7.a	3D operations on precision approach procedures:		
7.a.1	CAT I published approaches (all types):		
7.a.1.a	Manual approach with/without flight director including landing		
7.a.1.b	Autopilot/autothrottle coupled approach and manual landing		
7.a.1.c	Autopilot/autothrottle coupled approach, engine(s) inoperative		
7.a.1.d	Manual approach, engine(s) Inoperative		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
7.a.1.e	HUD/EFVS		
7.a.2	CAT II published approaches:-		
7.a.2.a	Autopilot/autothrottle coupled approach to DH and landing (manual and autoland)		
7.a.2.b	Autopilot/autothrottle coupled approach with one-engine-inoperative approach to DH and go-around (manual and autopilot).		
7.a.2.c	HUD/EFVS		
7.a.3	CAT III published approaches:-		
7.a.3.a	Autopilot/autothrottle coupled approach to DH and landing and rollout (manual and autoland)		
7.a.3.b	Autopilot/autothrottle coupled approach to DH and G/A (manual and autopilot)		
7.a.3.c	Autopilot/autothrottle coupled approach to land and rollout (if applicable) guidance with one engine inoperative (manual and autoland)		
7.a.3.d	Autopilot/autothrottle coupled approach to DH and G/A with one engine inoperative (manual and autopilot)		
7.a.3.e	HUD/EFVS		
7.a.4	Autopilot/autothrottle coupled approach (to a landing or to a go-around):		
7.a.4.a	With generator failure		
7.a.4.b	With maximum tail wind component certified or authorized		
7.a.4.c	With 10 kt tail wind		
7.a.4.d	With maximum crosswind component certified or authorised		
7.a.4.e	With 10 kt crosswind		
7.a.5	PAR approach, all engine(s) operating and with one or more engine(s) inoperative		
7.a.6	MLS, GBAS, all engine(s) operating and with one or more engine(s) inoperative		
7.b	2D and 3D operations on Non-precision approach procedures:-		
7.b.1	Surveillance radar approach, all engine(s) operating and with one or more engine(s) inoperative		
7.b.2	NDB approach (with and without CDFA), all engine(s) operating and with one or more engine(s) inoperative		
7.b.3	VOR, VOR/DME, VOR/TACAN approach (with and without CDFA), all engines(s) operating and with one or more engine(s) inoperative		
7.b.4	RNP APCH approach procedures (with and without CDFA) — localiser performance (LP) and lateral navigation (LNAV) minima (at nominal and minimum authorised temperatures), all engine(s) operating and with one or more engine(s) inoperative.		
7.b.5	ILS localiser only (LOC), and ILS localiser back course (LOC-BC) approaches (with and without CDFA), all engine(s) operating and with one or more engine(s) inoperative.		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
7.b.6	ILS offset localiser approach, all engine(s) operating and with one or more engine(s) inoperative.		
	NOTE. If standard operating procedures are to use autopilot for non-precision approaches, then these should be evaluated.		
7.c	3D operations on approach procedures with vertical guidance (APV), e.g. SBAS, flight path vector:		
7.c.1	RNP APCH Baro VNAV approach procedures (LNAV/VNAV minima), all engine(s) operating and with one or more engine(s) inoperative.		
7.c.2	RNP APCH approach procedures based on SBAS (LPV minima), all engine(s) operating and with one or more engine(s) inoperative.		
7.c.3	RNP AR APCH approach procedures with Baro-VNAV (RNP 0.3-0.1 minima), all engine(s) operating and with one or more engine(s) inoperative.		
8	**VISUAL APPROACHES (SEGMENT) AND LANDINGS**		
8.a	Manoeuvring, normal approach and landing all engines operating with and without visual and navigational approach aid guidance.		
8.b	Approach and landing with one or more engines inoperative.		
8.c	Operation of landing gear, flap/slats and speed brakes (normal and abnormal).		
8.d	Approach and landing with crosswind:		
8.d.1	Max. Demonstrated.		
8.d.2	Gusting.		
8.e	Approach and landing with flight control system failures, reconfiguration modes, manual reversion and associated handling (the most significant degradation which is probable):		
8.e.1	Approach and landing with trim malfunctions:		
8.e.1.a	longitudinal trim malfunction.		
8.e.1.b	lateral-directional trim malfunction.		
8.f	Approach and landing with standby (minimum) electrical/hydraulic power.		
8.g	Approach and landing from circling conditions (circling approach) Note. This test requires as a minimum a representative airport scene that can provide a heading difference of 90° or more, and 180° or less, between approach and landing runways. Any associated hazard lights or any other visual aids for use as part of the published circling procedure should be included in the correct position(s) and be of the appropriate colour(s), directionality and behaviour. However, where the requirement for the visual system fidelity level is G, a generic airport model to be consistent with published data used for aeroplane operations may be used and should contain both the approach and landing runways and have the capability to light both at the same time. Any associated hazard lights or any other visual aids for use as part of the published circling procedure need to be included in the correct position(s) and be of the appropriate colour(s) and behaviour.		
8.h	Approach and landing from a visual traffic pattern.		
8.i	Approach and landing from a non-precision approach.		
8.j	Approach and landing from a precision approach.		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
8.k	Approach and landing from published visual approach (including those that use PBN).		
8.l	Other		
	NOTE. FSTDS with visual systems, which permit completing a special approach procedure in accordance with applicable regulations, may be approved for that particular approach procedure.		
9	**MISSED APPROACH**		
9.a	All engines operating, manual and autopilot.		
9.b	One or more engine(s) inoperative, manual and autopilot.		
9.c	Rejected landing.		
9.d	With auto-flight, flight control system failures, reconfiguration modes and manual reversion.		
10	**SURFACE OPERATIONS (LANDING, AFTER LANDING, AND POST-FLIGHT)**		
10.a	Landing roll and taxi:-		
10.a.1	HUD/EFVS.		
10.a.2	Spoiler operation.		
10.a.3	Reverse thrust operation.		
10.a.4	Directional control and ground handling, both with and without reverse thrust.		
10.a.5	Reduction of rudder effectiveness with increased reverse thrust (rear pod-mounted engines.)		
10.a.6	Brake and anti-skid operation:		
10.a.6.a	Brake and anti-skid operation with dry, wet, icy, patchy wet, patchy ice, wet on rubber residue in touchdown zone conditions .		
10.a.6.b	Brake and anti-skid operation with dry and wet conditions.		
10.a.6.c	Brake operation with dry conditions.		
10.a.6.d	Auto-braking system operation where applicable		
10.a.7	Other.		
10.b	Engine shutdown and parking:		
10.b.1	Engine and systems operation.		
10.b.2	Parking brake operation.		
10.b.3	Other.		
11	**ANY FLIGHT PHASE**		
11.a	Aeroplane and powerplant systems operation:		
11.a.1	Air conditioning and pressurisation (environmental control system).		
11.a.2	De-icing/anti-icing.		
11.a.3	Auxiliary powerplant/auxiliary power unit (APU).		
11.a.4	Communications.		
11.a.5	Electrical.		
11.a.6	Fire and smoke detection and suppression.		
11.a.7	Flight controls (primary and secondary).		
11.a.8	Fuel and oil.		
11.a.9	Hydraulic.		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
11.a.10	Pneumatic.		
11.a.11	Landing gear.		
11.a.12	Oxygen.		
11.a.13	Powerplant.		
11.a.14	Airborne radar.		
11.a.15	Autopilot and flight director.		
11.a.16	Terrain awareness warning systems and collision avoidance systems (e.g. TAWS, EGPWS, GPWS, TCAS).		
11.a.17	Flight control computers including stability and control augmentation.		
11.a.18	Flight display systems.		
11.a.19	Flight management computers.		
11.a.20	Head-up guidance, head-up displays (including EFVS if appropriate).		
11.a.21	Navigation systems.		
11.a.22	Stall warning/avoidance.		
11.a.23	Wind shear avoidance/recovery guidance equipment.		
11.a.24	Flight envelope protections.		
11.a.25	Electronic flight bag.		
11.a.26	Automatic checklists (normal, abnormal, emergency and deferred procedures).		
11.a.27	Runway alerting and advisory systems.		
11.a.28	Other.		
11.b	Airborne procedures:		
11.b.1	Holding (conventional and RNAV).		
11.b.2	Air hazard avoidance (traffic, weather, including visual correlation).		
11.b.3	Windshear.		
	Prior to take-off rotation.		
11.b.3.b	At lift-off.		
11.b.3.c	During initial climb.		
11.b.3.d	On final approach, below 150 m (500 ft) AGL.		
11.b.4	Effects of airframe ice.		
12	**VISUAL SYSTEM**		
	This section is written in the context of the organisation operating FSTDs presenting models of real-world airports, serviced by the aeroplane type being simulated, for use in completion of the function and subjective tests described in this section. The models should also be airports that are used regularly in the training programme(s) and, as applicable, may be presented for approval of circling approaches. However, where the requirement for the device visual system fidelity level allows, the organisation operating FSTDs may elect to use demonstration models for use during the device initial qualification which need not be fully up to date nor replicate any particular airport (fictitious airport). During recurrent evaluations the competent authority may select any visual scene used in the air operator's training programme(s) for completion of the function and subjective tests, provided these visual scenes were modelled with the features required.		
12.a	Function test content requirements:-		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
	NOTE: The following are the minimum airport model content requirements to satisfy visual capability tests and provide suitable visual cues to allow completion of all function and subjective tests described in this section. organisation operating FSTDss are encouraged to use the model content described below for the function and subjective tests.		
12.a.1	Airport scenes:		
12.a.1.a	A minimum of three real-world airport models to be consistent with published data used for aeroplane operations and capable of demonstrating all the visual system features below. Each model should be in a different visual scene to permit assessment of FSTD automatic visual scene changes. Each model should be selectable from the IOS.		
12.a.1.b	A minimum of one generic airport model to be consistent with published data used for aeroplane operations. This model should be acceptable to the organisation operating FSTDs's competent authority and selectable from the IOS.		
12.a.2	Visual scene fidelity:		
12.a.2.a	The visual scene should correctly represent the parts of the airport and its surroundings used in the training programme.		
12.a.2.b	The fidelity of the visual scene should be sufficient for the flight crew to: visually identify the airport; determine the position of the aeroplane being simulated; successfully accomplish take-offs, approaches and landings; and manoeuvre around the airport on the ground as necessary.		
12.a.2.c	The fidelity of the visual scene should be sufficient for the flight crew to successfully accomplish take-offs, approaches and landings.		
12.a.3	Runways and taxiways:		
12.a.3.a	The airport runways and taxiways.		
12.a.3.b	Representative runways and taxiways.		
12.a.3.c	Generic runways and taxiways.		
12.a.4	If appropriate to the airport, two parallel runways and one crossing runway displayed simultaneously; at least two runways should be capable of being lit simultaneously.		
12.a.5	Runway threshold elevations and locations should be modelled to provide correlation with aeroplane systems (e.g. HUD, GPS, compass, altimeter).		
12.a.6	Slopes in runways, taxiways and ramp areas should not cause distracting or unrealistic effects, including pilot eyepoint height variation.		
12.a.7	Runway surface and markings for each 'in-use' runway should include the following, if appropriate:-		
12.a.7.a	Threshold markings.		
12.a.7.b	Runway numbers.		
12.a.7.c	Touchdown zone markings.		
12.a.7.d	Fixed distance markings.		
12.a.7.e	Edge markings.		
12.a.7.f	Centre line markings.		
12.a.7.g	Distance remaining signs.		
12.a.7.h	Signs at intersecting runways and taxiways.		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
12.a.7.i	Windsock that gives appropriate wind cues.		
12.a.8	Runway lighting of appropriate colours, directionality, behaviour and spacing for each 'in-use' runway including the following, if appropriate:		
12.a.8.a	Threshold lights.		
12.a.8.b	Edge lights.		
12.a.8.c	End lights.		
12.a.8.d	Centre line lights.		
12.a.8.e	Touchdown zone lights.		
12.a.8.f	Lead-off lights.		
12.a.8.g	Appropriate visual landing aid(s) for that runway.		
12.a.8.h	Appropriate approach lighting system for that runway.		
12.a.8.i	Lead-on lights.		
12.a.8.j	Runway status lights (RWSL).		
12.a.8.k	Land and hold short operations (LAHSO) lights.		
12.a.8.l	Runway guard lights.		
12.a.8.m	Final approach runway occupancy signal (FAROS).		
12.a.9	Taxiway surface and markings (associated with each 'in-use' runway) should include the following, if appropriate:-		
12.a.9.a	Edge markings.		
12.a.9.b	Centre line markings.		
12.a.9.c	Runway holding position markings.		
12.a.9.d	ILS critical area markings.		
12.a.9.e	All taxiway markings, lighting, and signage to taxi, as a minimum, from a designated parking position to a designated runway and return, after landing on the designated runway, to a designated parking position; a low-visibility taxi route (e.g. surface movement guidance control system, follow-me truck, daylight taxi lights) should also be demonstrated for operations authorised in low visibility. The designated runway and taxi routing should be consistent with that of that airport for operations in low visibility. The qualification of surface movement guidance control systems (SMGCS) is optional at the request of the organisation operating FSTDs. For the qualification of SMGCS, a demonstration model must be provided for evaluation.		
12.a.10	Taxiway lighting of appropriate colours, directionality, behaviour and spacing (associated with each 'in-use' runway) should include the following, if appropriate:-		
12.a.10.a	Edge lights.		
12.a.10.b	Centre line lights.		
12.a.10.c	Runway holding position and ILS critical area lights.		
12.a.11	Required visual model correlation with other aspects of the airport environment simulation:-		
12.a.11.a	The airport model should be properly aligned with the navigational aids that are associated with operations at the runway 'in-use'.		
12.a.11.b	The simulation of runway contaminants should be generally correlated with the displayed runway surface and lighting.		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
12.a.12	Airport buildings, structures and lighting:		
12.a.12.a	Buildings, structures and lighting:-		
12.a.12.a.1	The airport buildings, structures and lighting.		
12.a.12.a.2	Representative airport buildings, structures and lighting.		
12.a.12.a.3	Generic airport buildings, structures and lighting.		
12.a.12.b	At least one useable gate, set at the appropriate height (required only for aeroplanes that typically operate from terminal gates).		
12.a.12.c	Representative moving and static airport clutter (e.g. other aeroplanes, power carts, tugs, fuel trucks, additional gates).		
12.a.12.d	Gate/apron markings (e.g. hazard markings, lead-in lines, gate numbering), lighting and gate docking aids or a marshaller.		
12.a.13	Terrain and obstacles:		
12.a.13.a	Terrain and obstacles within 46 km (25 NM) of the reference airport.		
12.a.13.b	Representative depiction of terrain and obstacles within 46 km (25 NM) of the reference airport.		
12.a.14	Significant, identifiable natural and cultural features and moving airborne traffic:		
12.a.14.a	Significant, identifiable natural and cultural features within 46 km (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.*		
12.a.14.b	Representative depiction of significant and identifiable natural and cultural features within 46 km (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.*		
12.a.14.c	Characteristic stationary and moving other traffic — including the capability to present other aeroplane traffic both on the ground and airborne.		
12.b	Visual scene management:		
12.b.1	Airport runway, approach and taxiway lighting and cultural feature lighting intensity for any approach should be capable of being set to six different intensities (0 to 5); all visual scene light points should fade into view appropriately.		
12.b.2	Airport runway, approach and taxiway lighting and cultural feature 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.		
12.b.3	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.		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
12.c	Visual feature recognition: *Note. The following are 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° 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.*		
12.c.1	Runway definition, strobe lights, approach lights and runway edge white lights from 8 km (5 sm) of the runway threshold.		
12.c.2	Visual approach aids lights:		
12.c.2.a	Visual approach aids lights from 8 km (5 sm) of the runway threshold.		
12.c.2.b	Visual approach aids lights from 4.8 km (3 sm) of the runway threshold.		
12.c.3	Runway centre line lights and taxiway definition from 4.8 km (3 sm).		
12.c.4	Threshold lights and touchdown zone lights from 3.2 km (2 sm).		
12.c.5	Runway markings within range of landing lights for night scenes; as required by the surface resolution test on day scenes.		
12.c.6	For circling approaches, the runway of intended landing and associated lighting should fade into view in a non-distracting manner.		
12.d	Selectable airport visual scene capability for:-		
12.d.1	Night.		
12.d.2	Twilight.		
12.d.3	Day.		
12.d.4	Other aeroplane traffic dynamic effects – including the capability to present other aeroplane traffic undertaking both ground and airborne manoeuvres. Dynamic visual effects may include aeroplane lighting, landing gear, and control surfaces.		
12.d.5	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 at a specific airport.*		
12.e	Correlation with aeroplane and associated equipment:		
12.e.1	Visual cues to relate to actual aeroplane responses.		
12.e.2	Visual cues during take-off, approach and landing:		
12.e.2.a	Visual cues to assess sink rate and depth perception during landings.		
12.e.2.b	Visual cueing sufficient to support changes in approach path by using runway perspective. Changes in visual cues during take-off, approach and landing should not distract the pilot.		
12.e.3	Accurate portrayal of environment relating to aeroplane attitudes.		
12.e.4	The visual scene should correlate with integrated aeroplane systems, where fitted (e.g. terrain, traffic and weather avoidance systems and HUD/EFVS).		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
12.e.5	The effect of rain removal devices should be provided.		
12.f	Scene quality:		
12.f.1	Quantisation:		
12.f.1.a	Surfaces and textural cues should be free from apparent quantisation (aliasing).		
12.f.1.b	Surfaces and textural cues should not create distracting quantisation (aliasing).		
12.f.2	System capable of portraying full colour realistic textural cues.		
12.f.3	The system light points should be free from distracting jitter, smearing or streaking.		
12.f.4	System capable of providing focus effects that simulate rain.		
12.f.5	System capable of providing light point perspective growth.		
12.g	Environmental effects:		
12.g.1	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.		
12.g.2	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 airport surface and within a radius of 16 km (10 sm) from the airport.		
12.g.3	One airport with a snow scene, if appropriate to the air operator's area of operations, to include terrain snow and snow-covered taxiways and runways.		
12.g.4	In-cloud effects such as variable cloud density, speed cues and ambient changes should be provided.		
12.g.5	The effect of multiple cloud layers representing few, scattered, broken and overcast conditions giving partial or complete obstruction of the ground scene.		
12.g.6	Gradual break-out to ambient visibility/RVR, defined as up to 10 % of the respective cloud base or top, 6 m (20 ft) ≤ transition layer ≤ 61 m (200 ft); cloud effects should be checked at and below a height of 600 m (2 000 ft) above the airport and within a radius of 16 km (10 sm) from the airport. Transition effects should be complete when the IOS cloud base or top is reached when exiting and start when entering the cloud, i.e. transition effects should occur within the IOS defined cloud layer.		
12.g.7	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 airport and within a radius of 16 km (10 sm) from the airport.		
12.g.8	Patchy fog (sometimes referred to as patchy RVR) giving the effect of variable RVR. The lowest RVR should be that selected on the IOS, i.e. variability is only > IOS RVR.		
12.g.9	Effects of fog on airport lighting such as halos and defocus.		
12.g.10	Effect of ownship lighting in reduced visibility, such as reflected glare, to include landing lights, strobes and beacons.		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
12.g.11	Wind cues to provide the effect of blowing snow or sand across a dry runway or taxiway should be selectable from the instructor station.		
13	**MOTION AND VIBRATION EFFECTS**		
	The following specific motion and vibration effects are required to indicate the threshold at which a flight crew member should recognise an event or situation. Where applicable below, the FSTD pitch, side loading and directional control characteristics as well as the vibrational characteristics should be representative of the aeroplane. There is a need for motion objective tests to be validated against data.		
13.a	Taxiing effects such as lateral, longitudinal, and directional cues resulting from steering and braking inputs.		
13.b	Effects of runway rumble, oleo deflections, ground speed, uneven runway, runway centreline lights, runway contamination with associated anti-skid and taxiway characteristics.		
13.c	Buffets on the ground due to spoiler/speed brake extension and thrust.		
13.d	Bumps associated with the landing gear.		
13.e	Buffet during extension and retraction of landing gear.		
13.f	Buffet in the air due to flap and spoiler/speed brake extension.		
13.g	Buffet due to atmospheric disturbances.		
13.h	Approach-to-stall buffet and stall buffet (where applicable).		
13.i	Touchdown cues for main and nose gear.		
13.j	Nose wheel scuffing.		
13.k	Thrust effect with brakes set.		
13.l	Mach and manoeuvre buffet.		
13.m	Tyre failure dynamics.		
13.n	Engine failures, malfunction, engine and airframe structural damage.		
13.o	Tail, engine pods/propeller and wing strikes.		
13.p	Other.		
14	**SOUND SYSTEM**		
	The following checks should be performed during a normal flight profile with motion system ON where applicable.		
14.a	Precipitation.		
14.b	Rain removal equipment.		
14.c	Significant aeroplane noises perceptible to the pilot during normal operations, such as noises from engine, propeller, flaps, gear, anti-skid, spoiler extension/retraction and thrust reverser to a comparable level of that found in the aeroplane.		
14.d	Abnormal operations for which there are associated sound cues including, but not limited to, engine malfunctions, landing gear/tyre malfunctions, tail and engine pod/propeller strike and pressurisation malfunctions.		
14.e	Sound of a crash when the FSTD is landed in excess of limitations.		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
15	**SPECIAL EFFECTS**		
15.a	Braking dynamics Representative brake failure dynamics (including anti-skid) 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.		
15.b	Effects of airframe and engine icing. See CS FSTD(A).QB.110, 1.t.1. Required only for those aeroplanes authorised for operations in known icing conditions. Please refer to CS FSTD(A).UPRT.040.		
16	**SIMULATED AIR TRAFFIC CONTROL (ATC) ENVIRONMENT.**		
	Note 1. Where the 'Environment-ATC' fidelity level is 'N' (i.e. if the organisation operating FSTDs has elected to use the instructor to provide all ATC communications to the ownship), the operator will need to review the following functions list for applicability taking this into consideration. *Note 2. Where the 'Environment-ATC' fidelity level is not 'N', the tests in the section apply.* *Note 3. Features that are unrealistic or could potentially disrupt training (for example, issues with the visual representation of other traffic, ATC communication errors and incorrect clearances) should be corrected or removed.*		
16.a	Automated weather reporting:		
16.a.1	Instructor control.		
16.a.2	Correlation with reported weather.		
16.a.3	Station weather reporting:		
16.a.3.a	Single message.		
16.a.3.b	Message contents.		
16.a.3.c	Multiple messages.		
16.a.4	Message format and regional characteristics:		
16.a.4.a	ICAO.		
16.b	Other traffic:		
16.b.1	Other aeroplanes.		
16.b.2	Other traffic automation.		
16.b.3	Other aircraft performance.		
16.b.4	Other aeroplane behaviour:		
16.b.4.a	Appropriate routing.		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
16.b.4.b	Category and weight class.		
16.b.5	Other traffic transponder state.		
16.b.6	Other traffic transponder mode of operation.		
16.b.7	Other traffic correlation with ATC.		
16.b.8	Other traffic separation.		
16.b.9	Other aeroplane call sign and livery.		
16.b.10	Other aeroplane type and livery.		
16.b.11	Other aeroplane visual effects.		
16.c	Background radio communications:		
16.c.1	Presence.		
16.c.2	Atc services and other traffic operations.		
16.c.3	Errors.		
16.c.4	Number of transmissions.		
16.c.5	Overstepping on frequency:		
16.c.5.a	Other traffic and ATC.		
16.c.5.b	Ownship.		
16.d	ATC services:		
16.d.1	ATC service provision.		
16.d.2	Roles and frequency allocation.		
16.d.3	ATC procedures:		
16.d.3.a	Standard.		
16.d.3.b	Regional.		
16.d.3.c	Correlation.		
16.d.4	Radio ranging.		
16.d.5	ATC service continuity.		
16.e	Language and phraseology:		
16.e.1	Language:		
16.e.1.a	English.		
16.e.2	Standard phraseology:		
16.e.2.a	ICAO.		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
16.e.2.b	Regional.		
16.f	Voice characteristics:		
16.f.1	ATC voice assignment.		
16.f.2	Dedicated ATC voices.		
16.f.3	ATC voices:		
16.f.3.a	Distinct.		
16.f.3.b	Multiple distinct.		
16.f.4	Other traffic voices:		
16.f.4.a	Distinct.		
16.f.4.b	Multiple distinct.		
16.g	Airport and airspace modelling:		
16.g.1	Airports:		
16.g.1.a	Single airport.		
16.g.1.b	Multiple airports.		
16.g.2	Controlled airspace:		
16.g.2.a	Terminal and enroute.		
16.g.2.b	Location-specific terminal and en-route		
16.g.3	Minimum connected ground movement areas.		
16.g.4	Multiple connected ground movement areas.		
16.g.5	Single direction runway movements.		
16.g.7	Multiple runways.		
16.g.8	Runway operation modes.		
16.g.9	Airport runway lighting.		
16.g.10	Holding point lighting.		
16.g.11	Taxiway lighting.		
16.h	Weather:		
16.h.1	Airport operations and reported weather.		
16.h.2	Atc procedures and reported weather.		
16.i	Voice communications:		
16.i.1	Voice continuity.		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
16.i.2	Time of day.		
16.i.3	Communication initiation.		
16.i.4	Atc services and ownship operations.		
16.i.6	Ownship emergency conditions.		
16.i.7	ATC service continuity.		
16.i.8	Standby.		
16.i.9	Say again.		
16.i.10	Content errors and omissions.		
16.i.11	Incorrect frequency transmissions.		
16.i.12	Clearance deviations.		
16.i.13	Ownship routing:		
16.i.13.a	According to flight plan.		
16.i.13.b	Published routes.		
16.i.13.c	Appropriate runways.		
16.i.13.d	Appropriate ground routing.		
16.j	Data link communications:		
16.j.1	Message sequence.		
16.j.2	Message indications.		
16.j.3	Timing delays.		
16.j.4	ATS clearances.		
16.j.5	Data link weather.		
16.j.6	DLIC.		
16.j.7	Connection management.		
16.j.8	CPDLC:		
16.j.8.a	Messaging capability.		
16.j.8.b	Regional messaging.		
16.j.9	ADS-C		
16.j.10	FIS-B.		
16.j.11	Service failures.		
16.k	System correlation:		
16.k.1	Traffic on visual system.		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
16.k.1.a	Presence.		
16.k.1.b	Alignment.		
16.k.2	Visual system clutter.		
16.k.3	Navigation data alignment.		
16.k.3.a	Other aeroplanes.		
16.k.3.b	Airspace.		
16.k.4	Traffic on cockpit displays.		
16.k.5	ADS-B traffic.		
16.k.6	TCAS.		
16.k.6.a	Ownship event triggering.		
16.k.6.b	Ownship standard procedures and radio communications.		
16.l	Instructor interfaces and controls.		
16.l.1	Situational awareness.		
16.l.2	Instructor access to radio communications.		
16.l.3	Instructor access to data link communications.		
16.l.4	Simulator functions.		
16.l.4.a	Minimum support.		
16.l.5	Disable SATCE.		
16.l.6	Mute (background radio communications).		
16.l.7	Instructor other traffic control.		
16.l.7.a	Presence.		
16.l.7.b	Configurable flow.		
17	**INSTRUCTOR OPERATING STATION (IOS)**		
	Note. It is recognised that IOS functionality is bespoke to operator's needs. Consequently, the list below is not exhaustive but is intended to provide guidance of the sorts of functionalities that could be available to support the intended use. *It is suggested that the column 'APPLICABILITY' be completed by the operator in order to record the IOS capability and functionality to demonstrate that it supports its intended use.*		
17.a	Repositions: *NOTE. Repositions should be in-trim at the appropriate speed and configuration for the point.*		
17.a.1	Ramp/gate.		
17.a.2	Take-off position.		
17.a.3	Approach position (at least three positions at 1.8, 5.5 and 9.3 km (1.3 and 5 NM) from the runway threshold.		
17.a.4	Other.		
17.b	Resets:		

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Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
17.b.1	System.		
17.b.2	Temperature.		
17.b.3	Fluids and agents.		
17.c	Environment:		
17.c.1	Weather presets:		
17.c.1.a	Unlimited, CAVOK, VFR, non-precision, APV, precision (CAT I, CAT II, CAT III), EFVS (if appropriate).		
17.c.1.b	Unlimited, CAVOK, VFR.		
17.c.2	Visual effects:		
17.c.2.a	Time of day (day, dusk, night); clouds (bases, tops, layers, types, density); visibility in kilometres/statute miles; RVR in metres/feet; and special effects (precipitation, thunderstorms, blowing snow, sand, etc.).		
17.c.2.b	Time of day (day, dusk, night); clouds (bases, tops, layers, types, density); visibility in kilometres/statute miles; RVR in metres/feet; and special effects (precipitation, thunderstorms, etc.).		
17.c.2.c	Time of day (day, dusk, night); clouds (bases, tops); visibility in kilometres/statute miles.		
17.c.3	Wind:		
17.c.3.a	Surface.		
17.c.3.b	Intermediate levels.		
17.c.3.c	Typical gradient.		
17.c.3.d	Gust with associated heading and speed variance.		
17.c.3.e	Turbulence.		
17.c.4	Temperature — surface.		
17.c.5	Atmospheric pressure (QNH, QFE).		
17.d	Airport:		
17.d.1	Runway selection:		
17.d.1.a	To include active runway selection, and as appropriate to the airport, should be able to light at least one additional parallel or crossing runway.		
17.d.1.b	To include active runway selection.		
17.d.2	Airport lighting:		
17.d.2.a	Airport lighting including variable intensity and control of progressive low-visibility taxiway and stop bar lighting, as appropriate.		
17.d.2.b	Airport lighting.		
17.d.3	Dynamic effects including ground and flight traffic.		
17.e	Aeroplane configuration (fuel, weight, CoG, etc.).		
17.f	FMS — reloading of programmed data unless precluded by installed equipment.		
17.g	Plotting and recording (take-off and approach).		
17.h	Malfunctions (inserting and removing).		

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
17.i	Simulator power switches and emergency stops		
17.j	Sound controls On/ Off / Adjustment		
17.k	Motion / Control loading system		
17.l	Observer seats / Stations. Position / Adjustment / Positive restraint system.		
17.m	Locks and freezes.		
17.n	Aeroplane systems status.		
17.o	Ground crew functions (e.g. Ext. power, air, pushback)		
17.p	UPRT (UPRT instructor feedback mechanism as described in CS FSTD(A).UPRT.030 and GM1 to CS FSTD(A).UPRT.030.		
17.p.1	FSTD validation envelope.		
17.p.2	Flight control inputs.		
17.p.3	Aeroplane operational limits.		
17.p.4	Where applicable, activation of dynamic upset scenarios.		
17.p.5	Where applicable, operation of the recording mechanism.		

NOTES:

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

GM1 CS FSTD(A).FST.105 Table of functionand subjective tests

GUIDANCE FOR FUNCTION AND SUBJECTIVE TESTS

(a) General

Table 1 below shows a partially completed example of the type of information that would be practical, in this case for a high-level FSTD. It is not the intention to fully record or duplicate all the acceptance testing carried out but rather to summarise it from a training functional and subjective perspective.

The guidance below is just one example of how this could be achieved. It is up to the operator to determine the level of detail appropriate to the proposed FCS for review with the competent authority during the initial evaluation.

(b) Applicability

The 'Applicability' column should record whether a test is applicable or not for the FCS concerned. This will obviously vary depending on the type/level/FCS of the FSTD (type-specific, non-type-specific, etc.). Other information considered useful in this column, where it adds value in the appropriate F&S item, might include:

(1) ATA chapter malfunctions assessed,

(2) visual scenes assessed,

(3) specific PBN approaches conducted,

(4) low-visibility taxi routes assessed,

(5) low-visibility ops minima, etc.

This will also assist the operator in completing the relevant sections of the ESL.

(c) Result

The ‘Result’ column should indicate whether a test has been assessed satisfactorily or otherwise. Where a result has been declared unsatisfactory, it may be useful to annotate a reference to any relevant declared discrepancy for transparency.

Table 1: Example of partially completed F&S test list

Number	TABLE OF FUNCTION AND SUBJECTIVE TESTS	APPLICABILITY	RESULT
1	**PREPARATION FOR FLIGHT**		
1.a	**Pre-flight** Accomplish a functions check of all switches, indicators, systems, and equipment at all crew members' and instructors' stations and determine that:		
1.a.1	The flight deck design and functions are identical to those of the aeroplane simulated.	✓ B737-800W	**SAT ~~/ UNSAT~~**
1.a.2	The flight deck design and functions represent those of the simulated class of aeroplane.	N/A	N/A
1.a.3	The flight deck design and functions are aeroplane-like and generic but recognisable as within a class of aeroplane.	N/A	N/A
2	**SURFACE OPERATIONS (PRE-FLIGHT)**		
2.a	**Engine start**		
2.a.1	Normal start	✓	**SAT / ~~UNSAT~~**
2.a.2	Alternate start procedures	✓ Manual start Ext air, APU, X-Bleed	**SAT ~~/ UNSAT~~**
2.a.3	Abnormal starts and shutdowns (hot start, hung start, tail pipe fire, etc.)	✓ Hot/Hung start	**SAT ~~/ UNSAT~~**
2.b	**Taxi**		
2.b.1	Pushback/powerback	✓ Powerback is n/a	**SAT ~~/ UNSAT~~**
2.b.2	Thrust response	✓	**SAT ~~/ UNSAT~~**
2.b.3	Power lever friction	✓	**~~SAT~~ / UNSAT** **DR106**
2.b.4	Ground handling	✓	**SAT ~~/ UNSAT~~**
……	……	…..	…..
6	**DESCENT**		
6.a	Normal rate	✓	**SAT ~~/ UNSAT~~**
6.b	Maximum rate/emergency (clean and with speedbrake,etc.)	✓	**SAT ~~/ UNSAT~~**
6.c	With autopilot	✓	**SAT ~~/ UNSAT~~**
……	……	…..	…..
7	**INSTRUMENT APPROACHES OPERATIONS**		
7.a	3D operations on precision approach procedures:-		
7.a.1.a	Manual approach with/without flight director including landing	✓ EGCC 05R	**SAT ~~/ UNSAT~~**
7.a.1.b	Autopilot/autothrottle coupled approach and manual landing	✓ EGKK26L	**SAT ~~/ UNSAT~~**
……	……	…..	…..

GM2 CS FSTD(A).FST.105 Table of function and subjective tests

GUIDANCE FOR SIMULATOR FUNCTIONS

General

(a) The training industry has developed guidelines which define the simulator functions that are deemed to be required to allow FSTD training equipment to be used efficiently in a training environment while avoiding training interruptions requiring complicated resets or workarounds for typical simulation features such as freezes, repositioning, snapshot recall, flight plan loading, etc.). These capabilities can be divided into six functional categories:

(1) Simulation control (e.g. flight freeze, fuel freeze, position freeze)

(2) Scenario set-up (e.g. weight change, reposition, environment, internal system status reset)

(3) Optimisation (e.g. speed times N, snapshot)

(4) Maintenance set-up (e.g. fault memory upload, fault memory clear)

(5) Integrated architecture functions (e.g. embedded control panels)

(6) Other functions (e.g. head-up displays, flight management data export)

(b) ARINC document entitled 'Guidance for Design of Aircraft Equipment and Software For Use In Training Devices, ARINC Report 610', as amended, provides industry best practices and guidance to support compliance with CS FSTD(A) as appropriate to the qualification level sought.

(c) The FSTD functionality to enable integration of the applicable simulator functions described above should consist of software/hardware avionics and equipment taking into consideration the following:

(1) The equipment naturally handles ARINC 610 functions as part of its normal operation.

(2) The equipment can be made to handle ARINC 610 functions with training device changes per equipment supplier's guidance.

(3) The equipment handles ARINC 610 functions through the use of embedded ARINC 610-specific code or hardware.

SUBPART E – UPSET PREVENTION AND RECOVERY TRAINING (UPRT)

CS FSTD(A).UPRT.001 Upset, stall (including in icing conditions)

This CS provides standards for the qualification for upset and stall simulation (including in icing conditions).

(a) FSTD general requirements for feature fidelity levels — table of CS FSTD(A).QB.110

(1) 13. Miscellaneous, (§ 13.2.2.S):

(i) a suitably qualified pilot should:

(A) hold a type rating qualification for the aeroplane being simulated; and

(B) be familiar with the upset scenarios and associated recovery methods as well as the cues necessary to accomplish the required training objectives;

(ii) the SoC should also confirm that for each upset scenario, the recovery manoeuvre can be performed such that the FSTD does not exceed the FSTD training envelope, or when the envelope is exceeded, that the FSTD is within the realms of confidence in the simulation accuracy;

(iii) the unrealistic degradation of the FSTD functionality (such as degrading flight control effectiveness) to drive an aeroplane upset is not acceptable unless used purely as a tool for repositioning the FSTD with the pilot out of the loop; and

(iv) consideration should be given to flight-envelope-protected aeroplanes as artificially positioning the aeroplane to a specified attitude may incorrectly initialise flight control laws.

(2) 2. Flight model (aero and engine), 2.1.S.b:

(i) the FSTD should be evaluated for specific upset recovery manoeuvres; a minimum set of manoeuvres:

(A) a nose-high wings level aeroplane upset;

(B) a nose-low aeroplane upset; and

(C) a high bank angle aeroplane upset;

(ii) other upset recovery scenarios, as developed by the organisation operating FSTDs, should be evaluated in the same manner; and

(iii) these evaluations should be made available to the instructor/evaluator.

(3) 2. Flight model (aero and engine), 2.1.S.g :

(i) for continuity purposes, the model should remain useable beyond the FSTD training envelope to the extent that it allowa completion of the recovery training; and

(ii) where known limitations exist in the aerodynamic model for particular stall event manoeuvres (such as aeroplane configuration, approach-to-stall entry methods, and limited range for continuity of the modelling), these limitations should be declared in the required SoC.

(4) 2. Flight model (Aero and engine), 2.1.S.f:

(i) the aerodynamic stall modelling should include degradation of the static/dynamic lateral directional stability;

(ii) degradation in control response (pitch, roll, and yaw);

(iii) uncommanded roll response or roll-off requiring significant control deflection to counter;

(iv) apparent randomness or non-repeatability;

(v) changes in pitch stability;

(vi) Mach effects; and

(vii) stall buffet,

as appropriate to the aeroplane type;

(viii) the model should be capable of capturing the variations seen in the stall characteristics of the aeroplane (e.g. the presence or absence of a pitch break, deterrent buffet, or other indications of a stall where present on the aeroplane);

(ix) where known limitations exist in the aerodynamic model for particular stall manoeuvres (such as aeroplane configuration and stall-entry methods), these limitations must be declared in the required SoC;

(x) specific guidance should be available to the instructor which clearly communicates the flight configurations and stall manoeuvres that have been evaluated in the FSTD for use in training; and

(xi) FSTDs that are to be qualified for full-stall training tasks must also meet the IOS provisions for upset prevention and recovery training (UPRT) tasks as described under 13.2.1.S of the FSTD standards table.

(b) FSTD validation tests

(1) Stall characteristics test:

(i) Control inputs must be plotted and demonstrate correct trend and magnitude.

(ii) Each of the following stall entries must be demonstrated in at least one of the three flight conditions (please refer to the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105, Test, 2.c.8(a)):

(A) stall entry at wings level (1g);

(B) stall entry in turning flight of at least 25° bank angle (accelerated stall); and

(C) stall entry in a power-on condition (required only for propeller-driven aeroplanes).

(iii) The cruise flight condition must be conducted in a flaps-up (clean) configuration. The second-segment climb flight condition must use a different flap setting from that for the approach or landing flight condition.

(iv) The stall warning signal and initial buffet, if applicable, must be recorded. Time-history data must be recorded for a full stall through recovery to normal flight. The stall warning signal must occur in the proper relation to buffet/stall. FSTDs of aeroplanes exhibiting a sudden pitch attitude change or 'g break' must demonstrate this characteristic. FSTDs of aeroplanes exhibiting a roll-off or loss-of-roll control authority must demonstrate this characteristic.

(v) Numerical tolerances are not applicable past the stall angle of attack but must demonstrate correct trend through recovery. Please refer to CS FSTD(A).UPRT.005 for additional information concerning data sources and required angle of attack ranges.

(vi) For aeroplanes with stall envelope protection systems, the normal-mode testing is only required at an angle of attack range necessary to demonstrate the correct operation of the system. These tests may be used to satisfy the required (angle of attack) flight manoeuvre and envelope protection tests of CS FSTD(A). Non-normal control states must be tested through stall identification and recovery.

(vii) In instances where flight test validation data is limited due to safety-of-flight considerations, engineering simulator validation data may be used in lieu of flight test validation data for angles of attack that exceed the activation of a stall protection system or stick pusher system.

(viii) Where approved engineering simulation validation is used, the reduced engineering tolerances (as defined in CS FSTD(A).QTG.300(b)) do not apply.

(ix) Buffet threshold of perception should be based on 0.03 g peak to peak normal acceleration above the background noise at the pilot seat. Initial buffet to be based on normal acceleration at the pilot seat with a larger peak to peak value relative to buffet threshold of perception (some airframe manufacturers have used 0.1 g peak to peak). Demonstrate correct trend in growth of buffet amplitude from initial buffet to stall speed for normal and lateral acceleration.

(x) The maximum buffet may be limited based on motion platform capability/limitations or other simulator system limitations. If the maximum buffet is limited, the limit should be sufficient to allow proper use in training (e.g. not less than 0.5 g peak to peak), and in any case the instructor should be informed of the limitations.

(xi) Tests may be conducted at CoG and weights typically required for aeroplane certification stall testing.

(xii) This test is only for FSTDs that are to be qualified to conduct full-stall training tasks.

(2) Approach-to-stall characteristics test:

(i) Control displacements and flight control surfaces must be plotted and demonstrate correct trend and magnitude.

(ii) Each of the following stall entries must be demonstrated in at least one of the three flight conditions (please refer to the table of FSTD validation tests versus feature fidelity levels in CS FSTD(A).QTG.105, 2.c.8(b)):

(A) approach-to-stall entry at wings level (1g);

(B) approach-to-stall entry in turning flight of at least 25° bank angle (accelerated stall); and

(C) approach-to-stall entry in a power-on condition (required only for propeller-driven aeroplanes).

(iii) The cruise flight condition must be conducted in a flaps-up (clean) configuration. The second-segment climb flight condition must use a different flap setting from that for the approach or landing flight condition.

(iv) For computer-controlled aeroplanes (CCAs) with stall envelope protection systems, the normal-mode testing is only required at an angle of attack range necessary to demonstrate the correct operation of the system. These tests may be used to satisfy the required (angle of attack) flight manoeuvre and envelope protection tests of CS FSTD(A).QTG.105 (2)(h).

(3) Engine and airframe icing effects demonstration (high angle of attack):

(i) Time history of a full stall and of the initiation of the recovery: tests are intended to demonstrate representative aerodynamic effects caused by in-flight ice accretion. Flight test validation data is not required.

(ii) Two tests are required to demonstrate engine and airframe icing effects. One test demonstrates the FSTDs baseline performance without ice accretion, and the second test demonstrates the aerodynamic effects of ice accretion relative to the baseline test.

(iii) The test must utilise the icing model(s) as described in the SoC required in CS FSTD(A).QB.110 2.1.S.e. The test must include a rationale that describes the icing effects being demonstrated. Icing effects may include, but are not limited to, the following effects, as applicable to the particular aeroplane type:

(A) decrease in the stall angle of attack;

(B) changes in the pitching moment;

(C) decrease in control effectiveness;

(D) changes in control forces;

(E) increase in drag;

(F) change in stall buffet characteristics and threshold of perception; and

(G) engine effects (power reduction/variation, vibration, etc. where expected to be present on the aeroplane in the ice accretion scenario being tested).

(iv) Tests are evaluated for representative effects on relevant aerodynamic and other parameters, such as angle of attack, control inputs, and thrust/power settings.

Recorded parameters (in the validation test result) should include the following:

(A) altitude;

(B) airspeed;

(C) normal acceleration;

(D) engine power;

(E) angle of attack;

(F) pitch attitude;

(G) bank angle;

(H) flight control inputs; and

(I) stall warning and stall buffet onset.

CS FSTD(A).UPRT.005 High angle of attack/stall model

(a) This CS applies to all FSTDs that are used to satisfy training provisions for stall manoeuvres conducted at angles of attack beyond the activation of the stall warning system. This CS is not applicable to FSTDs that are only qualified for approach-to-stall manoeuvres where recovery is initiated at the first indication of the stall. This CS supplements the following:

(1) CS FSTD(A).QB.110 'FSTD general requirements for feature fidelity levels ';

(2) CS FSTD(A).QTG.105 'Table of FSTD validation tests versus feature fidelity levels'; and

(3) CS FSTD(A).FST.105'Table of function and subjective tests'.

(b) General provisions

The provisions for high angle of attack modelling should be applied to evaluate the recognition cues as well as performance and handling qualities of a developing stall through the stall identification angle of attack and stall recovery. Strict time-history-based evaluations against flight test data may not adequately validate the aerodynamic model in an unsteady and potentially unstable flight regime, such as stalled flight. As a result, the objective testing provisions of CS

FSTD(A).QTG.105 do not contain strict tolerances for any parameter at angles of attack beyond the stall identification angle of attack. In lieu of mandating such objective tolerances, an SoC should define the source data and methods used to develop the aerodynamic stall model.

(c) Fidelity provisions

The provisions for the evaluation of full-stall training manoeuvres should provide the following levels of fidelity:

(1) aeroplane-type-specific recognition cues of the first indication of the stall (such as the stall warning system or aerodynamic stall buffet);

(2) aeroplane-type-specific recognition cues of an impending aerodynamic stall; and

(3) recognition cues and handling qualities from stall break through recovery which are sufficiently characteristic of the aeroplane being simulated to allow successful completion of the stall recovery training tasks.

For the purposes of stall manoeuvre evaluation, the term 'representative' is defined as a level of fidelity that is type-specific for the simulated aeroplane to the extent that the training objectives can be satisfactorily accomplished. Therefore, the term 'representative' in this AMC is specifically limited to the characteristics of the aerodynamic model in the post-stall region. The description of this term is given to explain the intent of the model rather than to define the meaning of the term 'representative modelling' which may be described in other simulator definitions.

(d) SoC (aerodynamic model)

At a minimum, the following must be addressed in the SoC:

(1) Source data and modelling methods

The SoC must identify the sources of data used to develop the aerodynamic model. These data sources may be from the aeroplane original equipment manufacturer (OEM), the original FSTD manufacturer/data provider, or other data providers acceptable to the competent authority. Of particular interest is a mapping of test points in the form of an alpha/beta envelope plot for a minimum of flaps-up and flaps-down aeroplane configurations. For the flight test data, a list of the types of manoeuvres used to define the aerodynamic model for angle of attack ranges greater than the first indication of stall must be provided per flap setting. Flight test reports, when available, describing stall characteristics of the aeroplane type being modelled, issued by the OEM or flight test pilot, can be referred to. In cases where it is impractical to develop and validate a stall model with flight-test data (e.g. due to safety concerns involving the collection of flight test data past a certain angle of attack), the data provider is expected to make a reasonable attempt to develop a stall model through the required angle of attack range using analytical methods and empirical data (e.g. wind-tunnel data).

(2) Validity range

The organisation operating FSTDs should declare the range of angle of attack and sideslip where the aerodynamic model remains valid for training. Satisfactory aerodynamic model fidelity must be shown through stall recovery training tasks. For the purposes of determining this validity range, the stall identification angle of attack is defined as the angle of attack where the pilot is given a clear and distinctive indication to cease any further increase in the angle of attack where one or more of the following characteristics occur:

(i) no further increase in pitch occurs when the pitch control is held at the full aft stop for 2 seconds, leading to an inability to arrest the descent rate;

(ii) an uncommanded nose-down pitch that cannot be readily arrested, which may be accompanied by an uncommanded rolling motion;

(iii) buffeting of a magnitude and severity that is a strong and effective deterrent to a further increase in the angle of attack;

(iv) activation of a stick pusher.

For the validity range, the modelling continuity should allow for an angle of attack range that is adequate to allow for the completion of stall recovery; for pusher-equipped aeroplanes, this should be adequate to capture any inappropriate action during the recovery procedure.

For aeroplanes equipped with a stall envelope protection system, the model should allow training with the protection systems disabled or otherwise degraded (such as a degraded flight control mode as a result of a pitot/static system failure).

(3) Model characteristics

Within the declared model validity range, the SoC must address, and the aerodynamic model must incorporate, the following stall characteristics, where applicable by aeroplane type:

(i) degradation of the static/dynamic lateral-directional stability;

(ii) degradation in control response (pitch, roll, and yaw);

(iii) uncommanded roll acceleration or roll-off requiring significant control deflection to counter;

(iv) apparent randomness or non-repeatability;

(v) changes in pitch stability;

(vi) stall hysteresis;

(vii) Mach effects;

(viii) stall buffet; and

(ix) angle of attack rate effects.

An overview of the methodology used to address these features must be provided.

(e) SoC (subject matter expert (SME) pilot's evaluation)

The operator must provide an SOC confirming that the simulation stall model has been subjectively evaluated by an SME pilot knowledgeable of the aeroplane's stall characteristics (please refer to (d)(1) above).

The operator is also required to provide an SoC to state that the simulation stall model, as defined above, has been implemented and verifies that the aerodynamic stall training tasks can be accomplished on the FSTD.

The purpose is to ensure that the stall model has been sufficiently evaluated using those general aeroplane configurations and stall-entry methods that will likely be conducted in training.

In order to qualify as an acceptable SME to evaluate the stall model characteristics, the SME must meet the following criteria:

(1) has held or currently holds a type rating/qualification in the aeroplane being simulated;

(2) has direct experience in conducting stall manoeuvres in an aeroplane that shares the same type rating as the make, model, and series of the simulated aeroplane; this stall experience must include hands-on manipulation of the controls at angles of attack sufficient to identify the stall (e.g. deterrent buffet, stick pusher activation, etc.) through recovery to stable flight;

(3) where the SME's stall experience is in an aeroplane of a different make, model, and series within the same type rating, differences in aeroplane-specific stall recognition cues and handling characteristics must be addressed using available documentation; this documentation may include aeroplane operating manuals (OMs), aeroplane manufacturer flight test reports, or other documentation that describes the stall characteristics of the aeroplane; and

(4) be familiar with the intended stall training manoeuvres to be conducted in the FSTD (e.g. general aeroplane configurations, stall-entry methods, etc.) and the cues necessary to accomplish the required training objectives.

This SoC will only be required at the time the FSTD is initially qualified for stall training tasks as long as the FSTD's stall model remains unmodified compared to what was originally evaluated and qualified. Where an FSTD shares common aerodynamic and flight control models with those of an engineering or development simulator, the competent authority will accept an SoC from the aeroplane manufacturer or data provider confirming that the stall characteristics have been subjectively assessed by an SME pilot on the engineering/development simulator (please refer to CS FSTD(A).GEN.005 Terminology and CS FSTD(A).QTG.120(b) for the description of an engineering simulator).

In the context of this Subpart, a 'Development simulator' means a data provider's simulator, which serves as a platform for the development of alternative engineering simulation data and models. This could be based on a specific aeroplane or a representation of its of type. It would typically operate in real time and if necessary, can be flown by a pilot to subjectively evaluate the simulation.

An organisation operating FSTDs may submit a request to the competent authority for approval of a deviation from the SME pilot's experience provisions under this paragraph. This request for deviation must include the following information:

(1) an assessment of pilot availability demonstrating that an SME pilot, meeting the experience described in CS FSTD(A).UPRT.005(e), is not available; and

(2) alternative methods to subjectively evaluate the FSTD's capability to provide the stall recognition cues and handling characteristics needed to accomplish the training objectives.

(f) SoC (subjective tests)

Test provisions

The necessity of subjective tests arises from the need to confirm that the simulation model has been integrated correctly and performs as declared under (d) above. It is vital to examine, for example, that the simulation validity range allows modelling continuity that is adequate to allow for the completion of stall recovery.

Considerations on aeroplane certification flight test provisions

In aeroplane certification flight tests, there is no provision to go beyond the maximum coefficient of lift (CL max), and the aeroplane is not to be held indefinitely in a full stall condition, so this provision should be applied in the same way during the simulator's subjective evaluation.

The subjective tests of the simulation model should assess modelling continuity when slightly increasing the angle of attack beyond the validity range CL max defined in subparagraph (d)(2) of this CS.

The increase in angle of attack beyond the validity range CL max should be limited to a value not greater than the maximum angle achieved 2 seconds after stall recognition, which is sufficient to allow a proper recovery manoeuvre.

Stall recognition is defined as follows:

(1) no further increase in pitch occurs when the pitch control is held at the full aft stop for 2 seconds, leading to an inability to arrest the descent rate;

(2) an uncommanded nose-down pitch that cannot be readily arrested, which may be accompanied by an uncommanded rolling motion;

(3) buffeting of a magnitude and severity that is a strong and effective deterrent to a further increase in the angle of attack; and

(4) activation of a stick pusher.

Where known limitations exist in the aerodynamic model for particular stall event manoeuvres (such as aeroplane configuration, approach-to-stall entry methods, and limited range for continuity of the modelling), these limitations must be declared in the required SoC.

CS FSTD(A).UPRT.020 High angle of attack/stall model — Evaluation and approach to stall for previously qualified FSTDs

This CS defines the procedures for previously qualified FSTDs.

For FSTDs that are already qualified against standards prior to CS-FSTD(A) Issue 2, it may not always be possible to provide the required validation data for the new or revised objective test cases to support FSTD qualification for stall and approach to stall. These validation tests have the following characteristics:

(a) Objective testing for stall characteristics (please refer to the table of FSTD validation tests versus feature fidelity levels, 2.c.8a) and for approach to stall characteristics (please refer to the table of FSTD validation tests versus feature fidelity levels, 2.c.8b) are only required for the (wings level) second-segment climb and approach or landing flight conditions.

(b) For the testing of the high-altitude cruise and turning-flight stall and approach to stall conditions, these manoeuvres may be subjectively evaluated by a qualified SME pilot (please refer to CS FSTD(A).UPRT.005(e)) and addressed in the required SoC; these tests should utilise the footprint method to document the SME evaluation and this should be included in the approved master qualification test guide (MQTG). To allow for any randomisation during recurrent testing, one should apply engineering judgement to ensure that the key characteristics of the original SME assessment are maintained.

(c) Where existing flight test validation data in the FSTD's MQTG is missing required parameters, or is otherwise unsuitable to fully meet the objective testing provisions, the competent authority may accept alternative sources of validation, including subjective validation by an SME pilot with direct experience in the stall characteristics of the aeroplane (please refer to CS FSTD(A).UPRT.005(e)).

(d) Objective testing for characteristic motion vibrations (please refer to the table of FSTD validation tests versus feature fidelity levels, 3.f.(5)) is not required where the FSTD's stall buffets have been subjectively evaluated by an SME pilot. For previously qualified Level D FFSs that currently have objective approach-to-stall buffet tests in their approved MQTG, the results of these existing tests must be provided to the competent authority with the updated stall and stall buffet models in place.

(e) As described in CS FSTD(A).UPRT.005, the competent authority may accept an SoC from the data provider, confirming that the stall characteristics have been subjectively evaluated by an SME pilot on an engineering simulator or development simulator that is acceptable to the competent authority. Where this evaluation takes place on an engineering or development simulator, additional objective 'proof-of-match' testing for all flight conditions, as described in Tests 2.c.(8a) and 3.f.(5)), is required to verify the implementation of the stall model and stall buffets on the FSTD.

(f) Objective demonstration tests of engine and airframe icing effects (CS FSTD(A).QTG.105, FSTD Validation Tests, test 2.i) are not required for previously qualified FSTDs.

CS FSTD(A).UPRT.030 UPRT standards for the FSTD standards table

This CS provides UPRT standards to be applied to the FSTD standards table.

(a) Background

(1) This CS provides further details on CS FSTD(A).QB.110, namely on the following:

(i) 13.2.1.S (IOS tools);

(ii) 13.2.2.S (upset scenarios); and

(iii) 2.1.S.b (aerodynamics); and

(iv) 8.1. (Motion)

(2) This CS applies to all FTSDs that are used to satisfy training provisions for UPRT manoeuvres. For the purposes of this CS, an aeroplane upset is an undesired aeroplane state characterised by unintentional deviations from parameters experienced during normal operations. An aeroplane upset may involve pitch or bank angle deviations as well as inappropriate airspeeds for the given conditions.

(3) It also applies to FSTDs that are used to conduct training manoeuvres where the FSTD is repositioned either into an aeroplane upset condition or an artificial stimulus (such as weather phenomena or system failures) that is intended to result in a flight crew entering an aeroplane upset condition, must be evaluated and qualified.

(b) FSTD standards provisions

(1) The provisions of CS FSTD(A).QTG.300 define three basic elements that are required for qualifying an FSTD for UPRT manoeuvres:

(i) FSTD training envelope: see definition in CS FSTD(A).GEN.005 Terminology;

(ii) instructor feedback: provides the instructor/evaluator with a minimum set of feedback tools to properly evaluate the trainee's performance in accomplishing a UPRT task; and

(iii) upset scenarios: where dynamic upset scenarios or aeroplane system malfunctions are used to drive the FSTD into an aeroplane upset condition, specific guidance must be available to the instructor, e.g. on the IOS or manual, which describes how the upset scenario is driven along with any malfunction or degradation in FSTD functionality required to stimulate the upset.

(2) FSTD validation envelope

This envelope is defined by the following three subdivisions.

(i) Flight-test-validated region

This is the region of the flight envelope which has been validated with flight test data, typically by comparing the performance of the FSTD against the flight test data through tests incorporated in the QTG and other flight test data utilised to further extend the model beyond the minimum provisions. Within this region, there is high confidence that the FSTD responds similarly to the aeroplane. Please note that this region is not strictly limited to what has been tested in the QTG; as long as the aerodynamics mathematical model has been conformed to the flight test results, that portion of the mathematical model is considered to be within the flight-test-validated region.

(ii) Wind tunnel or analytical region

This is the region of the flight envelope for which there has been wind tunnel testing or the use of other reliable predictive methods (typically by the aeroplane manufacturer) to define the aerodynamic model. Any extensions to the aerodynamic model which have been evaluated in accordance with the definition of a representative stall model (as described in CS FSTD(A).UPRT.005) must be clearly indicated. Within this region, there is moderate confidence that the FSTD will respond in a similar way as the aeroplane.

(iii) Extrapolated region

This is the region extrapolated beyond the flight-test-validated and wind-tunnel/analytical regions. The extrapolation may be a linear one, a holding of the last value before the extrapolation began, or some other set of values. Whether this extrapolated data is provided by the aeroplane or FSTD manufacturer, it is a 'best estimation' only. Within this region, there is low confidence that the FSTD will respond in a similar way as the aeroplane.

(c) IOS feedback mechanism

(1) For the instructor/evaluator to provide feedback to the student during the upset prevention and recovery manoeuvre training, additional information must be accessible which indicates the fidelity of the simulation, the magnitude of the trainee's flight control inputs, as well as the aeroplane operational limits that could potentially affect the successful completion of the manoeuvre(s). At a minimum, the following must be available to the instructor/evaluator:

(i) FSTD validation envelope

The FSTD must employ a method to display the FSTD's expected fidelity with respect to the FSTD validation envelope. This may be displayed as an angle of attack versus sideslip (alpha/beta) envelope cross-plot on the IOS or other alternative method to clearly convey the FSTD's fidelity level during the manoeuvre. The cross-plot or other alternative method must display the relevant validity regions for flaps-up and flaps-down at a minimum. This validation envelope must be derived by the aerodynamic data provider or using information and data sources provided by the aerodynamic data provider.

(ii) Flight control inputs

The FSTD must employ a method for the instructor/evaluator to assess the trainee's flight control inputs during the upset recovery manoeuvre. Additional parameters, such as cockpit control forces (forces applied by the pilot to the controls) and the flight control law mode for fly-by-wire aeroplanes, must be portrayed in this feedback mechanism as well. For passive side-sticks, whose displacement is the flight control input, the force applied by the pilot to the controls does not need to be displayed. This tool must include a time history or other equivalent method of recording flight control positions.

(iii) Aeroplane operational limits

The FSTD must employ a method to provide the instructor/evaluator with real-time information concerning the aeroplane operational limits. The simulated aeroplane's parameters must be displayed dynamically in real time and provided in a time-history or equivalent format. At a minimum, the following parameters must be available to the instructor/evaluator:

(A) airspeed and airspeed limits, including the stall speed and maximum operating limit airspeed (VMO)/maximum operating Mach (MMO);

(B) load factor and operational load factor limits; and

(C) angle of attack and stall identification angle of attack (please refer to CS FSTD(A).UPRT.005(d)(2) for additional information on the definition of the stall identification angle of attack); this parameter may be displayed in conjunction with the FSTD validation envelope.

(2) Optionally, a recorded feedback mechanism is available to the instructor/evaluator.

GM1 CS FSTD(A).UPRT.030 UPRT standards for the FSTD standards table

(a) Introduction

The FSTD should be provided with information pertaining to the aeroplane's parameters as described in CS FSTD(A).UPRT.030. This CS details some of the performance provisions for these features.

The objective of the IOS feedback during UPRT exercises is to provide the instructor with the ability to assess the timely and proper control action, including sequence, to complete the recovery in a safe manner.

(b) Background

IOS feedback, which may also be via a separate mobile device, is used to monitor and debrief the crew regarding UPRT exercises in order to verify that proper control activity was executed. The instructor should have the necessary information to clearly establish whether the recovery was completed within the FSTD training envelope (please refer to CS FSTD(A).UPRT.030), and take any necessary action to complete the training.

The FSTD should include tools for the instructor to be able to immediately debrief the pilot(s) after the training event. All data recorded for the use in the UPRT debrief should be easily permanently deleted after the UPRT training event.

(c) IOS parameters

The tool should normally display the following:

(1) Pilot-induced control inputs, including:

(i) pitch,

(ii) roll,

(iii) rudder pedal,

(iv) throttles,

(v) flaps, and

(vi) speed brake/spoilers.

Time history of control inputs, including cockpit control forces and flight control law (fly-by-wire aeroplanes), as applicable.

In order to ascertain that the control inputs are applied in a correct, timely and smooth manner, the display should indicate these at a sampling frequency rate that is sufficiently high to prevent from missing possible abrupt pilot action. This may be limited to the debrief mode following the execution of the exercise or individual manoeuvre.

(2) Display of the primary flight parameters; if applicable, display a pseudo primary flight display (PFD); if a pseudo PFD is displayed, then the parameters should be the same as the ones displayed on the aeroplane PFD, including:

(i) pitch attitude,

(ii) roll attitude,

(iii) turn/sideslip,

(iv) indicated airspeed,

(v) stall warning speed/stall buffet speed,

(vi) VMO/MMO,

(vii) altitude,

(viii) rate of climb,

(ix) autopilot status, and

(x) auto-throttle status.

(3) Angle of attack.

(4) Angle of sideslip.

(5) G-loading.

The limitations of (3), (4), and (5) should also be indicated, as follows:

One method is the simultaneous depiction of the angle of attack versus angle of sideslip and the corresponding FSTD validation envelope.

A presentation of the G-loading as function of the current airspeed and flight configuration.

The V-n diagram indicates the limitations of the aeroplane under given conditions. It displays the flight envelope as function of the airspeed versus G-loading. It shows the lower airspeed limits by means of a parabolic line. The intersection of this line with the 1.0 g horizontal line corresponds to the stall speed at 1 g. The regions above the 2.5 g upper limit (maximum design limit) to the right of VNE and below the – 1.0 g lower limit are the structural exceedance limits and should be avoided. The shape of the V-n diagram depends on the aeroplane itself, its configuration, as well as the environmental and flight conditions.

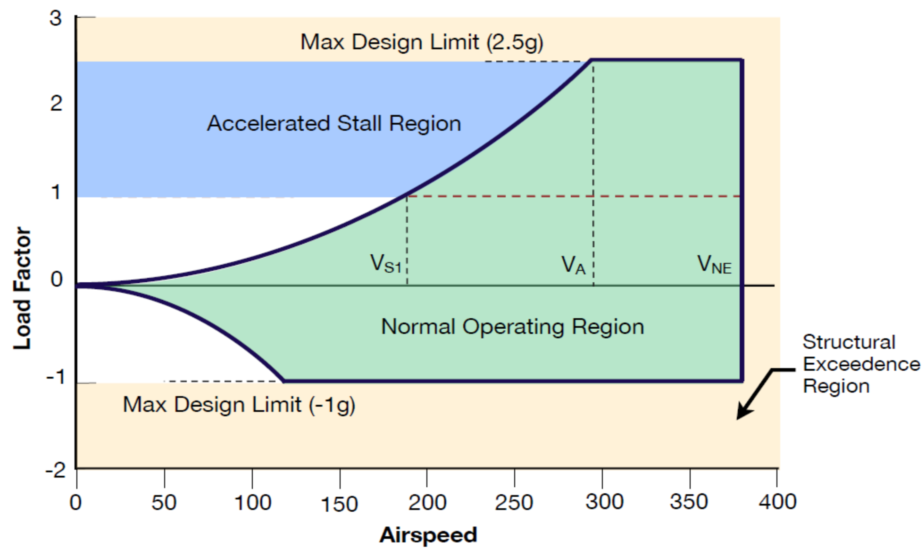


Figure 1: V-n diagram (example)

Legend to Figure 1:

V_{S1} = clean stall speed at 1 g

V_A = design manoeuvre speed

V_{NE} = never-exceed speed

CS FSTD(A).UPRT.040 Engine and airframe icing evaluation provisions

This CS defines requirements for engine and airframe icing evaluation.

(a) Applicability

This CS applies to all FSTDs that are used to satisfy training provisions for engine and airframe icing. New general provisions as well as objective provisions for FSTD qualification have been developed in order to define aeroplane-specific icing models that support training objectives for the recognition of, and recovery from, an in-flight ice accretion event.

(b) General provisions

The following elements should be considered when developing the qualified ice accretion models for use in FSTD training:

(1) icing models must be able to train the specific skills required for the recognition of ice accumulation and for generating the required response;

(2) icing models must contain aeroplane-specific recognition cues as determined through data supplied by an aeroplane original equipment manufacturer (OEM) or through other suitable analytical methods; and

(3) at least one qualified icing model must be objectively tested to demonstrate that it has been implemented correctly and that it generates the correct cues as necessary for training.

(c) Statement of compliance (SoC)

The SoC described in CS FSTD(A).QB.110 (2.1.S.e) must contain the following information to support FSTD qualification of aeroplane-specific icing models:

(1) A description of expected aeroplane-specific recognition cues and degradation effects due to a typical in-flight icing encounter.

Typical cues may include loss of lift, decrease in stall angle of attack, changes in pitching moment, decrease in control effectiveness, and changes in control forces in addition to any overall increase in drag. This description must be based on relevant data sources, such as aeroplane OEM-supplied data, accident/incident data, or other acceptable data sources. Where a particular airframe has demonstrated vulnerabilities to a specific type of ice accretion (due to accident/incident history), which requires specific training (such as supercooled large-droplet icing or tailplane icing), ice accretion models must be developed that address those training provisions.

(2) A description of the data sources used to develop the qualified ice accretion models. Acceptable data sources may be but are not limited to flight test data, aeroplane certification data, aeroplane OEM engineering simulation data, or other analytical methods based on established engineering principles.

(d) Objective demonstration testing

The purpose of the objective demonstration test is to demonstrate that the ice accretion models, as described in the SoC, have been correctly implemented and demonstrate the proper cues and effects, as defined in the validation data sources. At least one ice accretion model must be selected for testing and included in the MQTG. Two tests are required to demonstrate engine and airframe icing effects. One test demonstrates the FSTD's baseline performance without icing, and the second test demonstrates the aerodynamic effects of ice accretion relative to the baseline test.

(1) Recorded parameters: in each of the two required MQTG cases, a time-history recording of the following parameters should be made:

(i) altitude;

(ii) airspeed;

(iii) normal acceleration;

(iv) engine power/settings;

(v) angle of attack/pitch attitude;

(vi) bank angle;

(vii) pilot-induced flight control inputs;

(viii) stall warning and stall buffet onset; and

(ix) other parameters necessary to demonstrate the effects of ice accretion.

(2) Demonstration manoeuvre: the organisation operating FSTDs must select an ice accretion model, as identified in the SoC for testing. The selected manoeuvre must demonstrate the effects of ice accretion at high angles of attack from a trimmed condition through approach-to-stall and full stall (full stall is applicable only for those FSTDs that are to be qualified for full-stall training tasks), as compared to a baseline (no ice build-up) test. The ice accretion models must demonstrate the cues necessary to recognise the onset of ice accretion on the airframe, lifting surfaces, and engines, and provide a representative degradation in performance and handling qualities to the extent that a recovery can be executed. Typical recognition cues that may be present, depending on the simulated aeroplane, include:

(i) decrease in stall angle of attack;

(ii) increase in stall speed;

(iii) increase in stall buffet threshold of perception speed;

(iv) changes in pitching moment;

(v) changes in stall buffet characteristics;

(vi) changes in control effectiveness or control forces; and

(vii) engine effects (power variation, vibration, etc.).

The demonstration manoeuvre test may be conducted by initialising and maintaining a fixed amount of ice accretion throughout the manoeuvre in order to consistently evaluate the aerodynamic effects.

SUBPART F — MISCELLANEOUS

CS FSTD(A).MISC.010 Multi-configuration devices and their MQTG requirements

This CS defines the requirements for multi-configuration devices and their MQTG.

(a) An FSTD is defined by a single qualification certificate. Typical solutions are devices that can be configured by software or hardware changes to simulate different engine versions and variants, and avionics systems. However, FSTD platforms are sometime built to host multiple configurations of aeroplanes and need therefore be associated with more than one FSTD qualification certificate.

(b) Convertible FSTD platforms may have QTG tests that are applicable only for one FSTD configuration. The MQTG(s) should be appropriately arranged so that it is clear which tests are applicable for certain configurations amended by rationales and SoC where needed. An SoC should be presented in the MQTG to confirm which QTG tests are independent of the configuration and why.

GM1 CS FSTD(A).MISC.010 Multi-configuration devices and their MQTG requirements

The following general principles should be followed and are applicable to all FSTD qualification levels and FCS.

(a) Simulation software

(1) Every FSTD configuration is affected by the software architecture. Software is normally built as modules that comprise a software load. Convertible FSTD platforms may use different software modules or software loads for each FSTD configuration. The configuration control system should emphasise convertible FSTD platforms and their unique features.

(2) If the software changes between FSTD configurations are known to affect QTG tests (e.g. affect handling characteristics or transport delay, etc.), then separate QTG cases should be prepared for each FSTD configuration. The MQTG (see CS FSTD(A).QTG.005) should describe how the software loads and modules are structured for each FSTD configuration. This will indicate to the competent authority if separate QTGs are needed or not.

(b) Visual system

Visual QTG tests may be performed with only one configuration, except for those individual tests that are specific to each configuration such as visual ground segment, system geometry, and qualification airfield for each configuration if applicable (e.g. devices with interchangeable flight decks). An SoC should be given to indicate which tests are independent of configuration.

(c) Transport delay or latency QTG tests

Consideration should be given to transport delay or latency tests, since different configurations may use different software modules, software loads, hardware and avionics that may have an effect on the results. If this is not considered applicable by the applicant (e.g. because the software loads differ only so slightly that it does not affect transport delay), an SoC should be provided.

(d) Convertible avionics

(1) Typical examples of convertible avionics are different avionics suites, optional flight management and guidance computers (FMGC), selectable avionics options and different flight augmentation computer standards or versions. Any of these examples may affect QTG results.

(2) Different equipment (e.g. avionics) fit in one FSTD should not generally require separate qualification certificates (see Appendix IV to Annex VI (Part-ARA) to Regulation (EU) No 1178/2011 and Table 1). However, major differences in avionics may result in aeroplane variants which may require separate software loads and hence separate FSTD qualification certificates may be required.

(3) Convertible avionics should be segmented into those systems or components that can significantly affect the QTG results and those that cannot. This analysis should be done by the FSTD organisation supported by the aeroplane manufacturer, avionics manufacturer, data provider or FSTD manufacturer (or a combination of them) on a case-by-case basis as appropriate. (See CS FSTD(A).QTG.500, paragraph (c).)

(4) When a convertible avionics configuration can affect the QTG results, then additional QTG test cases should be included for all appropriate configurations.

(e) Alternate systems or equipment

(1) Typical examples of alternate systems or equipment are different brakes systems (e.g. steel and carbon brakes) and system configurations for aeroplane performance purposes (such as symmetric aileron deflection for take-off). These examples may affect QTG results.

(2) Appendix IV to Annex VI (Part-ARA) states that FSTD qualification certificates should present the simulated variant(s) and that different equipment fit on one FSTD should not require separate qualification certificates.

(3) When alternate systems or equipment affects the QTG results, additional QTG test cases should be included for all appropriate configurations.

(f) Alternate engines

(1) Typical examples of convertible engine set-ups are multiple simulated engine versions and different thrust ratings of the same aeroplane/engine combination. These will often affect QTGs.

(2) Different engine fit on one FSTD should not require separate qualification certificates (see Appendix IV to Annex VI (Part-ARA)).

(3) If an alternate engine is simulated, it should have additional QTG tests to validate the alternate configuration. The additional QTG tests should be included as an appendix or as a separate volume within the MQTG.

(4) CS FSTD(A).QTG.500 presents requirements for alternate engines and includes a table representing the list of QTG tests that are required related to validation of aerodynamic and engine models. In addition to those requirements, if any sound QTG test is affected by alternate engine fit, then additional QTG tests should be included for all appropriate tests and configurations. This is further presented in detail in CS FSTD(A).QTG.250(b).

- — CS FSTD(A).QTG.500 presents requirements on validation data as well as QTG tests.
- — Full QTG testing is expected for the baseline engine. Validation flight tests for the alternate engine are represented in Table 2 of CS FSTD(A).QTG.500.
- — CS FSTD(A).QTG.500 subparagraph (d)(3) adds that engineering validation data should be provided as appropriate for the alternate engine and that the entire QTG should be able to be run with the alternate engine configuration during recurrent testing

(5) Under certain cases (see CS FSTD(A).QTG.500), an alternate thrust rating does not require separate QTG tests. However, testing of such thrust rating should be included in the function and subjective tests.

(g) Example of configurations

Examples of possible configurations	**Qualification certificate (QC) required**
FSTD platform with following configurations: • Avionics Version A and Engine Model #1 • Avionics Version A and Engine Model #2 • Avionics Version B and Engine Model #1 • Avionics Version B and Engine Model #2	Avionic and engine versions are included in the same QC by default, so one QC covers all configurations. Nevertheless, if the differences between avionics versions are considered significant, then separate QCs for different avionics is required (and each QC lists all applicable engine models).

(h) Different aeroplane classes, types and variants

(1) For multi-configuration FSTD platforms, a change in the aeroplane type generally has a major effect on the QTGs while variants usually have a minor effect on the QTGs.

(2) Convertible FSTD platforms should have a separate qualification certificate for each aeroplane type (see Appendix IV to Annex VI (Part-ARA). Variants can often be included on one qualification certificate but based on their differences, separate FSTD qualification certificates may be justified. The competent authority considers this on a case-by-case basis.

(3) If another aeroplane type is simulated, it should have a complete and separate MQTG, except for those tests that are independent of the configuration.

(4) The visual ground segment test is usually not independent of the configuration, but is affected by factors such as airframe, window layout, cut-off angle, gear height, attitude, speed, etc.

(5) When a variant configuration can affect the QTG results, additional QTG test cases should be included for all appropriate configurations to validate the variant. The additional QTG tests should be included as an appendix to the MQTG.

(6) If a non-type-specific device simulates another aeroplane class, each configuration should have a complete and separate MQTG, except for those tests that are independent of the configuration.

(i) Devices with major interchangeable assemblies

(1) This subparagraph provides guidance regarding devices using major interchangeable assemblies, where noticeable hardware entities or modules are changed in order to change configuration. This can often affect QTG tests. Note: See other subparagraphs for minor hardware changes (e.g. change of individual cockpit panels).

(2) Devices with major interchangeable assemblies can use various architectures and methods. Not all possible set-ups can be considered in this guidance material due to their number. Details should be agreed with the competent authority well in advance before initial evaluation.

(3) Typical examples of devices with major interchangeable assemblies are the so-called roll-on/roll-off solutions where different flight decks can be inserted into different platforms. In addition, the roll-on/roll-off configurations could have further configurations for alternate engines, avionics, etc. See other subparagraphs regarding those configurations.

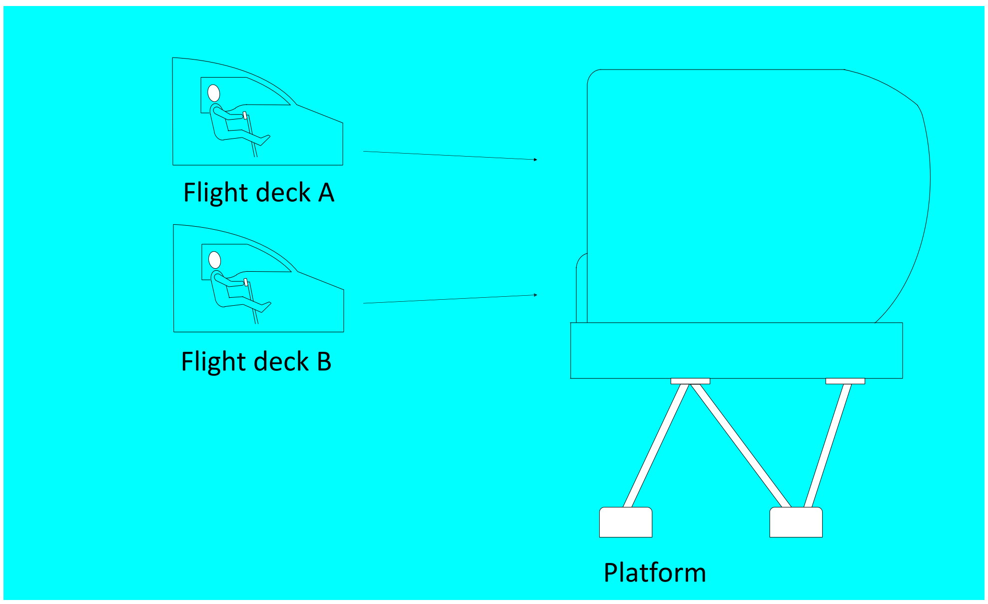


Figure 1: Example of a device with two interchangeable flight decks

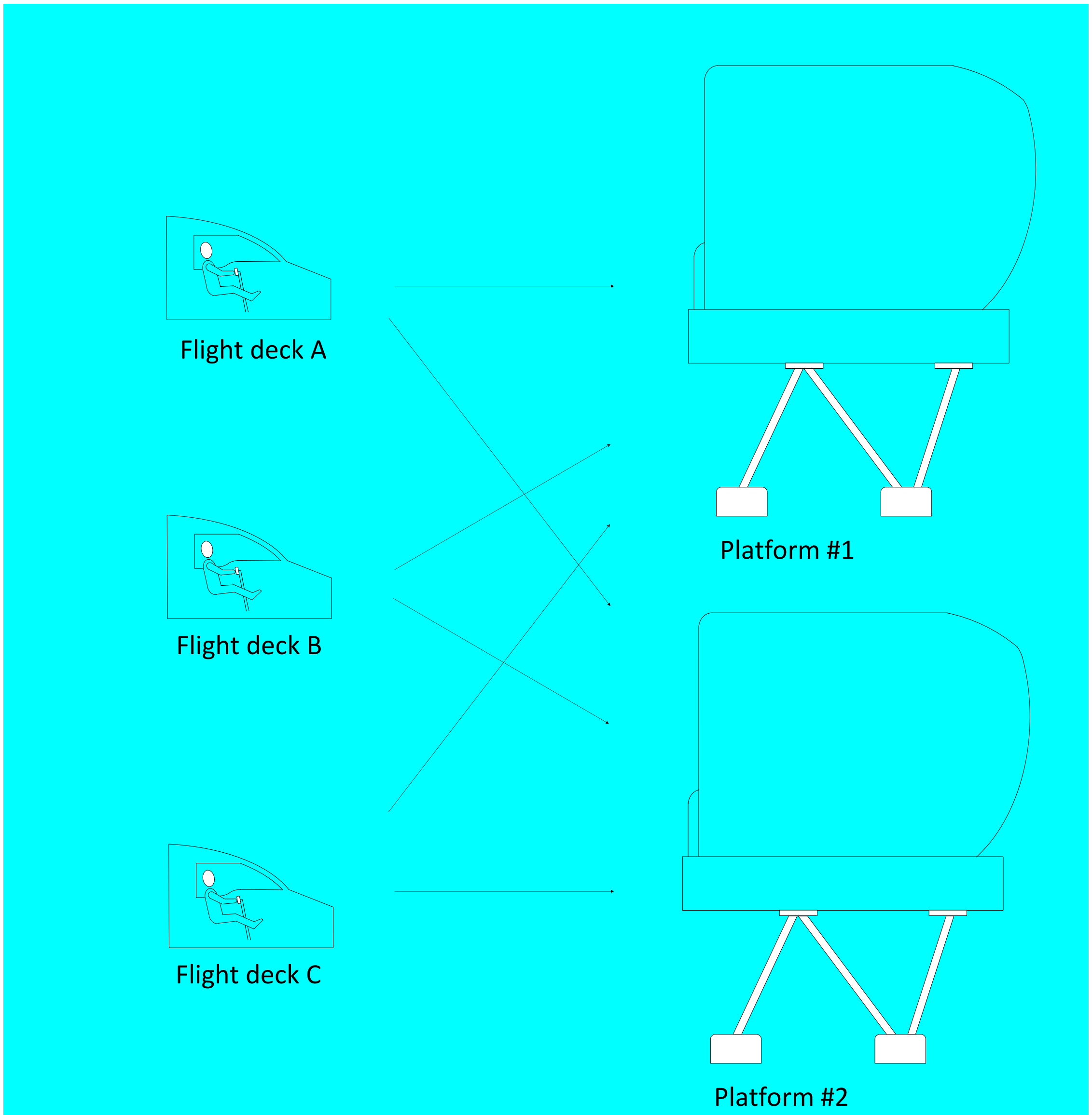


Figure 2: Example of two platforms with three interchangeable flight decks

Table 1: Additional guidance related to Figure 2

Platform	**Flight deck**			**Qualification certificate (QC) required**	**COMMENT**
1	A	B	C	One for each qualified platform / flight deck combination	QC contains platform and flight deck combination by serial numbers (Qualification level determined by CS-FSTD(A))
2	A	B	C	One for each qualified platform / flight deck combination	QC contains platform and flight deck combination by serial numbers (Qualification level determined by CS-FSTD(A))
None	A	B	C	One for each qualified flight deck. (Cockpit assemblies may be qualified separately e.g. to a lower qualification level if rules for that level are fulfilled.)	QC contains flight deck identification by serial number (Qualification level determined by CS-FSTD(A))

(4) The identification of each flight deck and platform should be established by using serial number placards. Each flight deck and platform combination should have a qualification certificate, which contains the identification of the flight deck and platform.

(5) Configuration control procedures should contain specific information regarding how the integrity of hardware and software of interchangeable assemblies is ensured. The configuration control logs should include records of all performed swaps.

(6) When a swap is performed, appropriate testing of the FSTD should be performed before the next training, testing or checking session. The testing process and associated procedures should cover as a minimum motion, sound, visual and safety systems and static and dynamic control checks if these can be affected by the swap. Testing procedures should be described in the organisation operating FSTDs's procedures manual.

(7) If each flight deck will be inserted into only one dedicated platform (see Figure 1):

— there should be a complete and separate MQTG for each flight deck and platform combination (i.e. all of the tests would be performed for each flight deck and platform combination); and

— the MQTG should identify the flight deck and platform. The individual QTG tests should also identify these.

(8) If each flight deck will be inserted into multiple platforms (see Figure 2):

— each flight deck should be appointed a platform that would be the baseline for QTG tests. This baseline should have a complete MQTG;

— the MQTG should identify the flight deck and platform. The individual QTG tests should also identify these;

— since the flight deck will be inserted into multiple platforms, the MQTG should be amended for each combination of those. The host computer and the software modules may be associated with the platform or the flight deck. This determines to which extent the software is common between flight deck and platform combinations. Hence, it will define which QTG tests that may be affected by swaps;

— for example, if the flight deck will be inserted into two different platforms, then there should be one complete MQTG (i.e. baseline) and an appendix for the tests related to the alternate platform. Any further combinations in addition to two will increase complexity (particularly for the MQTGs) and it should be agreed with the competent authority for approval on a case-by-case basis; and

— the configuration control system should contain processes and procedures to ensure that any software and hardware changes are managed appropriately for each flight deck and platform combinations.

(9) Recurrent functions and subjective tests and QTG tests should include all the required tests (i.e. as in the MQTG) for each flight deck and platform combination.

(10) If a flight deck is still used as a device when it is not inserted in a platform:

— there should be a separate FSTD qualification process and FSTD qualification certificate in order for the flight deck to be used as an FSTD. The FSTD qualification certificate should include the identification of the flight deck; and

— the MQTG should be prepared as is presented in paragraph (g).

CS FSTD(A).MISC.020 Design and qualification of non-type-specific FSTDs

This CS provides standards to be followed for the design and qualification of non-type-specific FSTDs.

(a) Background

Unlike type-specific FSTDs, non-type-specific FSTDs are intended to be representative of a group or class of aeroplane. The expression 'non-type-specific' has been used in place of 'generic' to preclude confusion with the simulation feature fidelity level G. It further reduces the implication that non-type-specific FSTDs are exclusively linked to simulation feature fidelity level G as they could include R or even S fidelity levels for some features. Fidelity level S could apply to one or more of the FSTD features for the aeroplane type relevant to the training programme, or to another type in the same group or class.

The principles given in this CS are applicable to devices with fidelity level G or R for any of the aeroplane-related features (flight deck layout and structure, flight model, ground handling, aeroplane systems, and flight controls and forces) where the intended use supports non-type-specific training.

(b) Design standards

(1) Designated aeroplane configuration

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

(2) Cockpit/flight deck components

As with any training device, the components used within the cockpit/flight deck area do not need to be aeroplane 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 flat display technology-based representations and touch-screen controls to represent objects other than basic push-button types of controls (e.g. rotary control knobs for setting barometric pressure or speed bugs) would not be acceptable. The training tasks envisaged for non-type-specific FSTDs are such that appropriate layout and feel is very important; for instance, the altimeter sub-scale knob needs to be physically located where it is in the represented class of aeroplane either equipped with glass cockpit avionics or classic instruments. With the use of flat display technologies, physical overlays incorporating operational switches/knobs/buttons replicating an aeroplane instrument panel may be required as described in CS FSTD(A).QTG.400, Table 1.

(3) Data package

The data used to model the aerodynamics, flight controls and engines should be soundly based on the designated aeroplane configuration.

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 aeroplane configuration being simulated. The models should be continuous and demonstrate the correct trend and magnitude throughout the required training flight envelope. Additional data to refine the non-type-specific model can be obtained from many sources, such as aeroplane design data, flight and maintenance manuals, observations on the ground and in flight, etc., without necessarily having to conduct expensive, dedicated flight testing. Data obtained on the ground and in flight can be measured and recorded using a range of simple means such as video cameras, paper and pencil, stopwatch, avionics data card output, avionics wireless data, HUMS, and low-cost GPS/inertial data loggers.

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

(c) Visual

Where the FSTD 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.

(d) System integrity

For an FSTD with non-type-specific flight and systems models, a transport delay test is the only suitable test that demonstrates that the FSTD systems do not exceed the permissible delay. If the FSTD is based upon a particular aeroplane type, either Transport Delay or Latency tests are acceptable.

CS FSTD(A).MISC.030 Qualification of an FSTD head-up display (HUD)

(a) Applicability

(1) This procedure applies to all FSTDs with a head-up display (HUD) installation.

(2) For the purposes of this CS, 'HUD' will be used as a generic term for any alternative aeroplane instrument system which displays information to a pilot through a combiner glass in the normal 'out-the-window' view.

(3) This CS details one means to evaluate and qualify an FSTD HUD system. If an organisation operating FSTDs desires to use other means, a proposal should be submitted to the competent authority for review and approval.

(4) QTGs for new, updated or upgraded FSTDs incorporating a HUD system should contain a HUD SoC. The SoC should be an attestation that HUD hardware and software, including associated displays, function the same way as the HUD installed in the aeroplane. A block diagram describing the input and output signal flow and comparing it to the aeroplane configuration should support this SoC.

(b) FSTD/HUD standards

(1) Whether the HUD system is an actual aeroplane system or is software-simulated, the system should be shown to perform its intended function for each operation and phase of flight.

(2) An active display (repeater) of all parameters displayed on the pilot's combiner should be located on the instructor operating station (IOS), or at another location approved by the competent authority. Display format of the repeater should replicate that of the combiner.

(c) Objective testing

(1) Static calibration tests should be included for HUD attitude alignment in the QTG. These tests may be combined with the alignment tests for the FSTD visual system. For additional information, see CS FSTD(A).QTG.105.

(2) HUD systems that are software-simulated (not being an actual aeroplane system) should include latency/throughput tests in all three axes. The HUD system display should be within 100 ms of the control input.

(d) Subjective testing

(1) The competent authority evaluator should evaluate accurate replication of HUD functions.

(2) The ground and flight tests that should be conducted for the qualification of HUD systems are listed below and may be combined with subjective manoeuvres not dedicated to HUD testing. Only those phases of flight for which the particular HUD system is authorised should be tested. The evaluation should be conducted using daylight, dusk and night conditions as available or applicable.

(i) pre-flight inspection of the HUD system;

(ii) taxi:

(A) HUD taxi guidance;

(B) combiner horizon matches the visual horizon within the manufacturer's tolerance;

(iii) take-off:

(A) normal take-off in visual meteorological conditions (centreline guidance if available);

(B) instrument take-off using the lowest RVR authorised for the particular HUD;

(C) engine-out take-off;

(D) maximum demonstrated crosswind take-off;

(E) wind shear during take-off;

(iv) in-flight:

(A) climb;

(B) turns;

(C) cruise;

(D) descent;

(v) approaches:

(A) normal approach in visual meteorological conditions;

(B) ILS approach with a crosswind:

— flight path vector should represent the inertial path of the aeroplane;

— course indication matches the track over the ground;

— HUD combiner should not excessively degrade the approach lights;

(C) engine-out approach and landing;

(D) non-precision approach;

(E) circling approach, if applicable;

(F) missed approach — normal and engine-out;

(G) maximum demonstrated crosswind approach and landing;

(H) wind shear on approach;

(vi) malfunctions:

(A) malfunctions causing abnormal pre-flight tests;

(B) malfunctions logically associated with training during take-off and approach; and

(C) malfunctions associated with any approved flight manual abnormal procedures which are not included above.

(3) Some HUD systems have been certified without emergency power backup. Therefore, they will blank out and effectively reboot if any temporary power loss occurs. This should be confirmed by checking the manufacturer's data.

CS FSTD(A).MISC.040 Qualification of an FSTD enhanced flight vision system (EFVS)

(a) Applicability

(1) This process applies to all FSTDs with an enhanced flight vision system (EFVS) installation and is in addition to the head-up display (HUD) requirements detailed in CS FSTD(A).MISC.030.

(2) For the purposes of this CS, 'EFVS' will be used as a generic term for any alternative aeroplane visual enhancement aid using imaging sensors, such as an infrared radiometer or a radar, which displays information to a pilot through an HUD combiner glass in the normal 'out-the-window' view.

(3) This CS details one means to evaluate and qualify an FSTD EFVS system. If an organisation operating FSTDs desires to use other means, a proposal should be submitted to the competent authority for review and approval.

(4) QTGs for new, updated or upgraded FSTDs incorporating an EFVS system should contain an EFVS SoC. The SoC should be an attestation that the EFVS hardware and software, including associated displays and annunciation, function in the same way or in an equivalent way to the system(s) installed in the aeroplane. A block diagram describing the input and output signal flow and comparing it to the aeroplane configuration should support this SoC.

(b) FSTD/EFVS standards

(1) Whether the EFVS system is an actual aeroplane system or is software-simulated, the system should be shown to perform its intended function for each operation and phase of flight.

(2) The minimum FSTD requirements for qualifying an EVS system in an FSTD are:

(i) the EFVS FSTD hardware and software, including associated cockpit displays and annunciation, should function the same or in an equivalent way to the EFVS installed in the aeroplane;

(ii) an active display (repeater) of the pilot's combiner should be located on the IOS, or at another location approved by the competent authority. It should include a duplicate display of the EFVS and HUD scene, as seen through the pilot's HUD combiner glass or the cockpit flight displays; and

(iii) a minimum of one airport should be modelled for EFVS. That model should have an ILS and a non-precision approach (with VNAV if required by the aeroplane flight manual for that type) available. In addition to EFVS modelling, the airport model should meet the requirements of CS-FSTD(A).

(c) Objective testing

Bothground and flight tests are required for qualification. Computer-generated FSTD test results should be provided for each test. The FSTD test results should be recorded on appropriate media acceptable to the competent authority. Time histories are required unless otherwise indicated. See CS FSTD(A).QTG.105 for the specific test requirements.

(d) Subjective testing

(1) Handling qualities, performance, and FSTD systems operation, while using the EFVS system, should be subjectively assessed.

(2) The ground and flight tests and other checks required for qualification of the EFVS system are listed below. They include manoeuvres and procedures to assure that the EFVS system functions and performs appropriately for use in pilot training and checking in the manoeuvres and procedures delineated in the relevant JOEB or EASA OEB report. The evaluation should be conducted using daylight, dusk, and night conditions. Daylight is the most difficult to simulate.

(i) IOS:

Check to ensure that the IOS has preset selections that match the training programme.

(ii) Pre-flight:

Carry out normal pre-flight procedures and checks, including warnings and annunciations.

(iii) Taxi:

(A) Observe parallax caused by sensor position.

(B) Observe ground hazards especially other aeroplane and nearby terrain.

(C) Signs may appear as a block (unreadable) due to the absence of temperature variation between the letters and the background, with an infrared sensor.

(iii) Take-off:

(A) Normal take-off in night VMC conditions. Observe the terrain and surrounding visual scene.

(B) Instrument take-off using visual RVR settings of 180 m. The EFVS RVR should be better than the visual RVR, i.e. 750 m+.

(iv) In-flight operations:

(A) Adjust the scene to VMC and see if the image horizon is conformal with the visual horizon and the combiner horizon.

(B) Using a VMC night or dusk scene, select a thunderstorm at a distance of at least (37 km) 20 nm and see if the imager detects the clouds.

(v) Approaches:

(A) Normal approach in night VMC conditions.

(B) ILS approach.

(a) Select the preset that allows the pilot to see the EFVS image at approximately 500 ft. This should preset the EFVS visibility to approximately 2 300 m, and the visual RVR to 750 m.

(b) Fly or reposition the aeroplane to 500 ft above ground level (AGL) on the ILS. Freeze position. The pilot flying (PF) should be able to see the image of the runway approach lights. The pilot not flying (PNF) should not be able to see any lights. (Some very slight bleed through of strobes is acceptable, but no steady lights).

(c) Continue the approach and freeze position at 200 ft AGL. The PF should be able to see approximately 1 nm down the runway, and the PNF should be able to visually acquire the approach lights and runway end identifier lights (REILs).

(d) Continue the approach and landing. Observe the blooming effect of the airport lights.

(C) Non-precision approach.

(D) Missed approach.

Note. Emphasis should be placed on the FSTD's capability to demonstrate that the EFVS is able to display the required visual cues for the pilot to identify the required visual references to descend below the published decision altitude (DA) when conducting instrument approaches with vertical guidance. The EFVS should continue to provide glide path and alignment information between DH and touchdown. During landing roll-out, visual alignment information should be available to the pilot.

(vi) Visual segment and landing:

(A) Normal:

(a) From non-precision approach.

(b) From precision approach.

(vii) Abnormal procedures:

(A) EFVS malfunctions on the ground.

(B) EFVS malfunctions in the air.

(e) Due to the uniqueness of this system and the normal FSTD environmental visual selections, the IOS should have pre-set weather conditions for EFVS operations. Recommended settings are such that EFVS 'visual' reference can be attained at approximately 500 ft (150 m) AGL, at CAT I and EFVS authorised minima, and below minima to force a go-around.

4. Impact assessment (IA)

4.1. Overview of the issues analysed in the IA

The objective of this IA is to assess the impacts (safety, social, economic, environmental) of the following items from ToR RMT.0196 'Update of flight simulation training device requirements', Issue 2, which are within the scope of Work Package 2[13]:

(a) Support the matrix and methodology from ICAO Doc 9625 and the proposed changes by the TTF in the Implementing Regulation (Part-ARA and Part-ORA) and in CS-FSTD, and develop associated AMC and GM.

(b) In the context of the matrix and methodology, determine the use of other FSTDs for complex high-performance single-pilot aeroplanes type rating training and checking, when no FFS qualified in accordance with CS-FSTD exists for that type or is not readily available and/or accessible.

(c) Explore and introduce ways of enabling the introduction of new technologies in training for the various aircraft categories (fixed wing and rotary wing).

The issues above were analysed as they constitute significant changes and have an impact on the affected stakeholders.

Outside the scope of this IA are the following items, which are subject to the proposed changes in CS-FSTD, but are not assessed as they pertain to regular update, clarifications, or guidance; therefore, they constitute negligible changes:

(a) Review the validation data roadmap (VDR) requirements for suitability;

(b) Align the CS-FSTD elements already present in CS-SIMD as one constituent of operational suitability data (OSD) to avoid duplication of information;

(c) Assess the requirements and impact on the training due to lack of ARINC 610 compliance with avionics software;

(d) Review the function and subjective testing requirements to better represent modern-day aircraft and operating environment;

(e) Develop requirements for industry updates in visual technologies;

(f) Review regulatory oversight issues with the management of visual databases – *the impact of the proposed changes is considered negligible, as these amendments are aimed at better and clearer classification of the databases. The impact for the organisation operating FSTDs will be to have a more structured mechanism to support the maintenance of the databases used in the training, testing and checking, and to provide the competent authority with a consistent approach to oversee the appropriate use of the visual scenes/databases in training;*

(g) Develop guidance on multi-configuration devices and their master (M) qualification test guide (QTG) requirements;

[13] https://www.easa.europa.eu/document-library/terms-of-reference-and-group-compositions/tor-rmt0196

(h) Review the requirements for the update of databases, such as FMS, GPS and EGPWS databases; and

(i) Review the gap analysis between ICAO Doc 9625 (Fourth Edition) and CS-FSTD(A) — Initial issue, whilst taking into account the FAA Part 60 Change 2, and consider the elements for incorporation into CS-FSTD(A) (to be continued in Work Package 3).

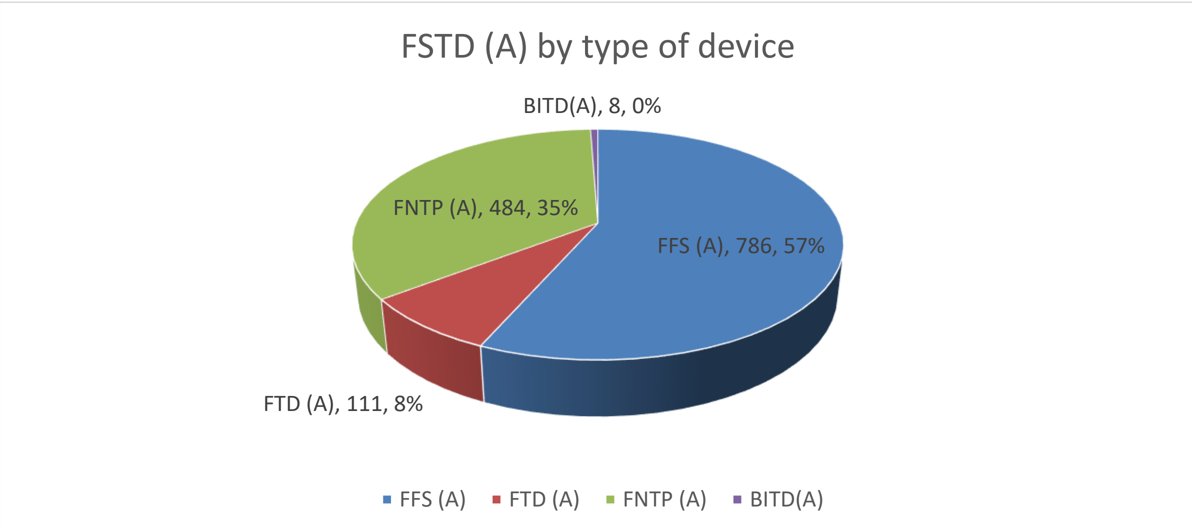
4.1.1. What is the issue?

High-fidelity training devices such as FFSs are a prevailing resource in training.

The existing requirements largely demand that the type rating training is performed in an FFS, thus limiting the possibility to use other types of devices. If a device other than an FFS is used in the training, it is not fully recognised and the training is therefore not always credited. In addition, the current regulatory framework (CS-FSTD) neither stimulates innovation nor paves the way for emerging technologies, such as virtual reality and artificial intelligence that might offer new possibilities to obtain (more) quality training whilst maintaining the safety level and cost efficiency. The existing regulatory paradigm in regard to the use of FSTDs in pilot training has not been changed for the past 25 years. EASA should therefore strive to facilitate the use of training devices that are optimal for achieving the training objectives with more flexibility in selecting the most appropriate device. The training needs and their evolution should take a larger role in driving the development of training tools, such as flight simulators. Given the pace of technological innovations, the highest-fidelity training device today (FFS) is no longer the only option for all training purposes. EASA should endeavour to ensure ICAO compliance within this domain to facilitate the mutual recognition of devices and to ease the development of bilateral agreements.

Currently, there are approximately 1 400 FSTDs for aeroplanes in EASA Member States and in third countries where EASA acts as the CA[14]: circa 60 % of them are FFSs and 40 % are fixed-based training devices (mostly FNPTs).

Figure 4: Overview of the FSTDs(A) by type of device



[14] EASA acts as the competent authority for organisations operating FSTDs having their principal place of business located outside the territories of the EU Member States and EASA countries (Switzerland, Norway, Lichtenstein and Iceland). Responsibilities for the oversight may be also reallocated to EASA by virtue of Articles 64 and 65 of Regulation (EU) 2018/1139.

Legend of the abbreviations used in Figure 1:

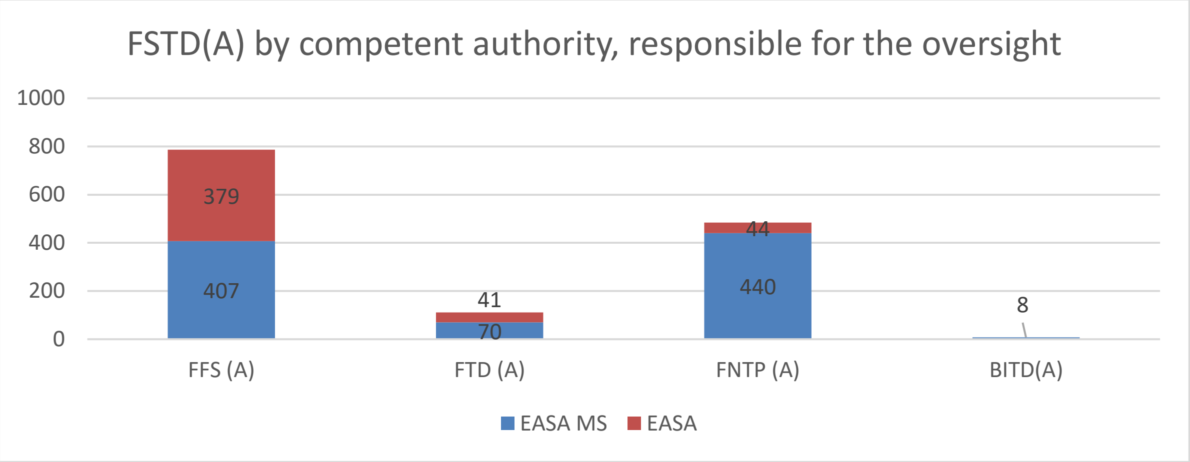
FFS — full flight simulator

FTD — flight training device

FNPT — flight and navigation procedures trainer

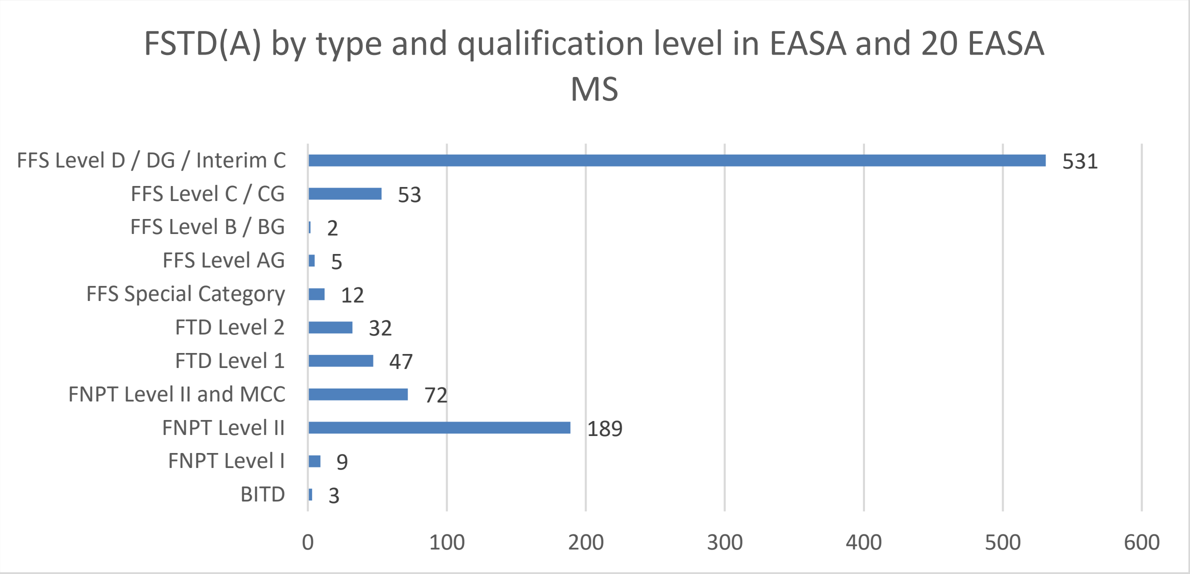
BITD — basic instrument training device

Figure 5:Overview of the FSTDs(A) by CA



In terms of qualification levels, the distribution of the existing devices is as follows[15]:

Figure 6: Overview of the FSTDs(A) by qualification level in 20 EASA Member States and under EASA oversight[16]

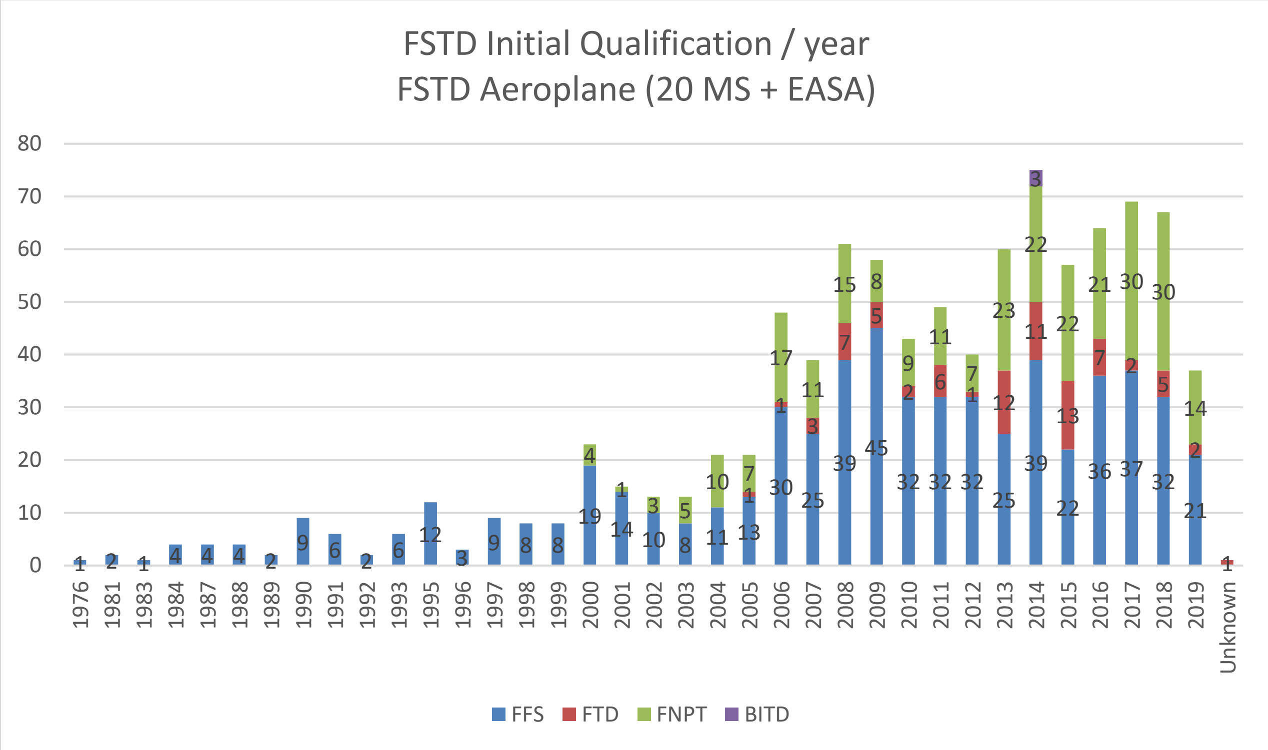


The majority of the existing FSTDs(A) have been qualified after 2003. From 2003 until 2018 (JAR-STD 1A Amendment 3 to CS-FSTD(A) Initial issue), the regulatory framework on FSTDs (technical criteria) has not changed.

[15] Data comprises FSTDs(A) overseen by EASA and 20 EASA Member States (Germany, Estonia, Spain, Finland, Croatia, Hungary, Italy, Lithuania, Luxemburg, Latvia, Netherlands, Norway, Poland, Romania, Sweden, Slovenia, Iceland, Malta, Bulgaria, and France).

[16] Standardisation data from 20 EASA Member States and from third countries, under EASA oversight.

Figure 7: Overview of the FSTDs(A) by initial qualification year in 20 EASA Member States and under EASA oversight[17]



The current practice reveals that there is insufficient utilisation of existing FSTD capabilities due to:

(a) Discrepancies between CS-FSTD, capabilities of the FSTD and Part-FCL in the Aircrew Regulation. The existing requirements largely demand that the type rating training is performed in an FFS, thus limiting the possibility to use other types of devices. Even though, for initial type rating training, out of the 32 hours at least 16 can be completed in an FTD, there is no clarity as to which tasks can be completed in an FTD and which must be completed in an FFS.

(b) Insufficient recognition/crediting of existing and new device capabilities in the training. If devices, other than FFSs, are used in the training, their features are not always fully recognised and the training is therefore not always credited. Currently, the training credits provided to FTDs is low. This is mainly due to the technical minimum requirements in CS-FSTD(A) that are not adapted to pilot training requirements. In ICAO Doc 9625, a device without motion has been defined that can support a complete type rating training: the FSTD type V.

(c) The current rules do not cater for innovations and are not compliant with ICAO Doc 9625 (Fourth Edition).

(d) The real capabilities of the devices are not shown on the FSTD certificate; thus, in some cases, it is not very clear what type of training tasks could be performed on a particular device.

4.1.2. Who is affected

The following stakeholders are affected by the proposed changes of the RMT:

17 Standardisation data from 20 EASA Member States and from third countries, under EASA oversight.

(a) Aircraft manufacturers and FSTD data providers

(b) FSTD manufacturers

(c) organisations operating FSTDs

(d) EASA and 32 EASA Member States' CAs

(e) Approved training organisations (ATOs) — circa 1 115 in EASA Member States

(f) AOC (A) holders — circa 640 in EASA Member States

(g) Pilots holding commercial ATPL (circa 78 000 in EASA Member States)

These stakeholders will be affected in a varying degree, depending on the type and qualification of the FSTD they operate (for the organisations operating FSTDs) and the type of training they provide (for the ATO). The impact of the proposed changes is depicted in Figures 5 and 6.

4.1.3. How could the issue/problem evolve

The insufficient utilisation of existing and future device capabilities would continue in the future. Another consequence might be the risk of not facilitating new technologies in the FSTD development. Finally, this new proposal is associated with several amendments (proposed through Opinions Nos 05/2017 and 06/2017) that have already been adopted and are applicable since 20 December 2019. If the amendments proposed with this NPA are not introduced, we will not ensure a much better utilisation of existing and future training tool capabilities.

4.2. What we want to achieve — objectives

The operational objectives of this proposal are to:

(a) better link FSTD with the initial (FCL) and recurrent (ORO.FC — OPS) training, ensuring that devices with appropriate fidelity levels in all qualification criteria are used for training;

(b) open the market for FSTDs tailored to the ICAO Doc 9625 requirements;

(c) standardise devices to have common criteria for FSTD qualification, based on ICAO Doc 9625 requirements; and

(d) cater for application of new technologies.

4.3. How it could be achieved — options

Table 1: Selected policy options

No	*Title*	Description
Option 0	*No policy change*	Baseline option (no change to the existing CS-FSTD and FCL initial and recurrent type rating). There is insufficient utilisation of existing and future device capabilities due to the problems/issues explained above.

Option 1	*FSTDs tailored to training needs*	The options envisages that training providers identify the device capabilities — training tool 'DNA[18]' (referred to as FCS) — based on analysing training task objectives. The identified FCS is subsequently matched with a training tool available on the market having the same FCS. Under this option, the FSTD would meet training needs and would be qualified using the updated technical standards in CS-FSTD. The technical standards would be updated to align with ICAO Doc 9625 (Fourth Edition). These standards/technical fidelity criteria will be incorporated and used for assessment of the FSTD training capability. The device qualification certificate would include the outcome of the device evaluation against 12 fidelity features. The outcome would be reflected in the FCS. The methodology to evaluate the device through objective and subjective testing remains; for existing FFSs level C and D, the signature would be predetermined. The FCS is specified in the FSTD certificate. The result of the assessment will be used when choosing FSTDs in initial and recurrent type rating training programmes. The training organisation can propose to the CA which device could be used for which part of the training, depending on the capabilities needed to achieve the training objectives. The training providers that currently use other than FFS level C and D devices (e.g. FTD) in their approved training courses would be allowed to continue using them unless they change their courses. <u>Only in the case of a (re-)approval of the course, the FCS of the FSTD must be used to check the suitability of the device.</u> The option envisages full alignment of CS-FSTD(A) types with the ICAO FSTD type, as well as the addition of one new level (FTD level A) further to the ICAO FSTD types (according to Table 2). **<u>All existing FSTDs</u>** would be accompanied by a new FSTD qualification certificate which would be issued at the next recurrent evaluation of the device. However, not all existing devices will have FCS (e.g. FNPT, BITD, FSTD helicopters will not currently have FCS in the FSTD certificate). Further details on which devices would be required to have FCS are provided in Figure 5. Apart from the new qualification certificate, an equipment and specifications list (ESL) will be issued for all existing FSTD for fixed and rotary wing. The latter will be provided and maintained by the organisation operating FSTDs. The ESL will be a stand-alone document separate from the FSTD qualification certificate and will provide information on the FSTD equipment and specifications.

The **<u>FSTDs(H)</u>** would not be affected by the proposed Work Package 2 of RMT.0196. Even though the new FSTD certificate would enter into force with the proposed changes in Part-ARA, the new FSTD

[18] By DNA, it is meant the concept of defining the level of fidelity of the device by using the FCS approach in assessing the device capabilities against fidelity features.

(H) qualification certificate will have no FCS (FCS 'N/A' issued). The FCS for helicopters will be available/applicable only after the finalisation of the RMT.0196 Work Package 3 (e.g. 2022)[19].

[19] EPAS 2020-2024, RMT.196 timeline.

Table 2: Proposal for new FSTD types and qualification levels

Type	Old Level	New Level	Remarks for existing and future (not yet qualified) FSTDs	Scenario to define/analyse the impact (Section 1.5 of the IA)
FFS	**D**	**D**	For existing FSTDs: Retaining qualification level and adding default FCS (grandfathering)	Impact presented in Figure 5 Scenario A.1
			For new FSTDs: alignment with ICAO type VII	Impact presented in Figure 5 Scenario A.3
	C	**-**	For existing FSTDs: Retaining qualification level and adding default FCS (grandfathering)	Impact presented in Figure 5 Scenario A.1
	B	**-**	For existing FSTDs: re-evaluation of the capabilities of the FSTD and assignment of FCS	Impact presented in Figure 5 Scenario A.2
	A	**-**	For existing FSTDs: re-evaluation of the capabilities of the FSTD and assignment of FCS	Impact presented in Figure 5 Scenario A.2
FTD	**-**	**B**	For new FSTDs: alignment with ICAO type V	Impact presented in Figure 5 Scenario A.3
	1,2	**A**	For existing FTDs: evaluation of the capabilities of the FSTD and assignment of FCS	Impact presented in Figure 5 Scenario A.2
			For new FSTDs: new type	Impact presented in Figure 5 Scenario A.3
FNPT	**-**	**E**	For new FSTDs: alignment with ICAO type VI	Impact presented in Figure 5 Scenario A.3
	-	**D**	For new FSTDs: alignment with ICAO type IV	Impact presented in Ffigure 5 Scenario A.3
	-	**C**	For new FSTDs: alignment with ICAO type III	Impact presented in Figure 5 Scenario A.3
	-	**B**	For new FSTDs: alignment with ICAO type II	Impact presented in Figure 5 Scenario A.3
	-	**A**	For new FSTDs: alignment with ICAO type I	Impact presented in Figure 5 Scenario A.3

	II (MCC)	-	For existing FSTDs: no impact to introduce the new FSTD qualification certificate, unless the organisation operating FSTDs would like to evaluate the FSTD and assign the FCS on a voluntary basis. The new certificate for FNPT will not have an FCS and will be replaced at the next recurrent evaluation of the device. There would be minimal impact for the existing FSTDs which would be supported with an ESL.	Impact presented in Ffigure 5 Scenario A.0
	II	**-**		Impact presented in Figure 5 Scenario A.0
	I	**-**		Impact presented in Figure 5 Scenario A.0
BITD	**N/A**	**-**	For existing FSTDs: no impact to introduce the new FSTD qualification certificate. The new certificate for BITD will not have an FCS and will be replaced at the next recurrent evaluation of the device. There would be minimal impact for the existing FSTDs which would be supported with an ESL.	Impact presented in Figure 5 Scenario A.0
			For new FSTDs: no such type	-

Based on an initial analysis of the options, the following options have been discarded due to the reasons mentioned below.

Table 3: List of the discarded options

Option	*Title*	*Description*	*Rational for being discarded*
2	FSTD meets training needs while abandoning the current baseline FSTD qualification levels	Classification of the FSTD qualification levels (FFS, FTD, FNPT, and BITD) will be abandoned. The devices are qualified only according to the 12 FSTD simulator features. Device qualification includes the outcome of the device evaluation against 12 fidelity features ('FCS').	This option, while being completely compliant with ICAO Doc 9625 Volume I Part III (that the new CS FSTD(A) issue 3 is based upon), would require radical changes to Part FCL for all other training types than just the changes described in this NPA for initial type rating. In addition, the removal of FFS Level D qualification level could have a negative impact upon the Bilateral Aviation Safety Agreement (BASA) with the FAA. This option might lead to variation in device standards as every device would be in effect unique, and this would potentially result in increased costs.
3	Abandoning FSTD qualification level; instead, setting up a conversion table defining the FSTD level equivalence in a set of FCS	The option is proposed to mitigate the negative impact of Option 2 in terms of alignment with ICAO and the FAA and envisages setting up a conversion table defining the FSTD level equivalence in a set of 'FCS'. This will facilitate the conversion, without having a negative impact on alignment with FAA and ICAO requirements.	The idea of setting up a conversion table is not accepted, as it is not practical/feasible. This option might induce problems with its correct application. It may lead to wrong interpretation and 'multiple-conversion' errors.

4.4. Methodology and data

4.4.1. Data collection

This IA has been performed using the following data sources:

(a) OEMs, data package providers, FSTD manufacturers, organisations operating FSTDs, CAs and airlines, through members of RMG RMT.0196;

(b) ATOs and airlines, through members of the EASA Training Task Force;

(c) 2018 standardisation inspections data on the number of active FSTDs qualified by EASA[20] and by EASA Member States' CAs; and

(d) complementary data on the FSTD type level per Member State, collected by 20 Member States[21].

4.4.2. Methodology applied

The IA was developed as a partially quantitative analysis of the costs and benefits, using the multi-criteria analysis (MCA). MCA covers a wide range of techniques that aim at combining positive and negative impacts into a single framework for an easier comparison of scenarios. The scoring of the impacts uses a scale of – 5 to + 5 to indicate, respectively, the negative and positive impacts of each

[20] https://lisstdis.easa.europa.eu/eqstdis/

[21] Data provided by the following countries (aeroplane only): Germany, Estonia, Spain, Finland, Croatia, Hungary, Italy, Lithuania, Luxemburg, Latvia, Netherlands, Norway, Poland, Romania, Sweden, Slovenia, Iceland, Malta, Bulgaria, France.

option (ranging from 'very low' to 'very high' negative/positive impacts). The intermediate scores are termed 'low, 'medium', and 'high', providing a total of five levels of all impacts in each direction (positive and/or negative). A 'no impact' score is also possible.

Table 4: Scoring of impacts

Positive impact	Score	Negative impact	Score
+ 5	Very high positive impact	– 5	Very high negative impact
+ 4	High positive impact	– 4	High negative impact
+ 3	Medium positive impact	– 3	Medium negative impact
+ 2	Low positive impact	– 2	Low negative impact
+ 1	Very low positive impact	– 1	Very low negative impact
0	Neutral/insignificant	0	Neutral/insignificant

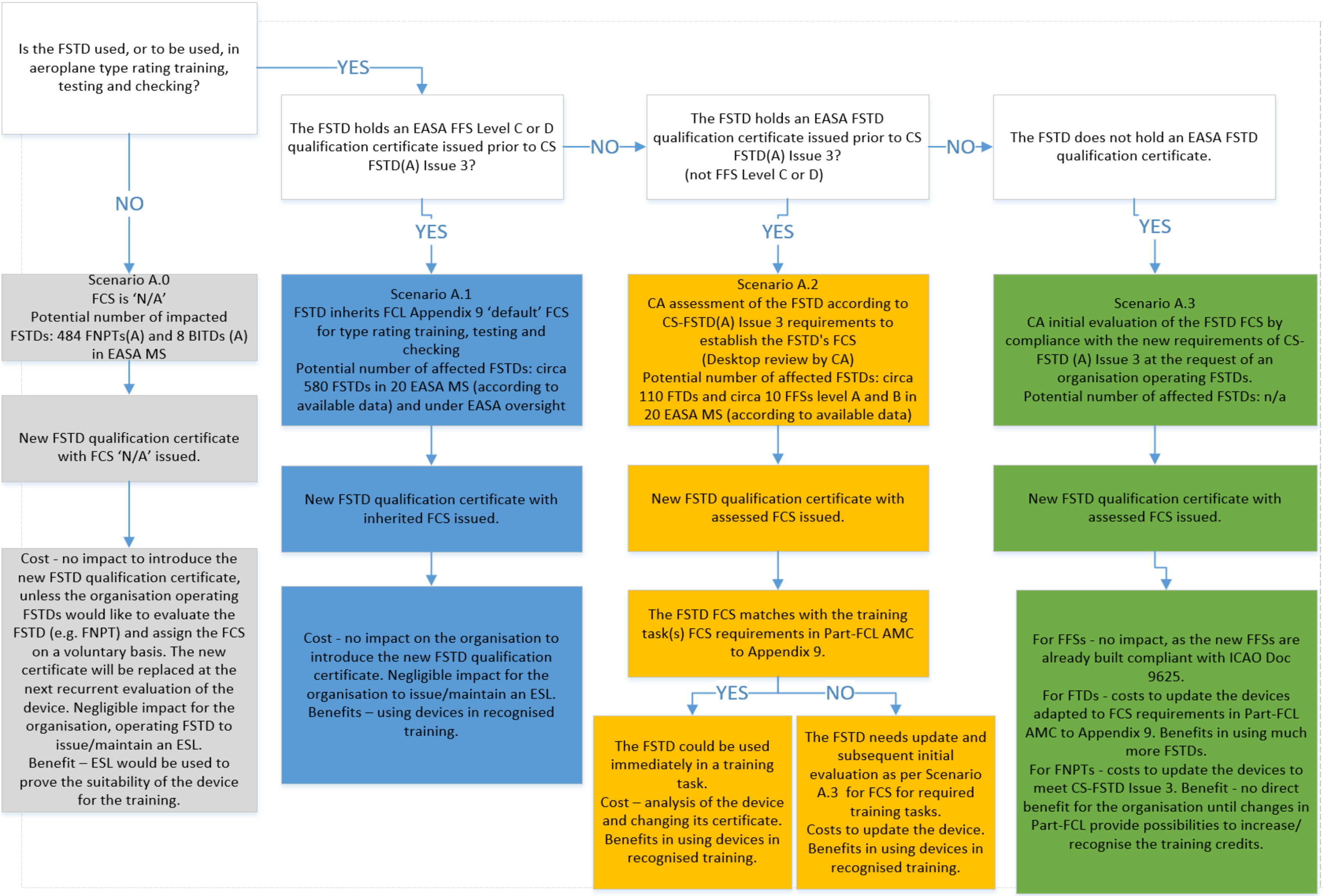
Table 5: Definition of economic scale

			CAs	**Organisations, operating FSTDs**
		Turnover (M€)	1 000	4 800
Qualitative description	Score	Turnover impact		
Very high impact	+/- 5	> +1.5%	15	72
		]1 to 1.5 %['	15	72
High impact	+/- 4	]0.8 to 1 %[	10	48
		]0.6 to 0.8 %[	8	38.4
Medium impact	+/- 3	]0.4 to 0.6 %[	6	28.8
		]0.2 to 0.4 %[	4	19.2
Low impact	+/- 2	]0.1 to 0.2 %[	2	9.6
		]0.05 to 0.1 %[	1	4.8
Very low impact	+/- 1	]0.02 to 0.05 %[	0.5	2.4
		]0 to 0.02 %[	0.2	0.96
No impact	0		0	0

4.5. What are the impacts

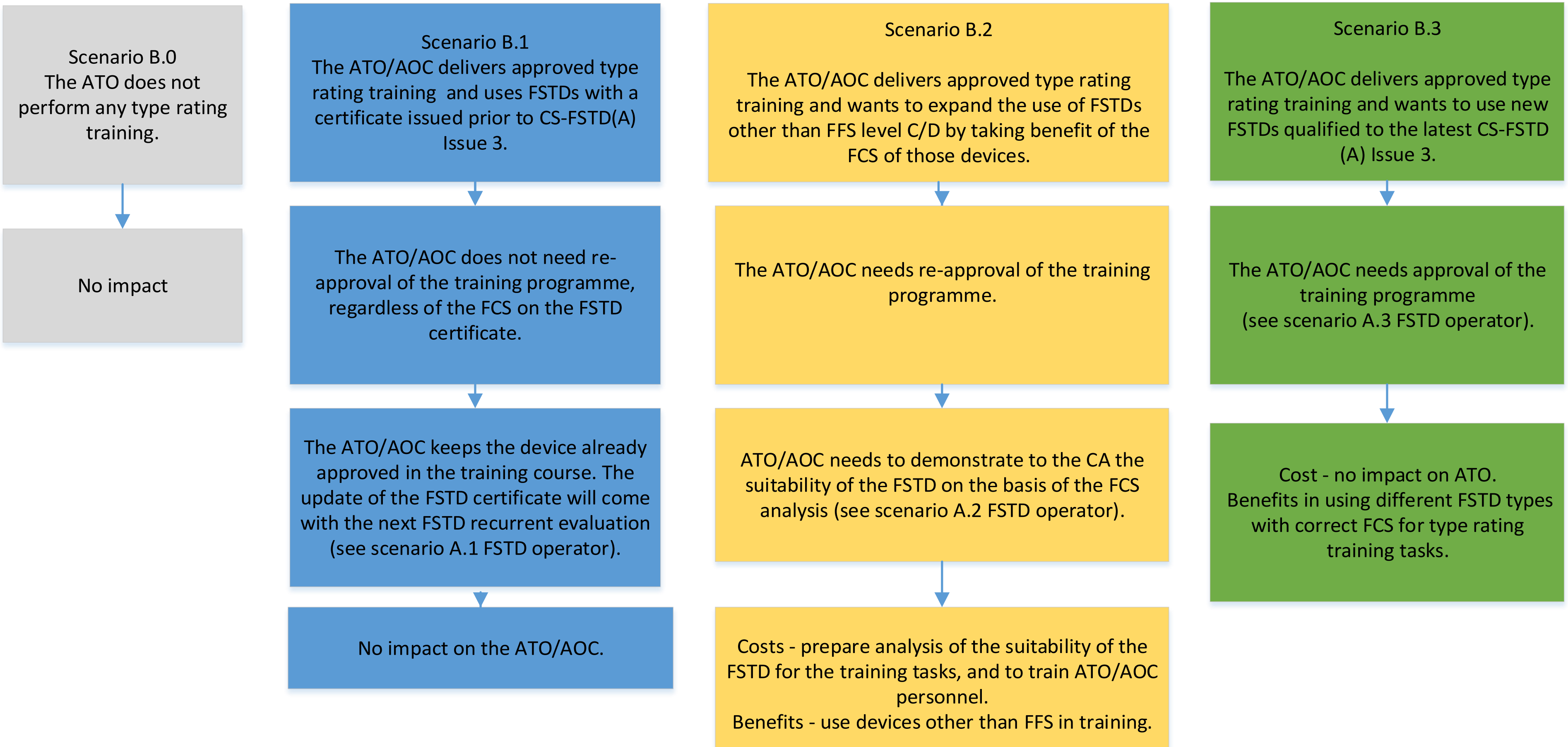
The impact for each stakeholder affected by option 1 is illustrated in the graphs below.

Figure 8: Option 1 and impact for organisations operating FSTDs



Option 1 with different scenarios and impact for ATOs

Figure 9: Option 1 and impacts for ATOs



4.5.1. Safety impact

Option 0 — No policy change

No impact

Option 1 — FSTDs tailored to training needs

Pilot training needs would fully match with the training device capabilities, which would lead to correct usage of FSTDs according to their respective capabilities. This provides for safety improvements due to:

(a) more effective and positive transfer of training to the actual aeroplane;

(b) improvement of the availability and access to FSTDs other than FFS or sole use of the aeroplane itself, especially for aeroplane types in the business jet segment; and

(c) better standardisation of FSTD evaluations and training course approvals by CA technical and flight inspectors.

Table 6: Safety impacts per option

Criterion	***Option 0*** *No policy change*	***Option 1*** *FSTDs tailored to training needs*
Safety	No impact	Contribution to potential safety improvement due to correct usage of FSTDs to perform training tasks for type rating, and improved availability and access to FSTDs (especially for single-pilot high-performance complex aeroplanes)
	0	+2
	Neutral	Low positive impact

4.5.2. Environmental impact

Option 0 — No policy change

No impact

Option 1 — FSTDs tailored to training needs

If FTDs are used instead of FFSs for some training tasks, there might be an environmental benefit as a result of using less energy for the FTD than for the FFS (e.g. air conditioning, electrical supply). For example, the energy consumption for FFSs with hydraulic/electric motion system varies around 210-270 KVA, whereas for FTDs (without a motion system) is around 20 KVA.

In some cases, there might be environmental gains, as the pilots might travel less to have access to the training devices due to the increased range of accessible devices. It should be noted that this impact depends on the organisation operating FSTDs and the proximity of devices.

Table 7: Environmental impacts per option

Criterion	***Option 0*** *No policy change*	***Option 1*** *FSTDs tailored to training needs*
Environme nt	No impact 0 Neutral	Environmental benefit as a result of using less energy for the FTD than for the FFS +2 Low positive impact

4.5.3. Social impact

Option 0 — No policy change

No impact

Option 1 — FSTDs tailored to training needs

The option is expected to result in much more effective type training of the pilots due to the direct link between the training tasks and the suitability of the training device. Eventually, higher amount of type rating might be offered, based on the increased flexibility and deepening on the specific footprint.

Another positive change is the effect of the introduction of the ESL on the workload of the CA. As mentioned in the option description, it would be a responsibility of the organisation, operating FSTDs to issue and maintain the ESL. Currently, the 'guidance information for training, testing and checking consideration' is part of the FSTD qualification certificate and is checked and approved by the CA during the initial and recurrent evaluation. As a result of the proposal, the CA will not have any more the responsibility to check and reissue an FSTD qualification certificate in the case of minor changes. Therefore, the CA will benefit from the decrease in the workload for 'maintaining' the guidance information for training, testing and checking consideration. In quantitative terms, the decreased workload is estimated at around 0.5 FTE per year, considering the EASA case (2h per certificate update*350 certificates updated per year). The impact for the Member States' CAs might be lower, depending on the number of the qualification certificates they reissue per year for minor changes.

Other non-quantifiable positive social impacts are:

(a) Clear responsibilities of the training organisation, the organisation operating FSTDs and the CAs in the process of approving FSTDs according to their suitability for the training.

(b) Information on list of airports, malfunctions and other special features available in the ESL is an improvement to help the training organisations prepare their training programme to maximise the efficient usage of the relevant FSTDs.

Table 8: Social impacts per option

Criterion	***Option 0*** *No policy change*	***Option 1*** *FSTDs tailored to training needs*
Social	No impact	More effective type rating for the ATPL holders Some workload decrease for the CAs
	0	+2
	Neutral	Low positive impact

4.5.4. Economic impact

Option 0 — No policy change

No impact

Option 1 — FSTDs tailored to training needs

<u>Economic benefits</u>

(a) The proposal paves the way for further innovations when designing and producing new FSTDs. Europe would be among the first globally in utilising the innovative possibilities provided by the latest revision of ICAO Doc 9625.

(b) Level playing field and equal treatment of stakeholders through harmonisation with ICAO Doc 9625.

(c) CS-FSTD (A) Issue 3 will be almost fully aligned with all the ICAO Doc 9625 device types, and future-proof together with Part-ARA and Part-ORA from an FSTD perspective when EASA widens the scope of the new training paradigm beyond just that of type rating training.

(d) Facilitation of the standardisation of FSTD through issuing/maintaining one new FSTD qualification certificate for all types of FSTD.

(e) Net benefit for the training provider/pilots due to lower costs in using FTDs instead of FFSs (lower building costs for the premises of the device, energy consumption, personnel costs, etc.). This benefit will be gained under the assumption that the data package providers will price the package to reflect the device capability.

(f) Accessibility to an increased range of FSTDs (more than 100 existing FTDs) and removal of the need for dual qualified devices.

(g) Higher flexibility and accurate use of specific FSTDs, resulting in:

(1) higher efficiency of the training and reduction of training costs (nowadays the recurrent costs for the maintenance of an FFS[22] are 50-200 EUR/hour and are two times more than those for an FTD). Currently, the dry cost to use a simulator (without an instructor) for an FFS is indicatively 250-500 EUR/hour, while for an FTD is indicatively 100-200 EUR/hour. It is expected that the savings in type rating training when using an FTD

[22] Electricity, staff costs, building maintenance, regular updates, revalidation of certificate, etc.

instead of an FFS might be up to 20 %[23]. This is due to the lower costs when using an FTD (the dry lease of an FTD costs 200 EUR/hour) and due to the extended usage of an FTD (depending on the specific footprint). For example, currently, in a typical course 32 hours are performed in FFSs and in future part of these hours could be performed in a device other than FFS and this number might increase after implementing the proposed changes; and

(2) a higher amount of training sessions being offered, based on the increased flexibility and more tailored training footprints.

<u>Economic costs</u>

Competent authorities

(a) Internal training

The technical and flight inspectors as well as the inspectors for FCL and OPS training need to be trained on the new fidelity features and their different levels.

(b) Software change

In order to be able to issue an FSTD qualification certificate, the CA's software needs to be changed according to the new system.

(c) Trainings manuals

All trainings manuals of ATOs and AOC holders need to be evaluated and approved.

(d) FSTD qualification certificates

All certificates need to be updated and therefore the corresponding documentation of every single FSTD has to be reviewed. It might also include a subjective evaluation, which would then lead to an even bigger time frame for implementation.

(e) Harmonisation with existing OSD reports will be necessary.

(f) The overall costs for training, re-evaluation as well as approval of training manuals and certification will be on average approximately EUR 50 000 per CA (one-off cost). For all 32 EASA MS, the overall costs are estimated around EUR 1.6 M. Using the scale for the impact of this cost with regard to the CA budget (Table 5), the overall impact on the CA is low. Furthermore, these costs will be ultimately passed on to the organisations operating FSTDs through the fees and then to the end users (pilots).

Training organisations

(a) Only when the ATO would like to use the flexibility of the increased range of the devices in the training (Figure 6), it would have costs to do an analysis of the device capabilities needed to achieve the training objectives and to train its personnel on the new fidelity features and their application. These costs are not quantified, but are expected to be in the scale of low negative impact for the training organisations.

[23] Considering the average amount of type rating training is circa EUR 30 000 in EASA Member States.

Questions to training organisations:

1. Training organisations are invited to share information about the expected costs to:
   a) perform an analysis of the device capabilities needed to achieve the training objectives (Scenario B.2);
   b) change their training programmes as a result of the analysis;
   c) train their personnel on the new fidelity features and their application.
2. Training organisations are expected to comment on the assumption that these costs would be outweighed by the expected economic benefits.

Organisation operating FSTDs

Table 10: Economic impacts for the organisation operating FSTDs — different scenarios

Scenario according to Figure 5	Type of costs	Indicative amount of costs (EUR)	Economic benefit
A.0 New FSTD certificate with no FCS	Cost for the organisation operating FSTDs to invest time/resources in creating an equipment and specifications list (ESL) for each FSTD (one-off costs). Minor recurrent costs are expected to maintain the ESL.	One-off costs for ESL: circa 2 000 EUR per device (10 hours for the FSTD manufacturer to review the configuration and assist the organisation). Recurrent costs for ESL: minor. Total one-off costs for all affected 484 devices is circa 1 million EUR. Comparing the total costs with the turnover of the organisation operating FSTDs (see Table 5), the **<u>overall impact is expected to be very low.</u>**	The ESL would be used to prove the suitability of the device for the training.
A.1 FSTD inherits FCL Appendix 9 'default' FCS for type rating training, testing and checking	No cost for the organisation to introduce the new FSTD qualification certificate, as the FSTD certificate will have a default FCS for type rating training, testing and checking. Cost for the organisation operating FSTDs to invest time/resources in creating an ESL for each FSTD (one-off costs). Minor recurrent costs are expected to maintain the ESL.	One-off costs for ESL: circa 2 000 EUR per device (10 hours for the FSTD manufacturer to review the configuration and assist the organisation). Recurrent costs for ESL: minor. Total one-off costs for all affected 580 devices is circa 1.2 million EUR. Comparing the total costs with the turnover of the organisations operating FSTDs (see Table 5), the **<u>overall</u>**	Using FFS devices in recognised training. The ESL would be used to prove the suitability of the device for the training.

		impact is expected to be very low.	
A.2 New FSTD qualification certificate with assessed FCS issued.	One-off costs to evaluate the device capabilities and propose an FCS to be reflected in the qualification certificate. The affected existing FSTDs that will be evaluated and assigned with an FCS are circa 120 (circa 10 FFSs level A and B and 110 FTDs in EASA Member States). If the FCS of the existing FSTD does not match with the requirements of the training task (Figure 5, scenario A.2), the FSTD may be updated, if the organisation would like to use it in the training. There will be costs for FSTD update (one-off); however, they could not be estimated due to lack of available data. It should be noted that these costs incurred by the organisations operating FSTDs may be absorbed partially by the device manufacturers and ultimately transferred to the end users.	One-off cost for the existing devices circa 10 000 EUR per device. Total costs for all affected 120 FSTDs is circa 1.2 million EUR. Comparing the investment with the turnover of the organisation operating FSTDs, the **overall impact is expected to be very low.**	Expected that the savings in type rating training when using an FTD instead of an FFS might be up to 20 %[24]. This is due to the lower costs when using an FTD (the dry lease of an FTD costs 200 EUR/hour) and due to the extended usage of an FTD (depending on the specific footprint) A higher amount of training sessions being offered, based on the increased flexibility and more tailored training footprints.
A.3 Newly produced FSTD with new FSTD qualification certificate issued according to CS-FSTD (A) Issue 3	For FFSs, it is assumed that there would be no impact, as the new FFSs are already built compliant with ICAO Doc 9625. For FTDs, there would be costs to update the devices to meet CS-FSTD Issue 3 which would be overweighed by the potential benefits of using the FTD in training with increased/recognised training credits. For FNPTs, there are expected costs to produce/operate a device according to the new standards in CS-FSTD (A) Issue 3. These costs would not be overweighed by a direct short-term benefit until EASA initiates changes in Part-FCL to provide possibilities to	FFSs and FTDs – costs are not estimated, but expected to be balanced with the expected benefits FNPTs – one-off costs to produce a new FNPT qualified according to CS-FSTD Issue 3, which are around 15-20 % more than the price of current FNPTs (current FNPTs cost indicatively 300 000 EUR). FNPT recurrent costs to operate a new FNPT qualified according to CS-FSTD Issue 3, which are around 10 % more than the price of current FNPTs (current FNPTs cost indicatively 300 000	FFSs and FTDs – benefits in using the device more in type rating training and getting training credits. FNPTs — no direct short-term benefit for the organisation until there are changes in Part-FCL to provide possibilities to increase/recognise the training credits. The overall benefit of using new FSTDs is harmonisation with ICAO Doc 9625.

[24] Considering the average amount of type rating training is circa EUR 30 000 in EASA Member States.

	increase/recognise the training credits when using FNPTs[25].	EUR).	

Questions to organisations operating FSTDs:

1. Organisations operating FSTDs are invited to comment on the economic impacts and estimated costs and their significance (low impact) for the different scenarios, explained above.
2. Organisations operating FSTDs that operate FNPTs are invited to confirm the expected cost increase to produce/operate a new FNPT according to CS-FSTD Issue 3 and to provide justification (scenario A.3).
3. Organisations operating FSTDs that operate FNPTs are invited to comment whether there would be any benefits from the implementation of scenario A.3 (e.g. a new FSTD is produced/operated according to the latest CS-FSTD Issue 3).

Aircraft manufacturers/data package suppliers (OEMs)

(a) Charge engineering hours for any additional data package necessary for already qualified FSTDs if this is the case under scenario A.2 for the organisations operating FSTDs (difficult to evaluate this cost).

(b) For new FSTDs of newly certified aircraft under CS-SIMD, additional engineering time and flight test hours can be added directly in the price of the FSTD and may have very little impact on future data package costs, if any.

Simulator manufacturers

(a) For existing FSTDs, cost to cover any additional data package necessary for already qualified FSTDs if this is the case under scenario A.2 for the organisations operating FSTDs (difficult to evaluate the cost).

(b) As regards the new devices, manufactures would be required to produce new devices tailored to the needs of training tasks/objectives. This caters for innovations and may open new markets for tailored devices.

Pilots

(a) As end users, the pilots would have to pay the overall cost in the chain; however, the overall cost will likely be reduced in comparison with training exclusively in an FFS.

(b) It is expected that the pilots might be exposed to more travelling, as they may go to an FTD for type rating training and then on an FFS for testing and checking (currently, the pilots may go only to one FFS for training and checking). It should be noted that a pilot may be exposed to less travelling from home base if the FSTD is located at home base.

EASA

[25] There is currently no rulemaking task planned in the EPAS 2020-2024 to change Part-FCL Appendix 9 to increase training credits for initial pilot raining. However, it is the intent of EASA to extend the scope of the new training paradigm of Part-FCL Appendix 9 to other-than type rating training.

Apart from the rulemaking resources, which EASA allocated for this RMT, it should be noted that the new proposal (Option 1) requires resources in terms of implementation support (workshop to present, explain and steer its good implementation). These resources are assessed to be around 300 working hours.

Table 9: Economic impacts per option

Criterion	*Option 0* *No policy change*	*Option 1* *FSTDs tailored to training needs*
Economic	No impact	Overall, cost-effective proposal, balancing the costs and the benefits for the whole training FSTD system (except FNPTs where there are no short-term benefits in terms of increase of training credits)
	0 Neutral	+2 low positive impact

4.6. Comparison of options and conclusion

The IA concludes that the proposed option 1 is cost-effective and instils transformation of the system by applying an innovative approach that complies with ICAO provisions, and introduces this paradigm shift into the regulatory framework for initial (FCL) and recurrent (OPS) type rating training. Europe would be among the first globally in utilising the innovative possibilities provided by the latest revision of ICAO Doc 9625. The proposal strives for providing flexibility in using the devices according to their actual capabilities and for paving the way for further innovations when designing and producing new FSTDs.

The table below summarises the impacts of all options.

Table 10: Summary of the benefits and costs of the proposed option 1

Criteria	*Option 0* *No policy change*	*Option 1* *FSTDs tailored to training needs*	*Score*
Safety	0	Safety benefit due to full match of training with the device capabilities: effective and positive transfer of training	+2 low positive impact
Social	0	More effective type rating for the ATPL holders Some workload decrease for the CAs	+2 Low positive impact
Environmental	0	Environmental benefit as a result of using less energy for the FTD than for the FFS	+2 Low positive impact
Economic	0	**Benefits**: • Fostering innovations and enabling savings (up to 20 %) in type rating training when using an FTD instead of an FFS • Improving availability and access to FSTDs other than FFSs (currently circa 110 FTDs and circa 10 FFSs level A and B exist) • Harmonisation with ICAO Doc 9625 **Costs**: • CAs (low negative impact): train inspectors, change qualification certificate, software change (circa EUR 50 000 per authority — one-off cost) and in	+2 low positive impact

		total 1.6 M EUR for all EASA MS • Organisations operating FSTDs: ▪ for existing devices, low negative impact (ca 1.2 Million EUR, depending on the type of FSTD they operate); ▪ for new devices, produced according to CS-FSTD Issue 3, benefits are expected to outweigh the disbenefits (except for FNPTs where there would be no short-term benefits in terms of increase of training credits); • ATOs/airlines: perform analysis of the suitability of the device for the training tasks and objectives; • EASA: circa 300 working hours to explain the new paradigm (training, implementation support) Overall, it is a cost-effective proposal, balancing the costs and the benefits for the whole training FSTD system (except for existing and newly produced FNPTs in accordance with CS-FSTD Issue 3 where there would be no short-term benefits in terms of increase of training credits).
TOTAL	**0**	**+7**

4.7. Monitoring and evaluation

It is recommended that the new CS-FSTD(A) Issue 3 is subject to monitoring and in case of necessity to an evaluation of the effectiveness and efficiency of the proposed changes.

The proposal is expected to induce a shift in the global FSTD manufacturers'/organisations' business model, moving away from the traditional product line of FFSs to include other more tailored devices, thus paving the way for innovations and new technologies and opening the market for more FTDs, whilst maintaining the level of safety. The proportion of fixed-based FSTDs now is 8 % of all FSTDs, which are operated mainly by EU organisations operating FSTDs, and in several years, it is expected to be more than double. Hence, the proposed approach strives to provide an enhanced competitive environment to the benefit of EU FSTD manufacturers/organisations operating FSTDs.

In addition, the proposal should be well-presented and explained to the affected stakeholders by EASA by means of <u>implementation support, promotion, workshops</u>, etc. Hence, it is suggested that the <u>transition period should be at least 12 months to support is proper implementation.</u>

It is recommended that the following monitoring indicators are used to review the implementation of the new provisions:

Table 11: Proposed indicative indicators to monitor the implementation of the rules, regarding CS-FSTD(A) Issue 3

Monitoring indicator	Source of data	Indicative frequency	Tool for data collection
Number of FSTDs by type of device	EASA Continuous Monitoring Approach EASA database for FSTDs under its oversight	Annually	Regular standardisation inspections of CAs and oversight in non-EU countries' activities
Monitoring by assessing the quality of training in FTDs (compared to what	Survey to the organisations operating FSTD and	3 years after the rules are in force	Survey

could have been achieved if carried out in FFSs)	training organisations (ATOs/airlines)		

In addition to these tools, the standardisation inspections and the EASA Annual Standardisation Report should provide information on any recurrent issues with the implementation of the new provisions.

Based on the monitoring results, EASA may undertake an evaluation of the impact of the adopted changes in CS-FSTD(A). This evaluation shall assess the achieved impact of the changes versus the expected consequences and conclude on the overall relevance, effectiveness and efficiency of the rules. It is recommended to be carried out indicatively 5 years after the rules are in force.

5. Proposed actions to support implementation

— Focused communication for Advisory Body meeting(s) (MAB/SAB/TeB/TEC)

(Advisory Body members)

— Detailed explanation with clarification on the EASA website

(Primarily targeted audience: industry, CAs)

— Dedicated thematic workshop/session

(Primarily targeted audience: industry, CAs)

6. References

6.1. Related regulations

— Commission Regulation (EU) No 1178/2011 of 3 November 2011 laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (OJ L 311, 25.11.2011, p. 1)

— Commission Regulation (EU) No 965/2012 of 5 October 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (OJ L 296, 25.10.2012, p. 1)

6.2. Related decisions

— Decision N° 2012/006/Directorate R of the Executive Director of the Agency of 19th April 2012 on Acceptable Means of Compliance and Guidance Material to Commission Regulation (EU) No 1178/2011 of 3 November 2011 laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council — 'Acceptable Means of Compliance and Guidance Material to Part-ARA'

— Decision N° 2012/007/ Directorate R of the Executive Director of the Agency of 19th April 2012 on Acceptable Means of Compliance and Guidance Material to Commission Regulation (EU) No 1178/2011 of 3 November 2011 laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council — 'Acceptable Means of Compliance and Guidance Material to Part-ORA'

— Decision 2018/006/Directorate R of the Executive Director of the Agency of 3 May 2018 issuing the Certification Specifications for Aeroplane Flight Simulation Training Devices — 'CS-FSTD(A) — Issue 2'

6.3. Other reference documents

Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010, (EU) No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC) No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91 (OJ L 212, 22.8.2018, p. 1)

7. Quality of the document

If you are not satisfied with the quality of this document, please indicate the areas which you believe could be improved and provide a short justification/explanation:

— **technical quality** of the draft proposed rules and/or regulations and/or the draft proposed amendments to them

— the clarity and readability of the text

— the quality of the impact assessment (IA)

— application of the better regulation principles[26] [delete if not applicable]

— others (please specify)

Note: Your replies and/or comments to this section shall be considered for internal quality assurance and management purposes only and will not be published in the related CRD.

[26] For information and guidance, see:
- https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-and-how/better-regulation-guidelines-and-toolbox_en
- https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-and-how_en
- https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-and-how/better-regulation-guidelines-and-toolbox/better-regulation-toolbox_en

